Identifying and fostering
sustainable development competencies

Combining lessons
from non-Western and Western contexts

Yared Nigussie Demssie

Propositions

1. Education for sustainable development that does not consider learners' worldviews and identity has little relevance.

   (this thesis)

2. Entrusting learners with knowledge construction and authentic learning environments are key to foster systems thinking competence.

   (this thesis)

3. Utilized alone, neither individualism nor collectivism is efficient in managing crises such as Covid-19.

4. Ethnic federalism is a recipe for interethnic conflicts and national disunity.

5. Doing a PhD abroad should, fully or partially, be a requirement for all PhD students in social sciences.

6. Loss of social trust causes loss of lives.

Propositions belonging to the thesis, entitled

Identifying and fostering sustainable development competencies: Combining lessons from non-Western and Western contexts

Yared Nigussie Demssie
Wageningen, 7 December 2021

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Thesis

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Prof. Dr A.P.J. Mol,

in the presence of the

Thesis Committee appointed by the Academic Board

to be defended in public

on Tuesday 7 December 2021

at 11 a.m. in the Aula.

To my mom,

Tsehay Tamiru Gebremariam

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List of Abbreviations

AAU	Addis Ababa University
BoP	Base of the pyramid
CSR	Corporate social responsibility
EOTC	Ethiopian Orthodox Tewahedo Church
ESD	Education for sustainable development
FGD	Focus group discussion
HPFI	Health and Performance Food International
ICTs	Information and Communication Technologies
IK	Indigenous knowledge
IQR	Interquartile range
MPG	Mobile phone group
PPG	Paper-and-pencil group
R	Relevant
SCs	Sustainability competencies
SDGs	Sustainable development goals
STC	Systems thinking competence
VR	Very relevant
WMS	Waste management system
WUR	Wageningen University and Research

CHAPTER 1
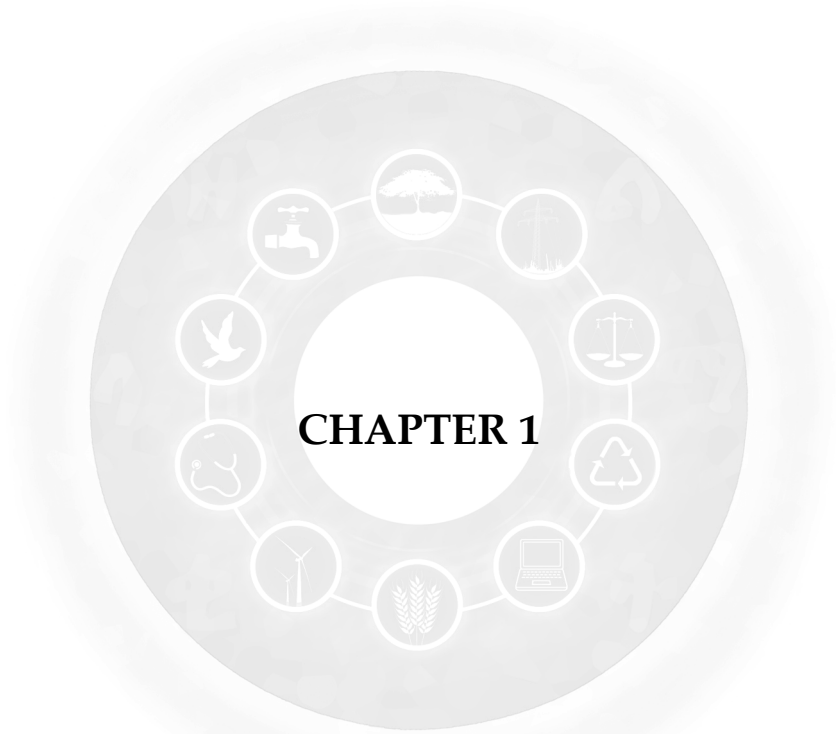
General introduction

1.1   Introduction

Major challenges facing humanity include climate change, inequality, poverty, conflict, lack of access to shelter, water, food and nutrition, medication, and sanitation. Among others, these sustainability issues are frequently mentioned in the literature (Katundu, 2019; Rieckmann, 2012; Wiek et al., 2011).

In addition to the scientific literature, international organizations such as the United Nations identify these problems as global challenges that need to be addressed through international efforts. Preparation of the UN sustainable development goals (SDGs) is an important indication of these efforts. The SDGs address social, environmental, and economic issues, including strengthening peace and justice and addressing poverty, inequality, climate change, and sustainable consumption. The 17 goals and their 169 targets are universal and are intended to achieve sustainable development by 2030 (United Nations, 2015).

Another major international initiative is the Paris Agreement. It is intended to prevent climate change by keeping global warming below 2°C, as doing so is believed to facilitate the achievement of the SDGs.

Though the major global challenges have been acknowledged, and international initiatives have been put in place, the progress toward addressing the challenges is not promising. The United Nations Environment Programme Emissions Gap Report (2020) states, "A dramatic strengthening of ambition is needed if the Paris Agreement goals are to be achieved." The report specifically states that "…countries must collectively increase their NDC (i.e., Nationally Determined Contributions) ambitions threefold to get on track to a 2°C goal and more than fivefold to get on track to the 1.5°C goal" (p.XI).

Recently, the United Nations (2020) published its sustainable development goals progress report. The report states: "One third of the way into our SDG journey, the world is not on track to achieve the global Goals by 2030." It also explains the impacts of the COVID-19 pandemic on the achievement of the SDGs: "The pandemic abruptly disrupted implementation toward many of the SDGs and, in some cases, turned back decades of progress." (p.3). In the five years since they were set, the progress toward achieving both the Paris Agreement goals and the SDGs indicates that a lot more remains to be done, that unforeseen factors (e.g., the Covid-19 pandemic) can affect the achievement of global sustainability initiatives, and that the commitment and contribution of each country is crucial.

Sustainability-related challenges require the efforts of all stakeholders, international and national organizations, companies, and individual citizens. The issue of lack of sustainable development is complex and related to several factors, which include greed (Dhiman, 2018) and lack of political will (Happaerts, 2012; Sneddon et al., 2006). Thus, addressing all the factors contributing to unsustainability at once is difficult. Therefore, in this dissertation, the focus is on addressing sustainable development from the point of view of competence. Specifically, the dissertation focuses on identifying and enhancing the competencies of individuals in corporations, academia, governmental, and non-governmental organizations in order to boost contributions toward a more sustainable future.

Among others, the sustainability-related attitude and commitment of decision-makers at different levels is important in order to initiate and implement initiatives and facilitate efforts to move toward a more sustainable world. On his first day in office, recently sworn-in President of the United States of America Joe Biden signed an executive order to have the United States re-enter the Paris Agreement from which his predecessor withdrew the United States in 2017.

The scientific literature and international initiatives such as the SDGs recognize that certain competencies are required to facilitate the effort toward a more sustainable future where the social, environmental, and economic needs of current and future generations could be met. These are sustainability competencies (SCs) consisting of integrated knowledge, skills, and attitudes. In this regard, education has the potential to equip

students - future sustainability change agents - with SCs to prevent further damage. Several authors note that in response to global sustainability challenges, an increasing number of sustainability-related programs are emerging in higher education systems of different countries. For instance, the works of Brundiers et al. (2020), Salovaara et al. (2020), and Wiek et al. (2011) focus on competencies required in the higher education programs on sustainability. Despite the large number of education programs on sustainability, a recent international study by Leal Filho et al. (2019) showed that "only 43% [of the respondents] indicated that their university has made the strategic decision to embed the SDGs in their curriculum" (p.290). This could affect the potential contribution of the higher education sector in the effort to achieve the SDGs. Furthermore, this finding suggests the need to step up efforts to prepare sustainability change agents equipped with relevant competencies to help them deal with global sustainability challenges such as the ones addressed in the SDGs.

Though all students at different levels should be aware of sustainability issues, the focus on higher education seems appropriate. A possible reason is that students of higher education are getting prepared to join the world of work after their graduation. As such, the SCs they develop could be utilized within a relatively shorter period. Accordingly, in this dissertation, the focus is on higher education.

To contribute to sustainable development, SCs of change agents (the concept of change agents will be discussed in Section 1.2) need to be enhanced, mainly through education intended for this purpose. Traditional learning approaches confined in classrooms and dominated by lectures, aimed at knowledge transfer instead of knowledge construction, give limited opportunities for learners to meaningfully engage in the learning process. Hence, these learning approaches are less relevant in fostering SCs. Lozano et al. (2019) questioned the relevance of traditional learning approaches in fostering SCs, as they note that the lecture method is one of the "least effective ways to develop sustainability competences" (p.8).

This dissertation presents the results of studies into the identification of competencies required for sustainable development and learning approaches to support the development of these competencies.

In the SCs literature, little is known whether different socioeconomic contexts, such as those with collectivist cultures, require a different set of SCs. This gap is more significant in the base of the pyramid (BoP) contexts (see Section 1.4).

The discourses in the SCs literature are not comprehensive enough to include perspectives such as indigenous knowledge (IK), worldviews, and non-Western contexts (Rieckmann, 2012; Sterling et al., 2017). A similar limitation is also observed in major global initiatives. For instance, Cummings et al. (2018) indicated that during the preparation of the SDGs, Western countries, excluding IK, determined what the SDGs should be. While there could be lessons from non-Western contexts, for instance, indigenous communities' harmony with nature, the knowledge gap regarding SCs from these contexts has limited the potential lessons such contexts could offer.

To address the limitations of excluding potential lessons from different contexts, the studies in this dissertation built on the Western literature and complemented these with less explored insights from the BoP context. Accordingly, the empirical studies of this dissertation were conducted in Ethiopia.

1.2 Sustainability change agents

There are different views of who sustainability change agents are. For instance, Wals (2014) considered the university community to be sustainable development change agents, saying, "some initiatives can be observed where universities are providing resources for members of the wider university community who can be considered SD[sustainable development]-change agents..." (p.12). Explaining who in an organization can be considered a change agent, Mohamad et al. (2021) note that "change agents are those who could initiate and

promote change regardless of their position in the organization." Hesselbarth and Schaltegger (2014) also support the idea that a person "on all levels internal or external of an organization" can be a sustainability change agent regardless of their position (p.26).

Daneri et al. (2015) note that students can be sustainability change agents while still in the learning process. This approach, according to the authors, can involve students to facilitate addressing sustainability issues and can be achieved through certain learning approaches, including "project-based learning, trans academic research, and internships." (p.14).

In this dissertation, it is argued that higher education students of any field should be considered as future sustainability change agents. From the complex nature of sustainable development issues, it seems that attaching the sustainability change agent title only to those professionals or students whose job titles or fields of study are explicitly related to sustainability may give the wrong impression that only those people should be concerned with sustainability issues. The decisions and actions of different professionals directly or indirectly contribute to (un)sustainability. Therefore, it would be helpful to equip higher education students of all fields with SCs. Doing so may contribute to making students sensitive to sustainability issues in their decisions and actions whatever their professions are going to be. Educating students of all fields to become sustainability change agents is important to speed up the progress toward achieving the SDGs, for which the world is not on track, according to the recent report mentioned above.

1.3 The Ethiopian context

As explained earlier, most research on SCs focuses on Western contexts, and there is limited knowledge regarding SCs in the context of the global south. To address this gap, the empirical studies in this dissertation were conducted in the Ethiopian context. Hence, a brief introduction of the distinct historical, cultural, and educational identity of Ethiopia is given below.

Ethiopia is one of the oldest countries in the world, with "3000 years of uninterrupted and recorded history" (Woldeyes, 2017, p. 125). It was never colonized; it kept its independence fighting off colonial forces (Kebede, 2006; Work, 1935). Regarding education, Ethiopia has an indigenous education system established and implemented by the Ethiopian Orthodox Tewahedo Church. The church was established in the fourth century (Pankhurst, 1974).

The country's ancient literary heritage is also noteworthy: "Among the very few languages of the world into which the Bible was translated during the first six centuries A.D., two were African languages, namely, Coptic, the old language of Egypt, and Ethiopic or Ge'ez, the classical language of Ethiopia." (Mikre-Sellassie, 2000, p. 302). Numerous Ethiopian manuscripts in Ge'ez (and to a limited extent in Amharic) are kept in different countries. The Ethiopian collection of the British Library and the Ethiopic Manuscript Collections of the Princeton University library are notable (British Library, 1973; Princeton University Library, 2008). Furthermore, several universities in different parts of the world offer courses related to the Ge'ez language (Appendix I). Another remarkable point about Ethiopia is that it has its own calendar and alphabet called Fidel (ፊደል). Even today, these are used for official and social purposes.

In addition to the above points, a brief overview of the socioeconomic features of Ethiopia helps to demonstrate the relevance of the sustainability competence topic in the study context. According to the World Bank (2021), with more than 112 million people, Ethiopia is the second most populous country in Africa.

In this dissertation, Ethiopia was taken as a BoP country, not as a representative of all other BoP environments, but because it has the features of the BoP context and it experiences severe impacts of climate change-induced drought (FDRE, 2011). In addition, the country contributes to sustainability efforts at national and

international levels. For instance, Ethiopia played a leadership role to unite African nations around common positions for climate negotiations of COP15 in Copenhagen (Endalew & Craft, 2016; Roger & Belliethathan, 2016). It also had a significant role in preparing the African position for the Paris Agreement (Chin-Yee, 2016). Furthermore, in 2016, Ethiopia prepared its second Growth and Transformation Plan. Among the basis for this five-year plan are the Sustainable Development Goals of the United Nations (NPC, 2016). The Ethiopian context was selected for this study for the above reasons.

1.4 Base of the pyramid context

The BoP context has unique socioeconomic features that set it apart from Western environments where most of the research on SCs took place. These features are the reason to expect the need for a different set of SCs than those required in Western contexts. Furthermore, the limited knowledge regarding SCs required in this context motivated this study to focus on the BoP context.

The BoP context refers to socioeconomic characteristics of mainly developing countries, such as low income, larger rural population, and limited infrastructure (Goyal et al., 2016; Halme et al., 2015; Prahalad et al., 2012; Prahalad & Hart, 2002). Based on these features, in this dissertation, the BoP context is defined as "an environment where a significant proportion of people with low income and limited infrastructure live mainly in rural regions of developing countries."

As the "Western" and/or "Eurocentric" context is far from homogenous, it is important to explain how these terms are used in this dissertation. The terms are intended to represent non-BoP contexts with the meaning explained by Schepen and Graness (2019) as follows:

"'Western' denotes Europe and Anglophone North America, while 'non-Western' refers to all other parts of the world, today also called the 'Global South'. We are quite aware that such a usage is a reduction of the enormous heterogeneity of the 'non-Western' world in respect to culture, religion, history, language, and, of course, the history of ideas. At the same time, it is a reduction of the 'West' as well." (p.1)

1.5 Competence

This dissertation focuses on the need to define the competencies that help sustainability change agents facilitate efforts toward a more sustainable future. Hence, this section discusses the concept of competence.

Approaches to competence can be categorized into behaviorist, generic, and comprehensive (Sturing et al., 2011). The first one which is based on behaviorist theories is said to be a task-oriented approach. It considers competence as a list of isolated job performance-related behavioral elements which are based on specific job descriptions required to perform a given task. The approach has limitations including failure to recognize the importance of context. From this emerged a generic approach that considered competence as a general and context-neutral concept and which focused on the personal characteristics of performers. A main criticism of this approach was that it ignored domain specificity of expertise and undermined the importance of context.

Because of the limitations of the behaviorist and the generic approaches, a comprehensive approach emerged. Rather than focusing on knowledge, skills, and attitudes in isolation, this approach focused on their integration. The approach also recognizes that competence is situation-dependent (Le Deist & Winterton, 2005; Wesselink et al., 2015). In addition to knowledge, skills, and attitudes, some authors specifically mention values as components of competence. Lambrechts et al. (2013, p. 65) state, "Competences integrate knowledge, skills, values, and attitudes." In this dissertation, the comprehensive approach and a related definition of the concept of competence are used - that is, integrated skills, knowledge, and attitudes to perform a task (Miller, 1990; Shavelson, 2013) and to solve a problem in specific real-life situations (Mulder, 2014; Wiek et al., 2011).

The competence framework has also been addressed from the point of view of what the unknown future requires. In this regard, Mulder (2019) emphasizes the importance of future-oriented competence, "not only for being able to function in tomorrow's society and to cope with the challenges ahead but also for shaping that society". The relevance of this dissertation to the future-oriented competence framework is further elaborated in the discussion section.

Among the important aspects of competence is its relationship with performance. As competence cannot be directly assessed; it is inferred from performance in real-life equivalent situations (Shavelson, 2013). Another key feature of competence is that it is context-specific (Mulder, 2014). This context-specificity characteristic of competence is among the reasons that motivated the studies in this dissertation to explore whether the BoP context requires a different set of SCs.

1.6 Identifying and fostering sustainability competencies

1.6.1 Sustainability competencies

In this dissertation, sustainability and sustainable development are used interchangeably. The importance of SCs for sustainability change agents to contribute to a more socially, environmentally, and economically sustainable future is recognized in the literature. Several studies have explored competencies relevant to sustainable development. Wiek et al. (2011)did a literature review on key SCs, which is the most frequently cited study on SCs to date. The authors defined SCs as "...complexes of knowledge, skills, and attitudes that enable successful task performance and problem-solving concerning real-world sustainability problems, challenges, and opportunities." (p.204). Osagie et al. (2014)explored individual competencies required in the context of corporate social responsibility.

While there seems to be an agreement in terms of what SCs are relevant to deal with sustainability issues, different ways of conceptualizing SCs are observed in the literature. For instance, Lozano et al. (2019) saw SCs as "desired educational outcomes" (p.2). However, Wiek et al. (2011) state that they "differentiate competencies from learning outcomes—the former being fairly abstract and therefore in need of translation into specific learning outcomes to be operational" (p.204).

1.6.2 Fostering sustainability competencies

The crucial role of higher education in fostering SCs is recognized (Brundiers et al., 2020; Lozano et al., 2019). Rieckmann (2012) states that the role of universities includes "generating new knowledge, contributing to the development of appropriate competencies, and raising sustainability awareness" (p.127). Wiek et al. (2011) characterize global sustainability challenges as, among other things, complex and urgent and indicate that the sustainability education field plays a role in dealing with these challenges (p.203).

To enhance their contribution, developing SCs of (future) change agents is important. In this regard, learning from and utilizing diverse worldviews helps change agents to realize the complex nature of sustainability issues and prepare them to better deal with the issues. For instance, Gordon et al. (2019) note, "Drawing on diverse forms of knowledge and know-how increases the likelihood that sustainability science can deliver solutions that address real-world challenges" (p.648). However, research into utilizing IK and integrating it with modern education is limited. Western worldviews and learning approaches dominate the literature on education for sustainable development. Hence, little is known about the potential contribution of other worldviews and pedagogies from different contexts. Chapter 3 of this dissertation reports the results of a study into the importance of utilizing various worldviews, pedagogies, and IK to enhance the SCs of students.

Another important issue several studies have noted regarding education for sustainable development is the role of traditional versus innovative learning approaches. Traditional learning approaches are typically detached from the real world and confined in classrooms where the teacher dominates. Such learning environments are mainly aimed at knowledge transfer and limit opportunities for students to engage in learning processes aimed at knowledge construction. This reduces the functions of learners to that of knowledge receivers from teachers in a form of lectures. Hence, traditional learning strategies are less relevant to foster SCs. Figueiró and Raufflet (2015) question the appropriateness of these learning approaches in the context of developing SCs, as they do not facilitate meaningful engagement of learners in the learning process.

Innovative learning approaches that facilitate the collaboration and meaningful engagement of learners are important in the effort to foster SCs of learners to help them deal with global sustainability challenges. Dziubaniuk and Nyholm (2020) conclude that active learning approaches such as collaborative learning are effective in sustainability-related education. (p.193). Similarly, Vare et al. (2019) emphasize the importance of learning approaches that utilize authentic environments and engage learners and help them to collaborate. This facilitates appreciation of the complex nature of systems, an important aspect of SCs (for more details, see the discussion on systems thinking competence in Chapter 4).

1.7 The knowledge gap and the research questions

Sustainability issues are global and complex. Societies, the environment, and the economy in countries with different socioeconomic features are affected by a lack of sustainability. Hence, addressing these global issues requires open-mindedness to appreciate the potential contribution of concerted efforts of stakeholders with different worldviews and ways of knowing (Gordon et al., 2019).

Recognition of the need to equip (future) sustainability change agents with relevant knowledge, skills, and attitudes has stimulated research into identifying competencies required to facilitate their endeavors toward more sustainability (Barth et al., 2005; Brundiers et al., 2020; Rieckmann, 2012; Wiek et al., 2011). However, the efforts to identify key SCs and foster them are predominantly Eurocentric in focus. Recently, Brundiers et al. (2020) studied whether there is agreement on what SCs are relevant, taking the work of Wiek et al. (2011) as a reference framework. Brundiers et al. (2020) indicated that exclusion of non-Western perspectives related to SCs is a limitation of the SCs discourse in the work of Wiek et al. (2011). Hence, it is unclear if non-Western contexts with different socioeconomic features (such as low per capita income, limited infrastructure, and rural population) require a different set of SCs. Research into this area is ongoing (Brundiers et al., 2020). One of the reasons to conduct the studies in this dissertation is to partially address this gap.

 A major purpose of identifying important SCs is to equip (future) sustainability change agents with these competencies through education. This helps to determine the combinations of knowledge, skills, and attitudes that pertinent education programs need to focus on when preparing students (future change agents). In this regard, the contribution of utilizing IK different from the dominant Western approaches in enhancing SCs remains unclear (Breidlid, 2009; Grosseck et al., 2019). Furthermore, studies on the contribution of implementing multiple learning approaches in authentic learning environments in fostering SCs such as systems thinking competence are lacking. These gaps are the other reasons that necessitated the studies in the dissertation to contribute to the education for sustainable development discourse.

Hence, the dissertation shows the importance of creating space for diverse worldviews, ways of knowing, and real-world learning environments guided by the following two overarching research questions and their sub-questions:

1.   What sustainability competencies are required for a base of the pyramid (in this case Ethiopian) context to contribute toward a more sustainable world?

   1.1   To what extent are the sustainability competencies that are identified in non-base of the pyramid contexts relevant in a base of the pyramid context as well?

   1.2   What competencies are relevant for sustainability professionals in a base of the pyramid context?

2.   How can relevant sustainability competencies be fostered in higher education students as future sustainability change agents?

   2.1   What indigenous knowledge can be utilized to enhance the sustainability competencies of higher education students?

   2.2   How can indigenous knowledge be included in modern higher education systems to enhance sustainability competencies?

   2.3   What learning approaches foster sustainability competencies in higher education?

   2.4   To what extent does the use of a combined set of learning strategies, (i.e., collaborative learning, field trips, mobile learning/paper-and-pencil approach) in an authentic context enable fostering systems thinking competence?

1.8 Research designs and methods

The empirical studies in this dissertation that follow this general introduction chapter are interrelated. They focus on two issues - identification of SCs and fostering such competencies in higher education students. Chapter 2 addressed the first research question ("What sustainability competencies are required for a BoP context to contribute toward a more sustainable world?") and its sub-questions. The chapter indicates that previous studies on competencies that (future) sustainability change agents need to effectively contribute to sustainable development are predominantly Eurocentric. It discusses the need to examine whether BoP contexts call for a different set of SCs than those identified in Eurocentric contexts. As indicated in Section 1.7, little is known whether different contexts with different socioeconomic features require different sets of SCs. For this purpose, a Delphi study was conducted in Chapter 2. This study built on the dominant (Eurocentric) perspectives by taking SCs from mainly this context as a starting point. Then, the study complemented these with less explored insights from Ethiopia, a country with features of the BoP context. Ethiopian experts in sustainable development from academia, the public sector, the private sector, and non-government organizations participated in the study.

The studies in Chapters 3 and 4 were conducted to explore how SCs can be developed in students using various worldviews and authentic learning contexts. As such, the chapters dealt with the second research question ("How can relevant sustainability competencies be fostered in higher education students – future sustainability change agents?") and its sub-questions. Chapter 3 answered sub-questions 2.1 to 2.3 regarding the importance of utilizing diverse worldviews and IK, learning approaches, and other learning environments in education for sustainable development, focusing on enhancing SCs, such as the ones identified in Chapter 2. The chapter indicates that IK can be used to develop the competencies of higher education students. It also presents pedagogies in the modern education system that are relevant in enhancing SCs and possible ways of integrating IK with modern education, all aimed at fostering SCs of learners.

The study in Chapter 3 was conducted using a qualitative design. Experts qualified in sustainable development and education contributed by participating in focus group discussions and responding to open-

ended questionnaire items. The findings, which suggest the need to include content from IK of different Ethiopian communities, were emphasized. Particularly, the integrated soil and water conservation practice of the Konso people and other sustainability-related contents from different societies were recommended to be explored and utilized. Furthermore, the importance of utilizing lessons from the indigenous Ethiopian Orthodox Tewahedo Church education system (i.e., valuing and using local content, languages, and scholars) to make the education for sustainable development more relevant to the Ethiopian context was underscored.

Chapter 4 addresses research sub-question 2.4 by exploring the contribution of simultaneously implementing a combined set of innovative learning approaches in real-world settings to foster one of the SCs, i.e. systems thinking competence. When important SCs were identified in Chapter 2, systems thinking competence gained the highest rating of experts. The study in Chapter 4 was conducted using a pre-test/post-test exploratory experimental design. This design involved students of the Bachelor of Arts program in Geography and Environmental Studies. The chapter explored the effectiveness of the combined use of collaborative learning, field trips, and mobile learning (these were recommended in Chapter 3) in real-world contexts to foster participants' systems thinking competence.

Chapter 5 presents and discusses a summary of the key findings and conclusions of the studies in Chapters 2 to 4. It also describes the implications of the major findings for SCs and education for sustainable development theories and practice. This final chapter also indicates the limitations of the studies in this dissertation and calls for future research to address them.

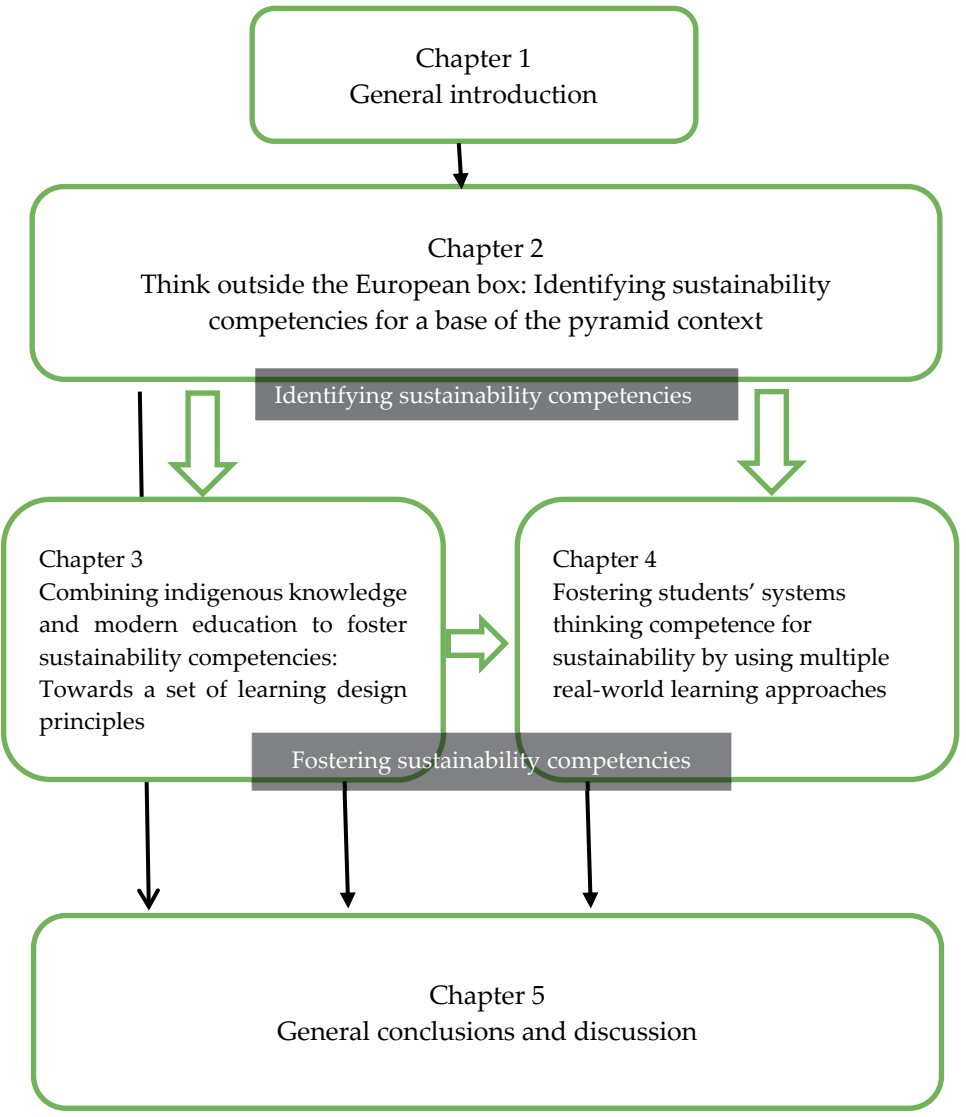Figure 1.1 presents an overview of the five chapters

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Identifying sustainability competencies

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Fostering sustainability competencies

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Figure 1.1 Representation of the chapters within this dissertation

CHAPTER 2

Think outside the European box: Identifying sustainability competencies for a base of the pyramid context[1]

Abstract

The complex and global nature of unsustainability requires concerted efforts of sustainability change agents from developed and developing countries all over the world. Various attempts have been made to define competencies needed for change agents to effectively contribute to sustainable development. However, most of the studies on sustainability competencies are Eurocentric in focus. Therefore, it is unclear if a base of the pyramid context requires a different set of competencies. This context is characterized by low per capita income, limited infrastructure, and a rural population. To address this gap, we conducted a Delphi study in two rounds in Ethiopia, as a country at the base of the pyramid. Experts (n = 33) from academia and the industry rated and confirmed seven competencies from the literature as being generally important for sustainable development. Additionally, they identified eight sustainability competencies specifically important for the Ethiopian context, and thus potentially for other countries with the features of the base of the pyramid context. Systems thinking and transdisciplinary competence gained the highest ratings. A subsequent specific literature search revealed that previous studies in contexts other than the base of the pyramid context also identified some of the eight additional sustainability competencies. This is important for future studies regarding the universal nature of certain sustainability competencies. The study brought together three fields of research: sustainability, competence, and base of the pyramid context. Our findings contribute to the theory of professional competence by showing that certain sustainability competencies can be of generic nature, independent of socioeconomic context, whereas others are context-specific. In addition, the sustainability competencies may serve as intended learning outcomes of education and training and development programs for sustainability.
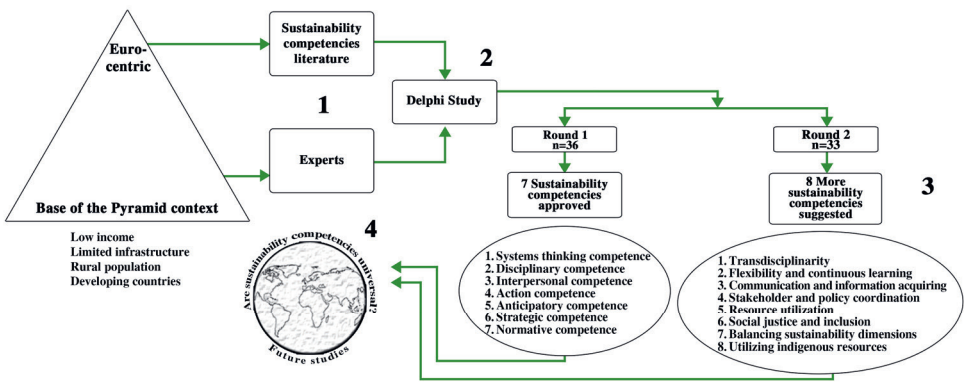

Figure 2.1 Graphical abstract

2.1 Introduction

Climate change and social problems such as poverty are among the major challenges facing humanity. Various authors and international organizations such as the United Nations recognize the need to deal with these sustainability challenges (Burns, 2013; Dale & Newman, 2005a; United Nations, 2015; Wiek et al., 2011). Fostering the competencies of sustainability professionals is recommended as one of the measures to deal with sustainability challenges. However, studies related to sustainability competencies (SCs) are scarce in the base of the pyramid (BoP) contexts. Rieckmann (2012, p. 130) argues "the often-Eurocentric focus of the discourse on sustainability key competencies should be challenged." Rahdari et al. (2016, p. 352) also identified 'Eurocentrism' as "one of the main challenges in the field of corporate responsibility research". Recently, Sterling et al. (2017, p. 163) found out that "Africa, Latin America, and Asia are almost totally absent in the discourse on sustainability competencies."

Competence is seen as the integrated knowledge, skills, and attitudes which is required for effective performance. A key dimension of competence is its context-specificity, i.e., different contexts may require different competencies (de Haan & Haan, 2010; Mulder, 2014). Context is important for sustainability professionals (Heiskanen et al., 2016). Idemudia (2011, p. 4) argues that "different cultural environments do present different challenges for CSR practices." Hence, the findings of previous research on the identification of relevant SCs in one socioeconomic context may not necessarily be relevant in a different context.

Given the unique socioeconomic features at the BoP, it is not clear whether a similar set of SCs identified by previous studies in non- BoP contexts is relevant in BoP contexts as well. It is also unclear if (or what) other SCs are relevant to the BoP context. There are few studies such as Rieckmann (2012) on SCs that included countries from the Global South. Therefore, we conducted this study to get insights into the unexplored area of competencies for sustainability professionals in a BoP context.

2.2   Theoretical framework

This section presents the key concepts in this chapter - sustainability, sustainability competencies, and sustainability competencies and corporate social responsibility.

2.2.1   Sustainability

Many authors have discussed the difficulty of defining sustainability. Having identified more than 100 definitions, White (2013) suggests that the concept is open for different interpretations. For some, the existence of multiple definitions is a source of confusion (Glavic & Lukman, 2007). For others, it is an advantage "because they allow for broader agreement" (Vos, 2007, p. 335). When defining sustainability, it is important to focus on what needs to be sustained (Costanza & Patten, 1995; Vos, 2007). Sustainable development implies the need to develop economically, socially, and environmentally. The reason why we need the social and environmental aspects is not to facilitate only economic development (Johnston et al., 2007).

The importance of all aspects of sustainability has implications on how developed and developing countries should balance the three elements. For instance, should BoP contexts prioritize economic growth or environmental protection? Are the two mutually exclusive? For instance, Ngosso (2013) suggests that there are situations in which poor countries should prioritize economic growth while at the same time indicating that prioritizing the environmental aspect can also lead to reducing poverty. There are also arguments that the three elements should be given equal priority (Tomšič et al., 2015). However, we argue that how to

prioritize the dimensions should depend on the socioeconomic status of a specific context. For example, based on national priorities.

Looking at sustainability from the perspective of its widely agreed features is also useful to get a better understanding of this concept. Accordingly, sustainability is a comprehensive, future-oriented, and intergenerational concept that encompasses and balances economic, social, and ecological aspects of development (Dale & Newman, 2005b; Lumley & Armstrong, 2004; Vos, 2007; White, 2013).

Based on its widely agreed elements of different definitions, we define sustainability as "an all-inclusive development intended to sustain relevant human and natural resources required for social, environmental, and economic progress of current and next generations."

In this current study and other studies (Figueiró & Raufflet, 2015; Lumley & Armstrong, 2004) sustainability and sustainable development are used interchangeably.

2.2.2   Sustainability competencies

As discussed in Section 1.6.1, acquiring certain competencies is required to deal with complex issues in unpredictable environments and to play a role in the effort towards sustainable development (Dale & Newman, 2005a; Rieckmann, 2012; Viegas et al., 2016; Wiek et al., 2011). Such competencies contribute to making individuals feel more responsible and get ready to participate vis-a'-vis sustainability (Mochizuki & Bryan, 2015). SCs are also viewed as "intended learning outcomes in education for sustainable development" (Barth, 2016, p. 5). As an example of sustainable development competence, Wals (2014) mentions "citizen's capacities to contribute to sustainable living both professionally and personally."

Based on the inputs from various sources (Akeel et al., 2019; Molderez & Ceulemans, 2018a; Wiek et al., 2011), we define SCs as the integration of knowledge, skills, and attitudes that facilitate efforts to sustain relevant human and natural resources required for social, environmental, and economic progress of current and future generations.

The SCs identified by the experts in this study and the ones taken from the literature are not isolated and independent of each other. Rather, they are related and sometimes complementary (Molderez & Fonseca, 2018; Wiek et al., 2011). Further discussion of how the SCs are relevant to the BoP context understudy is given in Section 2.5.

2.2.3   Sustainability competencies and corporate social responsibility

Corporate social responsibility (CSR) is a business approach to sustainable development. It refers to voluntarily integrating socioenvironmental aspects with business activities (van Marrewijk, 2003). Some authors use sustainability and CSR interchangeably (Osagie et al., 2014; Wesselink et al., 2015). Among the different stakeholders in sustainability are companies that use different types of resources. As such, if implemented genuinely, CSR could facilitate the contribution of companies to more sustainability.

As discussed in Section 1.4, the BoP context has unique features that set it apart from high-income environments. The difference in socioeconomic factors and context-specificity feature of competence motivated our study. Accordingly, we looked at the relevance of SCs identified mainly by Eurocentric studies for a BoP context. Furthermore, we identified additional SCs relevant in the BoP context.

2.3 Methodology

The major objective of this study was to identify SCs that are relevant to the BoP, Ethiopian, context. To this effect, we used the Delphi method. The following research questions guided our research:

1. Are the sustainability competencies identified in non-BoP contexts relevant in a BoP context?
2. What competencies are relevant for sustainability professionals in a BoP (Ethiopian) context?

2.3.1 The Delphi method

Sustainability is related to different fields of expertise and the issues related to it are complex. Hence, possible solutions to address sustainability issues are expected to come from a concerted effort of various professionals (Friman et al., 2018). We used the Delphi technique because it is a method appropriate for studies that seek a combined wisdom of a group of experts about issues that do not have clear-cut answers (Dalkey, 1969; Hasson et al., 2000). In addition, participants are groups of experts in the area under study and their decisions "have greater validity than those made by an individual" (Osborne et al., 2003, p. 698).

The study is based on the judgments of experts. In this case, the Delphi method is a better choice. Rowe and Wright (2001, p. 141) indicate that "research has shown that Delphi-like groups perform judgmental and forecasting tasks more effectively than other judgmental approaches." The other reason for choosing the Delphi technique is its potential to deal with the influence of dominant participants (Dalkey, 1969; Gupta & Clarke, 1996). Besides, the method enables participants to change their minds, i.e., their responses from round to round without fear of other participants' judgment (Ballantyne et al., 2016; Geist, 2010; Rowe & Wright, 2001). As the participants live in different geographical locations, the Delphi method enabled us to conduct the study without the need for face-to-face interactions of experts (Yousuf, 2007).

However, the Delphi method has some limitations too. These include its continuous modification and lack of proper guidelines (Hasson & Keeney, 2011). The different criteria used by Delphi researchers for the selection of experts, determining consensus, and the number of experts could be the result of a lack of proper guidelines. Awareness about these issues and adequate preparations may help to carefully plan and execute Delphi studies.

The Delphi method has some defining features. These include anonymous group responses, multiple rounds of data collection, and a summary of statistical group responses sent to participants after each round (Dalkey, 1969).

2.3.2 Identification of experts

The quality of Delphi studies depends on, inter alia, the appropriateness of participants' qualification (Powell, 2003). Previous Delphi studies used various criteria to select experts. These include expertise in research (Rieckmann, 2012), familiarity with the study context (Caron et al., 2016), and knowledge of the field under study (Day & Bobeva, 2005). Sustainability requires the contributions of both practitioners and researchers. Therefore, we included experts from academia and practitioners from the industry. The latter are sustainability professionals in non-governmental organizations, governmental organizations, and businesses. The business category included banks, an airline, mixed sector investments (agriculture, mining, and industries), and a brewery company. We selected the specific organizations because they are among the few organizations in Ethiopia engaged in sustainability.

Inclusion criteria

For all experts, it was a requirement to have their experience in Ethiopia. An academician should have at least a master's degree and five years of teaching and research experience. The experience should be in accredited higher education institutions and related to sustainability. Moreover, the person should have either taken or taught a course, published an article, or presented a conference paper, participated in negotiations, policymaking, training, or consultancy. A person from the industry should have at least a bachelor's degree and a minimum of three years of experience. The expertise should be in one or more of the areas listed above for academicians.

Expert recruitment strategies

We identified experts from April to December 2016 using different strategies. We contacted sustainability-related radio and television program hosts to obtain a list of notable potential experts who have been on their shows. In addition, we used conferences, resource persons, websites, and LinkedIn. The diversity of experts is important to generate widely applicable insights (Powell, 2003). Therefore, we first identified diverse experts and then used the snowball method. We did this by asking the experts to recommend more potential experts. Moreover, to secure diverse experts, we used the multiple means of identifying potential experts mentioned above. The combined expertise of these experts covers the three dimensions of sustainability.

Panel size

Delphi studies use different panel sizes depending on the availability of resources and other factors (Powell, 2003). The total number of experts identified through the aforementioned means was 85. Next, we met 67 of the potential experts in person and contacted the remaining through the phone. This was an opportunity to explain the purpose of the study, to create rapport, to check which potential experts meet the inclusion criteria, and to get their consent. At this time, participants gave their consent orally. Later, they indicated their consent by checking a box in the questionnaire. Meeting experts prior to data collection helps to increase the response rate (Hasson et al., 2000). During this meeting, 30 of the identified people informed the first author that they do not meet the criteria, or they cannot participate. Hence, we excluded them. We excluded ten others after checking their expertise vis-a'-vis our criteria. Finally, we sent invitation letters to 45 experts who met the criteria and expressed their willingness to participate. The letter informed them about the purpose of the study, the selection criteria, anonymity of the data, the estimated time commitment, possibility of a maximum of three rounds, operational definitions of key concepts, a promise to acknowledge experts, our intention to publish the study, and the contact details of the first author. This helped to create rapport, secure the commitment of respondents, and increase the response rate (Hasson et al., 2000). Table 2.1 depicts details of the demographic characteristics of the participants.

Table 2.1

Demographic characteristics of experts who participated in both rounds

Variable	Frequency	Percentage (%)
Education		
Bachelor's degree	3	9.09
Master's degree	17	51.51
PhD	13	39.39
Years of experience		
3-8	5	15.15
9-14	8	24.24
15-20	8	24.24
21-26	4	12.12
27-32	7	21.21
33 or more	1	3.03
Age		
25-34	6	18.18
35-44	10	30.30
45-54	11	33.33
55-64	3	9.09
Not given	3	9.09
Sector		
Academia	16	48.49
Industry	17	51.51
Experts from academia with industry experience		
Yes	12	75
No	4	25

2.3.3   Definition of consensus

To determine consensus in Delphi studies, various authors have either used or recommended different combinations of measures. These include median, mode, interquartile range (IQR), and percentage of positive or negative responses (Rayens & Hahn, 2000; von der Gracht, 2012) . Therefore, in this study, we used a combination of the sum of percentages of relevant and very relevant responses, median, and IQR to determine consensus.

2.3.4   Number of rounds

Initially, we designed our study to have a maximum of three rounds. However, the level of agreement in two rounds suggested that a third-round would not be necessary. For each round, we pilot tested the instruments and identified outlier responses. Also, Pearson's chi-square test was conducted. This was to see whether there

is a statistically significant (p < 0.05) difference between responses of experts from academia and those from the industry. The questionnaires included open-ended and closed-ended items. Therefore, we used qualitative and quantitative data analysis methods. We elaborated on these in their respective sections.

2.3.5   Round one instrument preparation, data collection, and analysis

Round one instrument preparation

As starting points, to identify SCs to be rated by experts, we used the following works for their relevance, methodological variety, and adequate descriptions of the SCs. Osagie et al. (2014), undertook a systematic literature review and conducted interviews to identify SCs. Wiek et al. (2011)used a broad (peer-reviewed and grey) literature review and prepared a framework. Roorda (2013, p. 104)identified competencies that 'typify a sustainability competent professional'. Heiskanen et al. (2016, p. 218) identified the competencies sustainability professionals learn from education in the real world and summarized the 'most important competencies of sustainability change agents". Though they are not exhaustive, we assume that the competencies from these studies include widely recognized SCs. We compared the SCs from the above studies using the terms and descriptions they used for the SCs. In most instances, the aforementioned authors used similar terms. In some cases, the names of the SCs were different while the descriptions were essentially similar. The overlap of the SCs is assumed to confirm their importance as the authors of these works used different methods and contexts.

Table 2.2

Sustainability competencies from the literature as starting points for round one questionnaire

Sources			
Osagie et al. (2014)	Wiek et al. (2011)	Roorda (2013)	Heiskanen et al. (2016)
1. Anticipating CSR challenges	Anticipatory competence	Future orientation	Anticipatory competences
2. Understanding CSR-relevant systems and subsystems	Systems-thinking competence	System orientation	Systems-thinking
3. Managing CSR implementation	Strategic competence	Action skills	Action skills
4. CSR leadership competencies	Strategic competence	Future orientation	Strategic competences
5. Interpersonal competencies	Interpersonal competence	Emotional intelligence	Interpersonal competences
6. Personal value driven competencies	Normative competence	Personal involvement	Normative competence
7.		Disciplinary competences	Subject-specific competences

As depicted in Table 2.2, six SCs overlap in all the four studies. These are generic competencies, i.e., they are relevant across different fields (Salgado et al., 2018). We used these and a seventh sustainability competence, i.e., disciplinary/subject-specific competences as starting points. We included 'Disciplinary competences' even

though it overlapped only in two of the four studies. This is because it would be an opportunity for our expert participants to think about subject-specific competencies when suggesting competencies for sustainability.

We prepared the closed-ended items based on the four studies used as starting points (see Table 2.2). In the round one instrument, for six of the seven SCs presented for rating, we used the descriptions (or parts thereof) given by their respective authors (see Table 2.6). Inputs from the pilot test about the need for more clarity led to the modification of the description for the 'disciplinary competence' given by the author.

The first round instrument comprised a combination of closed-ended and open-ended questions, instructions about how to complete the questionnaire, and operational definitions of key concepts. We presented the seven SCs and their descriptions identified from the literature to be rated by the experts. The rating used a 5-point Likert scale where 1 indicated 'very irrelevant' and 5 indicated 'very relevant'. Pilot testing in a Delphi study is suggested to enhance authenticity (Keeney et al., 2006), to improve methodological rigor (Hasson & Keeney, 2011), and to check the clarity of the questionnaire (Powell, 2003). For round one, three potential experts with the required expertise participated in the pilot testing. Based on their comments and inputs from coauthors, we improved the draft questionnaire. We finalized the questionnaire as a two pages document on Microsoft Word.

Round one data collection

We administered the questionnaires on February 7, 2017, mainly through emails. We also provided an additional option of hard copy versions. Delphi studies usually suffer from low response rates (Christie & Barela, 2005; Meijering et al., 2015). Therefore, we used follow-up mechanisms to remind experts. We received the last completed questionnaire on March 1, 2017. Out of the invited 45 experts, 36 completed and returned the questionnaires, i.e., a response rate of 80%.

Round one data analysis

In round one, we calculated frequency, percentage, median, mode, and IQR for all experts' ratings of each of the seven SCs. The consensus criteria in this round are a combined result of three measures. These are, 'relevant'(R) plus 'very relevant' (VR) responses greater than or equal to 80%, IQR of 1 or less, and median values of 4 (relevant) or 5 (very relevant).

2.3.6 Round two instrument preparation, data collection, and analysis

Round two instrument preparation

We developed round two questionnaires based on the additional SCs suggested by participants in round one. From the 36 experts who participated in the first round, 28 suggested additional SCs for the Ethiopian context. We compiled these texts verbatim. The generated data was of a manageable size and we did data analysis (content analysis) by hand using the 5 steps process by Taylor- Powell and Renner (2003). This involved repeatedly reading the text, focusing the analysis vis-'a-vis the purpose of our study, organizing the data, breaking down texts into themes, and identifying connections within and among categories. At the end of these steps, 11 categories (i.e., SCs) emerged.

Following this, we prepared descriptions to represent each of the 11 newly emerged categories. The experts who participated in the study suggested names for some of the categories. The remaining categories were named by the authors.

The first author completed the above five-step process. Next, the other coauthors reviewed and commented on the newly identified SCs and their descriptions. Accordingly, we improved the categories and their descriptions. As was the case in round one, we conducted pilot testing in round two with three people who fulfilled the inclusion criteria in this study. They detected redundancy and this led to the merger of two competencies. Information acquiring competence and communication competence became 'communication and information acquiring competence'. The pilot test also helped to improve the clarity of the SCs and their descriptions. Following this, we sent invitation letters via email to the 36 experts who participated in round one.

We prepared the questionnaire in a clickable PDF format. It comprised instructions, a promise to anonymously keep responses, demographic questions, the SCs to be rated and their descriptions, and a request for consent of participants. For experts from academia, we included one more question. That is, "Do you have sustainability-related experience in the industry, i.e., outside the higher education environment (e.g., consultancy or training, project development, implementation, or other services to government, non-governmental organizations, or business organizations)?" This was intended to see how many of these experts have sustainability experience in the industry, in addition to their experience in academia. Twelve (i.e., 75%) of the 16 experts from academia who participated in both rounds had experience both in the industry and in academia. These 16 experts were active in teaching and research; two of them were promoted to the rank of Full Professorship in the course of this study.

Round two data collection

On May 25, 2017, we distributed round two questionnaires by email among the 36 experts. We also sent a summary of the quantitative analysis of the first round, and the newly emerged SCs with their descriptions. This was to make sure that the inputs of the experts were duly accounted for and to create a common understanding regarding the SCs that would be rated as round two questionnaire items. This practice helps to ensure construct validity (Hasson & Keeney, 2011; Okoli & Pawlowski, 2004). In this round too, we carried out follow-up communications and obtained the last completed questionnaire on July 9, 2017. Of the thirty-six experts, 33 completed and returned the questionnaire. This is a response rate of 91.6% and 73.3% from round one and the total number of potential experts invited before round one respectively. Two of the three experts who dropped out in round two were from academia; one was from the industry.

Round two data analysis

In round two, we expected more agreement because the SCs to be rated would be the suggestions of the experts themselves. Therefore, as consensus criteria, we used the sum of relevant and very relevant responses of greater than or equal to 85%, the same median and IQR values as the ones specified for round one. A visual representation of the research process is given in Figure 2.2.
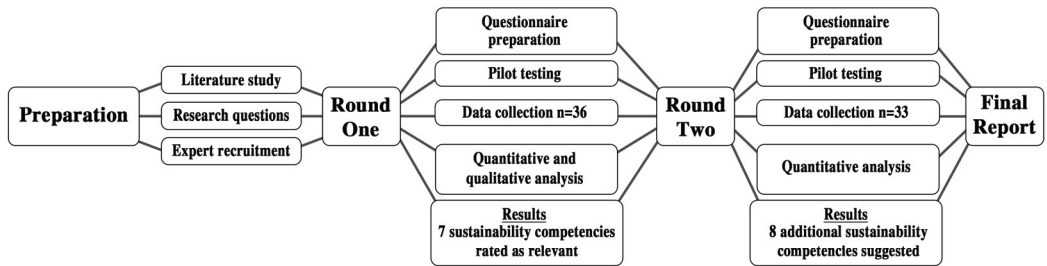
Figure 2.2 Schematic summary of the Delphi process

2.4   Results

2.4.1   Round one results

Table 2.3

Ranking of sustainability competencies by percentage of 'relevant' plus 'very relevant' responses

Rank	All Experts (n = 36)	Experts from academia (n = 18)	Experts from the industry (n = 18)
1.	Systems thinking competence (97.2%) 80.6%	Systems thinking competence (100%) 77.8%	Disciplinary competence (100%) 77.8%
2.	Disciplinary competence (97.1%) 69.4%	Interpersonal competence (94.5%) 66.7%	Systems thinking competence (94.4%) 83.3%
3.	Interpersonal competence (94.3%) 66.7%	Disciplinary competence (94.4%) 61.1%	Anticipatory competence (94.4%) 72.2%
4.	Action competence (94.3%) 52.8%	Action competence (94.4%) 61.1%	Interpersonal competence (94.4%) 66.7%
5.	Anticipatory competence (91.6%) 72.2%	Anticipatory competence (88.9%) 72.2%	Action competence (94.4%) 44.4%
6.	Strategic competence (88.8%) 61.1%	Strategic competence (88.9%) 55.6%	Strategic competence (88.9%) 66.7%
7	Normative competence (86%) 44.4%	Normative competence (88.9%) 38.9%	Normative competence (83.3%) 50.0%

The three columns in Table 2.3 are independent of each other. The 'All experts' column depicts the ranking of the seven SCs by all the 36 experts; it is not the sum of the next two columns. The 'Experts from academia' column shows the ranking of the SCs by calculating only the responses of the 18 experts from academia. The 'Experts from the industry' column represents ranking of the SCs by calculating only the responses of the 18 experts from the industry. Each column shows the percentages of 'very relevant' (VR) and 'relevant' (R) responses. For instance, the sustainability competency ranked 2nd based on the rating by all experts is disciplinary competence; according to experts from academia, it is interpersonal competence; based on rating by experts from the industry, it is systems thinking competence.

For some of the SCs in Table 2.3, the percentage of R plus VR responses (i.e., the figures given within parenthesis) are the same. In such cases, we used percentages of VR responses (i.e., the figures given off parenthesis) as additional means of ranking the SCs. In round one, systems thinking competence got the highest percentages of R plus very relevant VR ratings, i.e., R + VR = 97.2%, VR = 80.6 ratings by all experts. This is the only sustainability competency with an IQR of 0. The remaining six SCs have an IQR of 1. All the SCs ratings have median values of 5 except for 'normative competence' which has a median value of 4. All the 7 SCs gained agreement based on the predefined consensus criteria. Therefore, none of them had to be

presented in the next round. A Chi-square test in round one showed that there is no statistically significant difference between the ratings of the seven SCs by the experts from   academia and those from the industry.

Outlier responses in round one

In Delphi studies, it is recommended that experts whose ratings of an item are outliers provide their reasons for their decisions (von der Gracht, 2012). We defined outliers based on the 1.5 x IQR rule. These are responses significantly different from the aggregate responses of the whole panel. We found ratings of three SCs by two experts to be outliers. We contacted these experts to get their explanation for the ratings. Expert "I27" rated 'normative competence' as 'irrelevant'. He shared his reasons as, "unless the necessary administrative systems are put in place, normative competence by itself may not contribute to sustainability. Such systems are now lacking. Therefore, normative competence may not be relevant."

Expert "A15" rated 'strategic competence' and 'action competence' as 'very irrelevant'. His explanation about strategic competence was, "this competence is relevant only for policy makers, not for all sustainability professionals. Lower-level sustainability professionals do not engage in strategic issues. Therefore, they do not need this competence." The same expert explained why he rated 'action competence' as 'very irrelevant'. He said, "sustainability professionals from academia do not need action competence. Honestly, I did not remember the operational definition of 'sustainability professional'. However, I should have thought about sustainability professionals in the industry."

2

2.4.2 Round two results

Table 2.4

Ranking of sustainability competencies based on percentage of 'relevant' + 'very relevant' responses and 'very relevant' responses

Rank	All experts (n = 33)	Experts from academia (n = 16)	Experts from the industry (n = 17)
1	Transdisciplinary competence (100%) 75.8%	Transdisciplinary competence (100%) 81.3%	Flexibility and continuous learning competence (100%) 76.5%
2	Flexibility and continuous learning competence (100%) 72.7%	Communication and information acquiring competence (100%) 81.3%	Stakeholder coordination competence (100%) 76.5%
3	Communication and information acquiring competence (100%) 63.6%	Flexibility and continuous learning competence (100%) 68.8%	Transdisciplinary competence (100%) 70.6%
4	Stakeholder coordination competence (97%) 78.8%	Tolerance competence (100%) 68.8%	Resource utilization competence (100%) 64.7%
5	Resource utilization competence (97%) 72.7%	Resource utilization competence (93.8%) 81.3%	Policy integration and cooperation competence (100%) 64.7%
6	Tolerance competence (97%) 69.7%	Stakeholder coordination competence (93.8%) 81.3%	Social justice and inclusion competence (100%) 52.9%
7	Social justice and inclusion competence (97. %) 63.6%	Social justice and inclusion competence (93.8%) 75.0%	Communication and information acquiring competence (100%) 47.1%
8	Policy integration and cooperation competence (97%) 57.6%	Indigenous competence (93.8%) 68.8%	Tolerance competence (94.1%) 70.6%
9	Competence to balance sustainable development dimensions (90.9%) 60.6%	Competence to balance sustainable development dimensions (93.8%) 62.5%	Competence to balance sustainable development dimensions (88.2%) 58.8%
10	Indigenous competence (90.9%) 60.6%	Policy integration and cooperation competence (93.8%) 50.0%	Indigenous competence (88.2%) 2.9%

Table 2.4 is also structured in the same way as Table 2.3. That is, the three columns are independent of each other.

For some of the SCs, the percentage of R plus VR responses (i.e., the figures given within parenthesis) are the same. In such cases, we used the percentages of VR responses (i.e., the figures given off parenthesis) as additional means of ranking the SCs.

In this round, transdisciplinary competence got the maximum rating of R + VR = 100% with a VR rating of 75.8%. Based on the ratings by all experts, the median and mode relevance of all the ten SCs were 5 (i.e., very relevant). Except for 'stakeholder coordination competence' for which IQR value was 0, the remaining nine SCs had IQR of 1.

To see if experts from academia and the industry would rate the SCs differently, we performed a Chi-square test in the second round as well. Table 2.5 depicts the results of the test for communication and information acquiring competence.

Table 2.5

Pearson's Chi-square test for communication and information acquiring competence

Panel of Experts	Responses		
	Relevant	Very Relevant	Total
Academia	3	13	16
Industry	9	8	17
Total	12	21	33
Pearson chi2(1) = 4.1640	Pr = 0.041		

 "Communication and information acquiring competence" is the only sustainability competency where a statistically significant difference existed between the ratings by experts from the two sectors, $X2$ (1, N = 33) = 4.16,   p = 0.041. Experts from academia rated this competence as median = 5, mode = 5 and IQR = 0. Their counterparts from the industry rated it as median = 4, mode = 4, and IQR = 1. In the second round too, all the SCs gained consensus. Hence, there was no need to go for a third-round as initially planned. This agrees with the suggestion by Keeney et al. (2006) about how long the Delphi process continues. See Table 2.6 for the updated list and descriptions of all the SCs that gained consensus in both rounds.

Outlier responses in round two

In the second round, we found two responses by two experts to be outliers. We requested the experts to share their reasons. Expert "B" rated 'indigenous competence' as 'irrelevant'. He based his response on his own understanding of the word 'indigenous'; he did not consider the description of indigenous competence given in the round two questionnaires. Through email communications, he later explained that he would rate the competence favorably if he considered the description of the competence. Expert "C" rated 'Competence to balance sustainable development dimensions' as 'irrelevant'. We requested his explanation and he informed us that it was because of oversight. He requested the first author via email to rerate the item as 'relevant'. Hence, the rating was changed accordingly. In both rounds, the outlier responses of participants who did not change them after our discussions were kept as they were.

2.5   Discussion and conclusion

The BoP context has unique features that set it apart from high-income environments. Besides, studies related to SCs are predominantly Eurocentric in focus. Hence, it was not clear whether previous findings are relevant to the BoP context. The study involved participants selected from academia and the industry for having relevant expertise. Analysis of the data showed that in round one the experts confirmed the relevance of seven SCs to the BoP context. These are the SCs listed in Table 2.6 from number one to seven. In addition, the experts identified ten more SCs (see Table 2.4). After further processing of the ten SCs and merging two pairs of similar ones, the number of additional SCs became eight. These are listed in Table 2.6 from number eight to fifteen. Names of these and the seven SCs from the literature have also been modified to better reflect their essence and to show their relevance to sustainability.

Table 2.6

Sustainability competencies relevant to the base of the pyramid context

No.	Sustainability competencies	Descriptions
1	Systems thinking competence to understand complex sustainability issues	"ability to collectively analyze complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global)" (Wiek et al., 2011, p. 207)
2	Disciplinary competence in sustainability-related fields	In addition to generic competencies, a sustainable development professional should have competence in his/her specific field. (Roorda, 2013)
3	Interpersonal competence to facilitate collaboration of sustainability stakeholders	"ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving." (Wiek et al., 2011, p. 211)
4	Action competence for sustainability interventions	Decisiveness and capability to act (Roorda, 2013)
5	Anticipatory competence to predict future sustainability issues	Ability to foresee possible sustainability issues to be faced and devise frameworks to deal with them (Heiskanen et al., 2016; Osagie et al., 2014; Roorda, 2013; Wiek et al., 2011)
6	Strategic competence to devise sustainability interventions	"ability to collectively design and implement interventions, transitions, and transformative governance strategies toward sustainability." (Wiek et al., 2011, p. 210)
7	Normative competence for sustainability goals	"ability to collectively map, specify, apply, reconcile, and negotiate sustainability values, principles, goals, and targets." (Wiek et al., 2011, p. 209)
8	Transdisciplinary competence to collaborate with diverse sustainability experts	Understanding that sustainability requires collaboration of experts from different fields. This competence includes readiness and skills to work with experts from other disciplines.
9	Flexibility and continuous learning competence for sustainability	Realizing that sustainability issues are dynamic and that they require sustainability professionals to constantly update themselves. This includes skills and attitudes to learn timely and relevant knowledge the changing situations may demand to flexibly approach each situation.
10	Communication and information acquiring competence for sustainability	Knowledge about sustainable development dimensions and readiness to acquire and utilize information about socio-environmental issues. It includes capability to create sustainability awareness in the wider population, deal with, learn from, and influence stakeholders towards sustainability.
11	Stakeholder and policy coordination competence for sustainability	Ability to organize efforts of various actors including relevant individuals, societies, groups, and experts. It requires readiness, knowledge, and skills to create synergy, learn from each other, tap global cooperation opportunities, and coherently integrate local, national, and international sustainability policies.
12	Resource utilization competence for sustainability	Knowledge, skills, and readiness to efficiently allocate and use material resources, enhance analytical and technical skills of workers, and setup institutional arrangements.
13	Social justice and inclusion competence to promote sustainability	** Ability and readiness to consider the needs and values of diverse groups (including future generations). It includes skills, attitudes, and knowledge to promote tolerance, equitably distribute resources, listen to each other, and peacefully repair past and current harms.
14	Competence to balance sustainable development dimensions	Genuine concern for society and the environment with knowledge and skills to properly balance the three elements of sustainable development. It includes readiness to challenge too much focus only on the economic dimension at the expense of social and environmental sustainability.
15	Competence to utilize indigenous resources for sustainability	Appreciating one's own local competence, values, culture, history, languages, and the natural environment. The competence includes realizing the potential of local natural and human resources and skills to utilize these for sustainable development.

2

In Table 2.6, for SCs from number eight to fifteen, either the participants or the authors gave the descriptions.

**An expert, one of the participants in this study, used the term 'Social justice and inclusion competency' and parts of the description given by Loffredo (2016) accessed from https://www.naspa.org/ constituent-groups/posts/the-social-justice-and-inclusion- competency. A similar term and parts of the description are used in this study.

The SCs identified by all experts as most important in round one were systems thinking competence, disciplinary competence, and interpersonal competence. In round two, most experts favorably rated transdisciplinary competence, flexibility and continuous learning competence, and communication and information acquiring competence. We determined the relative importance of all the 15 SCs based on the sum of percentages of relevant and very relevant ratings. In 14 of the 15 SCs, there was no statistically significant difference between ratings of experts from academia and those from the industry. This could be because most (i.e., 75%) of the experts from academia had sustainability-related experience in the industry as well. Hence, they may appreciate the sustainability priorities somewhat similarly to their counterparts from the industry. The only exception was 'communication and information acquiring competence'. Academicians attached more importance to this competence. This could be because the competence is related to their job of fostering knowledge, skills, and attitudes of their students. Except 'disciplinary competence', the remaining 14 SCs are generic competencies. Hence, they are relevant across professions.

The findings can contribute theoretically to the BoP and SCs discourse by showing which SCs are relevant in this context. In addition, the identified SCs may be used as intended outcomes of education and training programs that focus on preparing sustainability change agents. To this end, one possibility could be to focus on these SCs when designing curriculum contents and sustainability trainings.

2.5.1 Relevance of sustainability competencies in base of the pyramid and non-base of the pyramid contexts

To get insights into the relevance of the SCs across contexts, we used a two-way process. In round one, the experts confirmed the relevance of the seven SCs taken from the literature. Specific literature search was carried out after the experts identified eight more SCs. The result revealed that several of these SCs appear to have been mentioned earlier in the literature as well. For instance, parts of the essence of what we identified as 'social justice and inclusion competence' had also been identified by Bauermeister and Diefenbacher (2015) as 'social justice'. Similar to our 'stakeholder and policy coordination competence', Frisk and Larson (2011) identified 'stakeholder engagement and group collaboration competence' as one of the key SCs.

Based only on these findings we cannot be certain that these SCs are universal. However, similarities of the SCs suggest the need for future research into the relevance of SCs in multiple contexts. The findings also indicate that the SCs identified in this study are not exclusively for the BoP context. Hence, the identified SCs have the features of generic competence. However, the SCs also have features of comprehensive competence, i.e., they are the integration of knowledge, skills, and attitudes.

2.5.2 Meaning and significance of the sustainability competencies in the study context

While there are SCs relevant in multiple contexts, the results also show that some of the SCs have contextual importance. Below, we discuss the relevance of some of the 15 SCs in the specific BoP, Ethiopian, context.

Competence to utilize indigenous resources

In general, local knowledge is crucial in the BoP environment because one of the features of this context is the lack of formal institutions (Scott, 2017a). Indigenous knowledge systems have the potential to contribute towards a more sustainable world (Kakoty, 2018). Let us look at two examples of the importance of indigenous human and natural resources in Ethiopia. Regarding health care, a significant majority of the human population and the livestock rely on indigenous medical practices and medicines (Demie et al., 2018). Another example is the Konso peoples' indigenous water and soil conservation practices. Using their more than four centuries old engineering and environmental knowledge, the Konso people protect the environment and cope with difficult environmental challenges by constructing stone terraces. This has been recognized as an 'outstanding universal value' and registered as one of the UNESCO World Heritage sites (Mulat, 2013; UNESCO, 2011). Hence, sustainability professionals in Ethiopia need the competence to realize the potential of indigenous wisdom and resources and the skills to utilize these in facilitating sustainable development.

Social justice and inclusion competence

Few points about the socio-political reality of the BoP context under study help to understand the contextual meaning and importance of this competence. Since the early 1990s, the Ethiopian political system is ethnic-based federalism that paid utmost attention to ethnic identity and undermined national unity. This system grants the regional states the right to self-determination up to secession (Bélair, 2016). Ethnic tensions and related conflicts are serious problems the country is grappling with (Abbink, 2011). Hence, social justice, inclusion, tolerance, fairness, participation, and repairing past and current harms are crucial for social sustainability in the country.

Systems thinking competence

From the practical examples our respondents gave, systems thinking is sustainability professionals' understanding that an organization does not exist or function in isolation; it is part of social, economic, and environmental systems. Its actions affect other systems, and vice versa. This agrees with the meaning of systems thinking in the literature (Molderez & Ceulemans, 2018b). This understanding helps the sustainability professionals to guide their organizations on a more responsible and sustainable path.

Examples of sustainability activities in some corporate organizations in Ethiopia

To get insights into how sustainability is conceptualized and practiced in the corporate organizations whose experts participated in our study, we conducted interviews with five expert-participants. Three of these participants indicated that in their organizations, sustainability is considered to be corporate social responsibility in the forms of community engagement and philanthropic programs. These include donations to charity organizations, mainly motivated by corporate image building. However, in the other two organizations, in addition to charitable donations, sustainability activities are directly related to their core business processes and aimed at enhancing environmental sustainability. In one of the two organizations (an airline), airplane wings were locally modified by which it succeeded in reducing airplane fuel consumption.

Another organization (an international brewery) managed to reduce water consumption. Research has shown that the reduction of water consumption, particularly by industries, is essential for sustainable economic development (Zhang et al., 2018).

2.5.3   Interrelationships among sustainability competencies

Our findings indicate that the identified SCs are interrelated and complementary. Next, we discuss the interrelationship among selected SCs.

Systems thinking competence and competence to balance sustainable development dimensions

The two SCs complement each other. The former is holistic thinking that systems and subsystems are interrelated (Roorda, 2013). The latter is about prioritizing the three dimensions of sustainable development. In the Ethiopian context, there are practical situations that call for both SCs. The experiences shared by our expert respondents indicate the same.

One of the respondents commented the following about the social and environmental impacts of floriculture industries in Ethiopia. "Workers are paid very low wages; they are not protected against harmful chemicals, and the environment is exposed to harmful practices. All this is happening because of too much focus only on short-term financial benefits. The government is not doing enough because of its focus only on the growth of the GDP [gross domestic product] which is happening at the expense of communities and the environment."

Another respondent said, "there are minimum requirements investors should fulfil regarding social and environmental impacts to get investment licenses. However, the requirements are just on paper without practical application." The need to consider environmental and social aspects of development is also suggested in the literature (Gast et al., 2017).

Transdisciplinary competence

Transdisciplinary competence is one of the additional SCs suggested by the experts. The competence includes readiness and skills to work with experts from other disciplines beyond one's own. One of the SCs that complement transdisciplinary competence is systems thinking. The latter helps to realize the interconnectedness of different systems and facilitates transdisciplinarity because it is "a tool for weighing, making decisions and taking action." (Molderez & Fonseca, 2018, p. 4399).

Regarding the practical situation vis-a'-vis transdisciplinarity in the study context, our expert participants indicated that cooperation of experts with others beyond their domain is crucial but not common. The meaning of this competence as suggested by the experts is not different from the definition in the literature. For instance, Sakao and Brambila-Macias (2018, p. 1400) define transdisciplinarity in terms of its features. That is, "relating to socially relevant issues, transcending and integrating disciplinary paradigms, participatory research, and searching for a unity of knowledge."

Stakeholder and policy coordination and resource utilization competence

'Stakeholder and policy coordination competence' and 'resource utilization competence' are related.

In 2016, Ethiopia launched its second five-year Growth and Transformation Plan. Among the basis for this plan were the Sustainable Development Goals of the United Nations (NPC, 2016). Respondents mentioned

this as a positive step that gives the country opportunities to tap global technological and financial support for sustainability. However, stakeholder and policy coordination at local levels is not encouraging. The respondents also indicated that sustainability-related top-down interventions without meaningfully involving local communities did not succeed. The respondents also stressed the importance of jointly designing and implementing interventions to avoid duplication of work, efficiently utilize resources, and create synergy.

Interpersonal, transdisciplinary, and stakeholder and policy coordination competencies

Interpersonal competence is required to facilitate the collaboration of stakeholders and experts (Wiek et al., 2011). Hence, it is related to transdisciplinary competence and stakeholder and policy coordination competence.

Transdisciplinary competence and stakeholder and policy coordination competence have similarities as both encourage stakeholders to work together towards a more sustainable future. However, the SCs involve different stakeholders. While the former has to do with professionals working in different aspects of sustainability, the latter concerns any actors, be it professionals, individuals, or groups.

2.5.4   Implications for theory and practice on sustainability

This study brought together three fields of research: sustainability, competence, and base of the pyramid context. The point of departure in our study relates to the unique features of the BoP context that set it apart from high-income contexts. Our assumptions were: competence is context specific, and the BoP has unique features. Therefore, we expected that these features may require a different set of SCs.

Our results showed that selected SCs, identified earlier mainly in Eurocentric contexts, are relevant to the BoP context under study as well. Experts in the BoP suggested additional SCs as important for the BoP context. Some of these additional SCs are relevant to non-BoP contexts as well. This has an important implication on the context-specificity feature of competence or SCs. The findings are believed to stimulate discussions on whether SCs are universally relevant regardless of differences in socioeconomic contexts.

The findings have implications for practice as well. They can serve as starting points for education for sustainable development. They indicate what competencies are required by sustainability change agents. The results of this study give a clue that (some) SCs could be relevant in multiple contexts regardless of socioeconomic differences. Hence, future studies are suggested to empirically examine this in multiple contexts (see Section 2.6 for details of our suggestions for future studies).

2.6   Limitations and suggestions for future research

There are indications of the possibility that the SCs identified in this study could be relevant to other BoP and non-BoP contexts. However, this cannot be concluded based on the findings of our study. This is because the study involved experts only from one country, Ethiopia. The details of these limitations and suggestions for future research to address them are presented in Section 5.5.

Another limitation of the study in Chapter 2 is related to how three participants completed parts of the questionnaire. That is, oversight of parts of the descriptions given to one of the SCs by one participant, attaching one's own meaning to one of the SCs instead of the descriptions in the questionnaire by another, and paying less attention to the operational definitions of the key concepts in the questionnaire by a third expert. This was the case although we took various preemptive measures. These include personal meetings

with the experts; provision of operational definitions and documents related to the qualitative data analysis, pilot testing, and reviewing of the qualitative data analysis process and the questionnaires by the coauthors. Other limitations of the study in this chapter stem from limitations of the Delphi method. These include the lack of proper guidelines for Delphi studies about the selection of experts, determining consensus, the number of experts, and continuous modifications of the method (Gupta & Clarke, 1996). Future Delphi studies should learn from this and take measures including the aforementioned ones to reduce misunderstanding or oversight. Awareness about these issues prior to designing the study helped us to carefully plan and execute our Delphi study.

Sustainability issues are complex and require the contributions of multiple stakeholders. Small steps such as the identification of SCs for different contexts may contribute towards a more sustainable future. The purpose of identifying SCs is to enhance the contributions of sustainability change agents. Therefore, we recommend follow-up studies on the application and effectiveness of such competencies.

CHAPTER 3

Combining indigenous knowledge and modern education to foster sustainability competencies: Towards a set of learning design principles[2]

Abstract

An important step in the endeavor towards a more socially, environmentally, and economically sustainable world is identifying and fostering sustainability competencies (SCs). There are major international initiatives that identified sustainability-related goals (the Sustainable Development Goals) and those that recognized the crucial role of education in achieving such goals (the Decade of Education for Sustainable Development). There are also academic studies that addressed education for sustainable development. Usually, such initiatives and studies take Western worldviews for granted. This limits opportunities for other worldviews which could contribute to sustainability. It is unclear what indigenous knowledge and pedagogies, apart from the dominant Western approaches, could help to enhance SCs. To address this gap, a qualitative study was conducted in Ethiopia, a country with more than seventeen centuries old indigenous education system and indigenous knowledge. To utilize alternative worldviews and pedagogies vis-à-vis fostering SCs and incorporating them in modern education systems, five learning design principles were proposed. These are: define worldviews, utilize indigenous knowledge, use sustainability-oriented pedagogies, engage learners, and build on students' experiences. Theoretically, the study contributes to sustainability, education for sustainable development, and indigenous knowledge. The findings may serve as a starting point in designing education and training for broader sustainability approaches.

3.1 Introduction

Identifying and developing SCs that enhance the contributions of individuals to sustainability is crucial to deal with the challenges of unsustainability (Demssie et al., 2019). Among others, education has the potential to equip students (i.e., future professionals) with SCs. This can be better facilitated when education aims at meaningfully promoting SCs (Hidalgo et al., 2013) and prepares learners to deal with social, ecological, and economic challenges (Burns, 2013).

The need for education focusing on enhancing SCs has been recognized by international organizations. In this regard, the United Nations Decade of Education for Sustainable Development and the Sustainable Development Goals (SDGs) are worth mentioning. Education for sustainable development (ESD) is a growing field of research in the scientific literature as well (Grosseck et al., 2019; Sherman & Burns, 2015). However, ESD and the SDGs tend to be limited to Western educational approaches without meaningfully taking advantage of indigenous knowledge (IK) and alternative worldviews different from the mainstream, Eurocentric approaches. Besides, empirical research on pedagogies that are effective in fostering SCs is limited (Gardiner & Rieckmann, 2015). This limitation is evident at the national and continental levels. Experiences from Ethiopia and Kenya show that the Western education system is dominant and that it does not build on the IK in these countries. As a result, Western education received without contextualizing has little relevance to the students, the context, and national development efforts in Ethiopia (Asgedom, 2005; Owuor, 2007; Woldeyes, 2017). Moreover, in Africa, as a continent, Western education has been argued to be of little relevance to societies' priorities (Heleta, 2016; Kaya & Seleti, 2014) and development efforts (Mawere, 2019). Challenges related to a lack of sustainability are global; the efforts to deal with these issues should also be global, with meaningful contributions based on diverse worldviews (Demssie et al., 2019).

IK has the potential to facilitate learning for sustainable development. For instance, lessons can be learned from the lifestyles of indigenous communities based on harmony with nature and among people (Magni, 2017; Wals, 2019). For this to be achieved, connecting learning with the cultural and historical identity of learners and the local environment where learning takes place is important.

In Ethiopia, the study context, there is indigenous education and modern, i.e., Western, education. The former was established and has been implemented by The Ethiopian Orthodox Tewahedo Church (EOTC) since the fourth century. The latter was introduced in Ethiopia in 1908 by Emperor Menelik II (Pankhurst, 1974).

Western higher education is far from homogeneous. There is a wide variety in terms of quality, access, financing, and educational philosophy. In recent years, the variety increased because of demands for profiling. Thus, various institutions capitalized on problem-based learning, some on project-based learning, others on entrepreneurial learning, and still others on web-based virtual learning. Innovations such as outcome-based education and competence-based education are more generic, and especially the latter has a history of over 50 years. Many higher education institutes implemented the ideas of competence-based education, albeit that they differ in the extent to which they articulated that. It would be hard to defend that universities would not want to develop competence in their students. However, when we speak about Western higher education, we do not refer to the models of higher education just mentioned. Rather, we refer to higher education systems that are well developed in terms of access, facilities, curricula, assessment strategies, quality control, and research standards. These cut across all models of higher education.

A study by Grigorenko (2007) also characterizes Western (i.e., modern) education as a globally dominant, secular system with a structured schedule that uses a curriculum, textbooks, and alphabet (pp. 165, 166).

In Ethiopia, currently, modern education is the predominant one. Recent reports on enrollment demonstrate this. The 2019 primary education total enrolment in the modern education system was 20,046,357 (Ministry of

Education, 2019). The current total number of students in the indigenous (EOTC) education is estimated to be about 100,000 (Mahibere Kidusan, 2019). This shows how the indigenous education is shrinking over time while modern education has become a becoming mainstream system.

In addition to the indigenous education, other local knowledge sources in the country can be utilized to enhance students' competence for sustainable development. However, proper recognition, exploration, and utilization of IK by decision-makers are lacking.

Understanding the potential of IK is important to facilitate the development of SCs. Integrating modern education and IK is a possible means to utilize the potential of the latter (Owuor, 2007).

3.1.1   The Ethiopian Orthodox Tewahedo Church education system

A comprehensive description of the church education system is beyond the scope of this study. However, we present a glimpse overview to provide a context. Isaac (1971) summarizes the different levels and fields of the church education system as follows:

> There are roughly four levels of church education. For the sake of convenience, I shall call them the Institute of Reading (for Deacons), the Institute of Singing and Dancing (for Priests), the Institute of Creative Writing (for Scribes), and the Institute of Literature (for Scholars). (p.8)

The church education types and levels have their nomenclature in Ge'ez and specific sub levels, specialization areas, and learning outcomes. What begins at the lowest level with the introduction to the Ethiopian alphabet in the "Institute of reading" slowly advances to the higher levels and specializations. Other fields of study include law, astronomy, philosophy, Ge'ez language, traditional medicine, and history (Isaac, 1971; Milkias, 1976; Pankhurst, 1974). The duration of the study and the choice of the field depends on the individual student's interest and determination. An important feature of the indigenous education is that its content is predominantly based on local scholars. For instance, Isaac (1971) notes that a prominent figure in the church education system is the sixth century Ethiopian saint Yared. He is credited for inventing the Ethiopian church music and music notation. Another example is Zara Yaacob, a seventeenth century Ethiopian philosopher.

Asgedom (2005) notes the period and the major locations where the Ethiopian indigenous education flourished: "Learning centres such as Gondar, Lalibella, Axum and Debre Abai reached their climax at a time when many European colleges and universities started to appear as innovations, in the 12th or 13th century." (p. 4). Therefore, taking Eurocentric approaches as dominant approaches and discarding a well-established and centuries-old indigenous education system and IK does not seem to help in preparing learners for the complex challenges of sustainability. Hence, this study aims to explore learning approaches for SCs, the potential of IK, and the possible means of incorporating IK in modern education to foster the development of SCs. In the subsequent sections, the theoretical framework, research methods, results, discussion, and conclusions are presented.

3.2   Theoretical Framework

In this section, the key elements of this study are discussed. These are, international initiatives concerning sustainable development goals, the role of education to facilitate sustainability, SCs, learning approaches, and IK vis-à-vis enhancing such competencies.

3.2.1   Education for Sustainable Development

Education for sustainable development, also referred to as education for sustainability, is a type of education that intends to foster SCs in students (Sherman & Burns, 2015). Education for sustainable development is a growing research area (Grosseck et al., 2019; Sherman & Burns, 2015). In recognition of the crucial role education has in developing the competencies required for sustainable development, in 2002 the UN proclaimed the decade starting from 2005 as the United Nations Decade of ESD. Reiterating the significant role of education for sustainability, UNESCO (2018) stated that ESD has been included in one of the SDGs. However, the ESD discourse itself is criticized for being confined to Western education and ignoring IK (Breidlid, 2009). Disregarding IK is considered a major limitation of modern education in Ethiopia (Asgedom, 2005), and in Africa (Negash, 1996).

3.2.2   Sustainable Development Goals

A major step by the United Nations to deal with serious global challenges is the preparation of the SDGs. Target 4.7 of Goal 4 recognizes the need for certain SCs and the role of ESD in fostering these competencies. Nevertheless, the SDGs are criticized for not recognizing and including IK as a viable opportunity in the effort of achieving the global goals. Cummings, Regeer, de Haan, Zweekhorst, and Bunders (2018) determined that in the process of preparing the SDGs, a technical support team and stakeholders representing indigenous groups provided advice about the potential of IK and in which areas this knowledge could contribute. However, "these discourses were virtually abandoned by the time that the SDGs were approved." (p. 737). The authors further point out that "developed countries and the corporate sector were very influential in determining the final text and were probably instrumental in excluding more transformational discourses and maintaining the status quo." (p. 727, 728).

3.2.3   Sustainability Competencies

Demssie et al. (2019) define sustainability competencies as the "integrated knowledge, skills, and attitudes that facilitate efforts to sustain relevant human and natural resources and enable social, environmental, and economic progress of current and [future] generations" (p. 830). We use this definition in this study.

3.2.4   Learning Approaches for Sustainability Competencies

As the effectiveness of traditional knowledge-oriented and passive learning for developing SCs is questioned, the utilization of learner-centered approaches is recommended by many (Figueiró & Raufflet, 2015; Hesselbarth & Schaltegger, 2014; Rieckmann, 2012; Segalàs et al., 2012). The latter approaches make learners "active knowledge producers instead of passive recipients . . ." (Figueiró & Raufflet, 2015, p. 28). Specific active learning strategies frequently suggested for sustainability include problem-based learning, experiential learning (Evans, 2019; Figueiró & Raufflet, 2015), action-oriented learning (Evans, 2019; Sinakou et al., 2018), and "real-world experience and service-learning" (Molderez & Ceulemans, 2018b, p. 4401).

3.2.5   Indigenous Knowledge and Sustainability Competencies

IK is a comprehensive system of a particular society that encompasses its worldviews, practices, laws, holistic know-how, and guidelines regarding interrelationships within the society and with the natural environment (Bechtel, 2016; Berkes et al., 2000; Guerrero-Gatica et al., 2020; Magni, 2017; Stevens, 2008). It includes the means of learning and perpetuating the knowledge (Owuor, 2007). Demssie et al. (2019) identified the 'Competence to utilize indigenous resources for sustainability' as one of the competencies required to facilitate efforts towards a more sustainable life. This competence entails capabilities to recognize and utilize the potential of IK for sustainability. The practice and potential of indigenous ecological knowledge and natural resource management have been documented (Boiral et al., 2020; Guerrero-Gatica et al., 2020; Rist et al., 2010). The use of IK for wildfire management is another example out of several potential applications of IK for sustainability (McKemey et al., 2020). Lozano et al. (2017) note that IK has the potential to help students learn "the ways that socio-ecological systems are integrated in specific cultures. The long-term knowledge of complex local ecosystems is a powerful tool for conserving biodiversity, often providing valuable deep-time information that is inaccessible in the shorter timeframes of Western scientific research projects." (p. 9).

The Western higher education system is argued to be "trended towards knowledge specialization, reductionist thinking, and the creation of disciplinary silos" Therefore, to deal with sustainability issues "integration of knowledge about natural and human systems, holistic thinking " is recommended (Remington-Doucette et al., 2013, p. 405). Hence, exploring and integrating alternative worldviews and ways of knowing is important to complement the dominant modern education. Agrawal (2009) notes that "there are potentially as many different ways of knowing as there are knowers!" (p. 158). Recognizing and utilizing diverse worldviews and knowledge systems is crucial. However, even in some of the attempts to integrate IK, it is usually considered inferior to the mainstream knowledge (Magni, 2017).

Despite the significance of IK for sustainable development, there is limited research on how to develop SCs utilizing IK (Breidlid, 2009; Grosseck et al., 2019). We conducted this study to address the following research questions.

1. What indigenous knowledge can be utilized to enhance the sustainability competencies of higher education students?
2. What learning approaches foster sustainability competencies in higher education?
3. How can indigenous knowledge be included in modern higher education systems to enhance sustainability competencies?

3.3   Methods

As a means of triangulation, we sourced data from two groups of purposely selected experts and used two data collection methods. These were focus group discussions (FGDs) with education experts, and open-ended questionnaire items to collect data from respondents with expertise in both sustainability and education.

3.3.1   Focus Group Discussions

Preparation of Questions for the Focus Group Discussions

A list of draft questions to guide the FGDs was prepared by the first author based on the theoretical framework discussed above. The questions were improved using inputs from the other co-authors and two faculty members of Addis Ababa University with extensive relevant experience.

Recruiting Focus Group Discussion Participants

To qualify as an expert and participate in the FGDs, the possession of at least a master's degree and three years' teaching and research experience in an accredited higher education institution in Ethiopia was required. In addition, participants should have practical experience in designing curricula, training university lecturers, publication of journal articles, conference papers, textbooks, or policymaking.

Addis Ababa University (AAU), Bahir Dar University, and Wollo University were purposely selected as sources of experts. The first two were selected for being among the oldest and well-established institutions with higher education fields. Wollo University was selected because it is one of the young universities in the country. This was considered an opportunity to involve a variety of faculty members with different demographic features to produce diverse perspectives.

We used university websites and resource persons to identify potential experts. Following this, an invitation letter was sent to ten potential participants each from among academicians at AAU and Bahir Dar University and seven at Wollo University. In the letter and follow-up face-to-face and telephone conversations, we gave operational definitions of the key concepts for a common understanding. The letter also explained the purpose of the study, that audio would be recorded, anonymity is guaranteed, and that their acceptance of the invitation is considered as giving consent.

Eight experts from AAU, seven from Bahir Dar University, and five from Wollo University, i.e., a total of 20 experts, participated in the three FGDs. Just before the FGDs, they completed a demographic questionnaire. The demographic characteristics of the FGD participants are given in Table 3.1.

Table 3.1

Demographic characteristics of the focus group discussion participants

Variable	Frequency	Percentage (%)
Education		
PhD	14	70
Master's degree	6	30
Gender		
Male	18	90
Female	2	10
Industry experience		
Yes	9	45
No	11	55
Academic Rank		
Associate Professor	4	20
Assistant Professor	10	50
Lecturer	6	30
Age		
55–64 years	2	10
45–54 years	7	35
35–44 years	4	20
25–34 years	6	30
Not Given	1	5
Experience		
≥33 years	4	20
27–32 years	1	5
21–26 years	2	10
15–20 years	3	15
9–14 years	5	25
3–8 years	5	25

Focus Group Discussion Procedure

Before the actual FGDs, a trial FGD with eight full-time lecturers of AAU was conducted to estimate the required time and prepare for the actual FGDs. The actual FGDs were conducted in 2017 and 2018 at AAU and Bahir Dar University. All the FGDs were audio-recorded. The average duration of the FGDs was 1 h and 27 min. The first author moderated the FGDs.

The moderator and participants used numbers, not names, to represent participants and keep them anonymous. When necessary, the moderator asked probing questions to better understand the participants' reasonings and arguments. For instance, when one of the participants said, "we have to make our curriculum Ethiopianized.", the moderator asked, "Can you elaborate a bit on Ethiopianization of the curriculum?"

3.3.2   Open-Ended Questionnaire Items

In addition to the FGDs, qualitative data were collected from 14 other experts. Each of them had expertise both in sustainability and education. These experts had participated in our earlier study (Demssie et al., 2019) on the identification of SCs. Eight of the fourteen participants were PhD holders; the remaining six were master's degree holders. The group consisted of young professionals with experience ranging between nine and fourteen years and seniors with more than twenty-seven years of experience. In the criteria for inclusion of participants, it was indicated that the experience could be gained in accredited higher education institutions as educators or researchers, or in the industry related to participation in negotiations, policymaking, training, or consultancy. Besides, it was required that an expert should have either taken or taught a course, published an article, or presented a conference paper related to sustainable development. The open-ended questions they answered were "What learning approaches do you recommend fostering SCs in higher education students? Why?"

3.3.3   Data Analysis

Analysis of Data from the Focus Group Discussions

An iterative process of inductive analysis was used. It started during the FGDs by taking note of the main points raised by participants. After repeatedly listening to the recorded audios to become immersed in the data, they were transcribed verbatim. Then, a preliminary analysis was conducted for each FGD by breaking down the texts and identifying the main themes. These themes were then labeled. Following this, similar points with the same labels from each FGD were collected and categories were identified. For instance, the participants made points about the contribution of students in knowledge construction, the need for students to have opportunities to learn, the effectiveness of learning approaches that facilitate engagement, and so on. These similar themes were grouped to form a category called 'engagement'. This process was repeated for all the FGDs.

Analysis of Data from the Open-Ended Questionnaire

Responses of participants to the open-ended questionnaire items were compiled verbatim. Subsequently, a preliminary analysis was conducted by breaking down the texts and identifying the main themes. These themes were then labeled. Following this, similar points with the same labels were collected and tentative categories were identified.

Categories from the Focus Group Discussions and Open-Ended Items

All categories were collected from the FGDs and the open-ended items to form a list of preliminary categories. Co-authors held a meeting to discuss the improvement of these categories and their descriptions that resulted from the said process.

In addition to the two methods of data collection (FGDs and questionnaire items) and two groups of experts (education and sustainability), we used member checking as a means of validity. Two participants from each of the FGDs reviewed a summary of the major findings of the data analysis. They confirmed that the points they made and the overall FGDs had been properly represented in the summary of the findings. Figure 3.1 summarizes the whole research process.
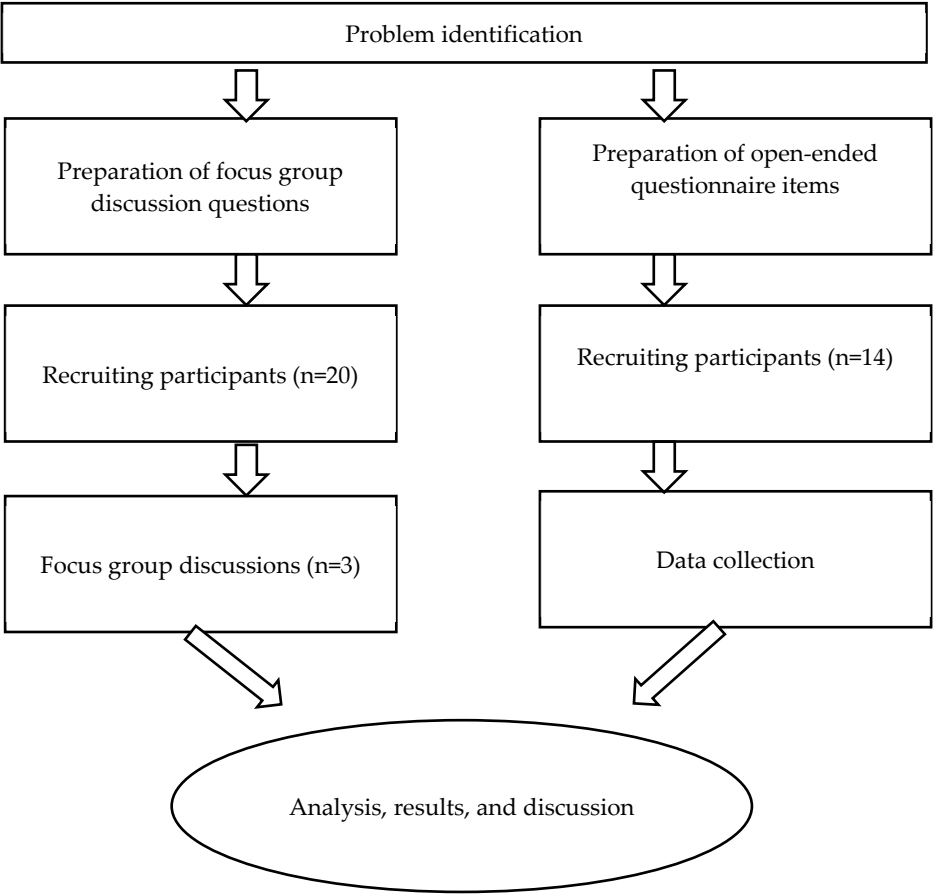
Figure 3.1 Summary of the research process.

3.4   Results

The results are organized as follows: the use of IK, learning environments and pedagogies in modern education, and possible ways of integrating the two to foster SCs.

3.4.1   Indigenous Knowledge to Enhance Sustainability Competencies

The findings regarding IK are related to the indigenous Ethiopian Orthodox Tewahedo Church (EOTC) education and other IK in Ethiopia. The participants raised points about the limitations of the modern education in Ethiopia and the need to utilize IK. The specific types of IK they discussed include farmers' weather forecasting knowledge, natural resource management, wegesha (bone setters), and shemane (traditional weavers). Participants' inputs to IK and developing SCs are organized under the topics: (1) current situations of modern education and (2) the relevant features of the EOTC education system that can be utilized to enhance SCs.

Current Situations of Modern Education in Ethiopia

The modern education in Ethiopia is detached from Ethiopia. Participants stressed that the current education system, its philosophy, and its elements, e.g., the curriculum, the content, and the methods of delivery are imported and have not been adequately localized. Failure to value, explore, and build on the Ethiopian IK and accepting the Western education system as it is created the education–reality gap. Participants noted that the imported system is Eurocentric in nature and that it does not fit the collectivist culture of Ethiopia. As a result, what students study in schools has little relevance to the reality of their environment.

Features of the Ethiopian Orthodox Tewahedo Church Education System

Participants identified the following features of the EOTC education system as having the potential to contribute to the development of SCs, directly or indirectly.

Elaborate system—the education system has clearly defined goals to be achieved at each stage of the educational trajectory. It takes thirty or more years to complete the highest levels depending on the performance of the individual student. Some participants in our study compared the highest levels of the church education to postgraduate levels of modern education.

Group dynamics and peer support—students at different grade levels (i.e., beginners, intermediate, and advanced) learn together. With this arrangement, peer support and collaboration culture are nurtured. The system makes senior students (or fast learners) responsible to support (tutor) their juniors (or slow learners). The system also addresses fast learners as they are given additional tasks. A participant described this feature as "it is when the senior students cannot solve a certain problem (or if the students do not agree on the solution) that they go back to their teacher."

A mix of lecture and independent learning—when students start learning for the first time, the teacher gives a lecture. Then, the learners are guided to learn by themselves with a little support.

The role of teachers—the teachers in the churches are highly proficient and passionate about what they teach. They engage and manage their students. They limit their talk, observe learners, and intervene only when a learner misses something.

The use of local languages— Ge'ez is the major Ethiopian language in the church education system and most of the documents in the church are written in Ge'ez. Nevertheless, participants pointed out that the appreciation, exploration, and promotion of local languages in which important literature from thousands of years has been accumulated was lacking at the decisionmakers' level. Participants noted that foreign academic institutions are aware of the value of this language and the literature preserved in it; arguing that several Western universities offer courses related to the Ge'ez language.

3.4.2   Conducive Learning Environments to Foster Sustainability Competencies

Participants discussed the following as important aspects of learning environments in the modern education system to facilitate the development of SCs.

Worldviews

To be effective and relevant, education systems should fit the worldviews of the particular context. Participants suggested the need to clearly define and use Ethiopian worldviews as a framework to redesign the country's education system. They explained collectivism as the dominant outlook in the Ethiopian and African context versus individualism in the Western context.

Extending Learning to Society

Currently, learning is confined to classrooms and disconnected from the reality in the study context. It is detached from social values, the reality outside classrooms, and students' lives. Students memorize content and assessment is based on testing memory. One participant noted: "I can boldly say what we do in the classroom is completely detached from the outside reality and the environment that the students are living in."

To deal with this problem and make learning relevant to enhancing SCs, participants emphasized the need for learning to go beyond the walls of a classroom and be connected to the context. It should be connected to societal priorities, students' lives, and the industry. A participant strengthened this, saying, "schools are miniature society, we say." Linking learning and communities helps to develop competencies related to the social and environmental aspects of sustainability. A participant noted how this can be done: "extend the school to the community [using] community projects. Can students develop, for instance, springs for a very poor community? In many rural areas, schools have land. So, can we use these as centers of agriculture innovation?"

Curriculum

Participants expressed their concerns that the curricula in the Ethiopian education system were not guided by relevant worldviews. To fit the philosophical orientation of the nation, it is recommended that the curricula should be reviewed and updated. Accordingly, the education system should utilize local resources and contexts and localize the content of curricula.

Engagement Opportunities

Participants noted that in the current education system, teachers have authority and dominate the learning process, using most of the time for knowledge transmission. As a result, students have limited opportunities to practice skills and to learn through interactions, discussions, brainstorming, and thinking. They depend on

the teacher. One participant noted: "teachers talk too much as if class time is given only for teachers." Participants discussed the need to limit the role of teachers to that of role models and coaches saying: "a teacher is a coach. And, a coach does not play in a game." To enhance the effectiveness of learning in fostering SCs, participants emphasized the need for the meaningful engagement of students. Providing opportunities for students to use the learning time, explore their environment, and make sense of the content is crucial to develop SCs. Participants suggested that such environments encourage students to think and interact with each other and with the environment.

Students' Local Experience

When designing and implementing learning for SCs, the cultural capital students bring from different places should be utilized. Also, the results of this study indicate that it is important to consider the interest, experiences, economic status, and backgrounds of students.

Pedagogical Approaches

Participants noted that there is not just one pedagogical approach relevant in all situations. The appropriate pedagogy depends on the specific purpose, subject, students' background, and other factors. The following pedagogies that facilitate engagement, prepare students for future sustainability challenges, and help them to be fit, i.e., competent in society, have been suggested.

- Cooperative Learning

Stressing that Ethiopia is a multicultural country, participants suggested cooperative learning to create opportunities for students from different backgrounds to work together and acquire competencies for social sustainability. A participant noted the importance of diversity in cooperative learning, "when we use cooperative learning, the groups are sometimes based on compatibility (similarity) in terms of ethnicity, sex, language, or religion. And in that case, that cooperative learning would not help us to achieve this inclusion or social justice competency."

- Learning by Doing

Practice/learning by doing helps to foster sustainability-related knowledge, skills, and attitudes in an integrated fashion. For this to be effective, the use of mandatory extracurricular activities related to the desired competence was suggested.

- Modeling

Participants suggested modeling as a means to influence students' attitudes. They explained that in Ethiopia, there is a culture of modeling parents, teachers, elders, religious leaders, and others. This can be utilized to contextualize learning and address the attitude aspect of competence by involving role models and using the stories or achievements of people.

- Place-Based Learning

Involving diverse groups of students and teachers from different study areas to solve sustainability-related local problems was suggested by participants. This approach allows students to learn from and work with interdisciplinary groups. A participant shared the preparation they are making to use place-based learning as follows.

> Currently, water hyacinth, an aquatic plant, infestation in Lake Tana, i.e., the largest lake in Ethiopia and the source of the Blue Nile (i.e., *Abay,* as Ethiopians call it), is a burning issue. We

formed a team and identified this as our local problem for place-based learning. The objective was to engage students from different departments to participate in this learning approach. For instance, students from chemistry, geography, biology, mathematics, and other departments could involve in this process. This gives students the opportunity to work together to explore the problem vis-à-vis the different disciplines' points of view and identify potential solutions.

- Field Trips

Several participants suggested fields trips as one of the effective learning approaches in enhancing SCs of learners. Participants from one of the three universities participating in this study shared their experience with the use of field trips.

We took our students to local charity organizations in Addis Ababa that care for the elderly and mentally disabled people. The students were touched by the experience and expressed the positive effect of the trip on their readiness to help their community. We understand that the effect of the trip was more significant than the discussions they had in class about related topics.

- Information and Communication Technologies (ICT)

ICT-supported strategies including simulation were suggested to affect the attitude aspect of SCs. Participants suggested that topics related to environmental sustainability including the impact of climate change and deforestation as appropriate to be visualized using ICT. They noted that ICT enables the preparation of such content and creating access to students across the country.

- Real-World Learning

Real-world learning is suggested as an effective method to help students learn the social and environmental aspects of sustainability. A participant strengthened this, explaining how students learn, "(in the classroom) they learn their environment, the physical environment, and the social environment subjectively. They are just narrating. The teacher is narrating. But it's invisible to the students. Students should go out and enquire the nature, and society."

3.4.3   Possible ways of incorporating indigenous knowledge in the modern education to enhance sustainability competencies

Integration of IK and modern education is crucial to realize the untapped potential of IK. Based on the results of the data analysis, the following possible ways of integrating IK and modern education are identified.

Define Ethiopian Worldviews

In its current form, the relevance of modern education in Ethiopia is questioned by participants. That is, the education system and the worldview it is based on are not Afrocentric or Ethio-centric (focusing on Ethiopian history or culture). Participants noted that the collectivist culture of Ethiopia requires educational approaches relevant to such worldviews. To enhance the relevance of education and utilize both modern and indigenous approaches, the consideration of Ethiopian worldviews as a framework is recommended.

Local Content and Examples

When teaching theories, principles, and so on, the use of relevant real-world local applications can make learning more effective and concrete. The following example given by a participant explains this.

> In psychology (classical conditioning and) operant conditioning we only talk about Pavlov's dog and Skinner's rat. But there are real-world applications in our context. One among these is, how farmers train their oxen to work their land. They use operant conditioning. Let's go to our society and benefit from what's already there.

Apprenticeship

Learning in the modern education in Ethiopia is confined to classrooms. The opportunities in the local environment have not yet been taken advantage of. For instance, indigenous ecological practices, the activities of wegesha, and shemane can be used to let students go out. As such, students may learn from society and come back to classrooms for reflection. Participants also suggested using local expertise related to chemistry. Also, topics such as distillation and fermentation could benefit from local knowledge of traditional drink making.

Indigenous Experts as Guest Lecturers

People with IK should be included to teach parts of a course (in the modern education) where their expertise is relevant. This helps learners to gain practical experience and makes learning more meaningful for them. An example regarding the relevance of IK for social sustainability relates to healthcare. The majority of the Ethiopian population and livestock depend on indigenous medical practices. Another example by a participant: "Indigenous weather forecasting knowledge of farmers is one applicable IK. The farmer observes different features of the sky and predicts the weather." Exploring and improving such IK and learning these from indigenous experts were suggested by participants.

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3.5   Discussion

To facilitate different stakeholders' endeavors towards a socially, environmentally, and economically sustainable world, identifying relevant knowledge, skills, and attitudes, (i.e., SCs) is crucial (Demssie et al., 2019). These competencies should be acquired by students and professionals in areas related to sustainable development. One of the means to foster learners' competencies is education, purposely designed to facilitate this. However, current approaches to developing SCs are dominated by Eurocentric approaches and these approaches do not always connect with the Ethiopian context. Therefore, this paper aims to explore learning approaches for SCs, and the potential and ways of integrating IK to facilitate the development of SCs in Ethiopia. Based on the main findings, to make learning effective in fostering SCs, we propose the five learning design principles in Table 3.2. The principles summarize the importance of worldviews, the potential of IK, the learning environment and pedagogies in modern education, and the possible ways of integrating the two systems to foster SCs.

Table 3.2

Learning design principles

No.	Principle	Description
1	Define worldviews	Define worldviews of the context where learning happens and use them as a framework to design the education system.
2	Utilize indigenous knowledge	Use local content, languages, and examples; apprenticeship to explore IK; local experts as guest lecturers; IK courses in modern education.
3	Build on students' local experiences	Take advantage of the diverse interests, backgrounds, and cultural resources students bring from their localities.
4	Provide engagement opportunities	Create an enabling environment for learners to play active roles in the learning process.
5	Utilize sustainability-oriented pedagogies	Use pedagogies relevant in fostering SCs including field trips, cooperative, practice-based, and place-based learning.

In Table 3.2 'IK' stands for indigenous knowledge and 'SCs' stands for sustainability competencies.

In this section, we discuss the above design principles in relation to our findings and the related literature.

3.5.1   Define Worldviews and Use Them as a Framework

It is important to consider the worldviews and priorities of the context where learning happens (Neeganagwedgin, 2013; Wals, 2007). Without this, learning would be disconnected from reality. In Ethiopia, participants expressed concern that the modern education was divorced from the context. The imported modern system is implemented without making adjustments to fit the Ethiopian sociocultural, historical, and

other contexts. This disconnected the curriculum, learning activities, and contents from the students' social values and the environment.

The modern education in Ethiopia does not play a meaningful role in national development efforts because it disregarded the IK in Ethiopia (Asgedom, 2005; Woldeyes, 2017). Mawere (2019) argues that in Africa at a continental level, the content of the imported Western education has little relevance to the context.

The modern education system introduced in Ethiopia did not only ignore IK as if it was irrelevant, it produced learners who detested their tradition and values (Kebede, 2006). The system produced "Westernized elites" who considered the schools in the indigenous education as "conservatives and irrelevant to the development needs of the country" (Asgedom, 2005, p. 8). According to Negash (1996), the major limitation of the modern education system in Ethiopia is its disregard for the indigenous education system that existed before it. The disconnection between the indigenous Ethiopian education and the modern education created graduates that are disconnected from their society (Woldeyes, 2017).

The Ethiopian worldviews and the Eurocentric modern education system keep going without one significantly influencing the content and characteristics of the other. For instance, Negash (1996) states, "the idea of the school and its curriculum as it operates in Ethiopia today came with Europeans. Although schools organised along European lines have been functioning for nearly a century, the school system still retains its foreign origin and character." (p. 31). This created what participants identified as a gap between the European education system and the Ethiopian cultural and worldview context. Asgedom (1998) puts this as "the two cultures have been in contact for more than 100 years. Yet, the Ethiopian culture remained Ethiopian and the Western is Western (p. 2)." Hence, to be relevant, education should build on the worldviews of the context where the learning happens (Asgedom, 2005; Owuor, 2007; Woldeyes, 2017).

To address sustainable development-related issues, it is crucial to recognize that dominant Western worldviews are not universal and that there are diverse worldviews. Valuing and utilizing multiple worldviews facilitates a better understanding of sustainable development and the engagement of various actors in the efforts towards a more sustainable world (Van Opstal & Hugé, 2013).

Hewitt (2000) strengthens this as "learning is culturally based and thus every method of teaching and learning must take cognizance of the learner's worldview" (p. 111). Lack of this consideration creates the education-reality gap.

Participants emphasized the need for an educational system that incorporates learning methods and content inspired by Afrocentric/Ethio-centric thinking to fit the collectivist worldviews of the Ethiopian context. Isaac (1971) suggests maintaining the Ethiopian indigenous learning in relation to national identity "if Ethiopian self-understanding and national consciousness are to remain, a major portion of the subjects of traditional learning in the three higher levels of study must be retained" (p.12). A participant explained the philosophical difference between what she called the "Western dualistic worldviews and African/Ethiopian harmony/unity assumption". Accordingly, the participant described the former as classifying "everything versus everything else; nature versus technology . . . expanding infrastructure at the expense of nature..." She argued that Ethiopian worldviews "maintain nature and infrastructure at the same time" providing the example of the monolithic rock-hewn churches of Lalibela, a UNESCO world heritage site in Ethiopia. "It maintains both infrastructure and nature together. It is a natural rock; it was already there. The rocks are shaped exactly where they were into something. It is important to challenge the dualistic mindset to inculcate values related to sustainability." Kaya and Seleti (2014) agree with this participant as they characterize the African indigenous knowledge system as "holistic and community-based" (p. 41).

Holistic approaches are crucial for sustainability education (Remington-Doucette et al., 2013). Hence, this is one of the possible areas indigenous worldviews can complement Western education to deal with the reductionist feature of the latter.

3.5.2   Utilize Indigenous Knowledge to Develop Sustainability Competencies

Ethiopia is a multicultural country with more than eighty ethnic groups. Each group has its own IK Negash (1996). Here, we discuss the IK of Ethiopia related to the indigenous Ethiopian Orthodox Tewahedo Church education system and other types of IK highlighted by participants. In addition to offering the indigenous Ethiopian education, the Church plays a direct role in natural resource management, particularly forest biodiversity conservation. Forests are one of the distinguishing features of the EOTC. Klepeis et al. (2016) summarize the contributions of the EOTC as

> what is clear is that church forests protect some of the last native forest in South Gondar . . . , contain many of Ethiopia's endangered plant and invertebrate taxa . . . , support the highest richness of tree species in the region . . . , and provide a range of social benefits to community members. (p. 718).

 The number of church forests in Ethiopia is considerable. Orlowska and Klepeis (2018) documented the existence of 8000 church forests in just one of the regional states, i.e., Amhara Regional State. Negash (1996) notes the potential of religious institutions in Ethiopia vis-à-vis sustainability education suggesting that such institutions "can indeed form the basis for launching a sustainable environmental education programme." (p. 40).

Lessons from the Features of the Indigenous Ethiopian Church Education and IK

Major features of the EOTC emphasized by participants are discussed in Section 3.4.1. Participants described this education system as an elaborate system and compared the highest levels of the church education to advanced degrees in the modern education. Similarly, some authors compared the highest learned scholars in the church system to professors in the Western context (Pankhurst, 1974). Isaac (1971) concludes that "any graduate of the Scholar's Institute (the highest level of the church education), by the schooling for at least thirty years, is as competent as any well-trained theologian in Europe or America in sophisticated philosophical and theological discourse." (p.10)

The modern education can benefit from some features of the indigenous EOTC education. Possible lessons related to the use of local languages and content are discussed below. The Ethiopian language Ge'ez (ግዕዝ), also known as Ethiopic, is of paramount significance because the recorded and ancient IK of Ethiopia is preserved mainly in this language. Knowledge of Ge'ez enables learners to access IK, especially the ones related to EOTC. Participants pointed out that cognizant of its value, several universities in Europe and North America offer courses related to Ge'ez. The results of an internet search confirmed that several universities in different countries offer Ge'ez-related courses (See Appendix I). However, as suggested by participants, the proper appreciation of the value and efforts to explore the language were lacking at a national level in Ethiopia. In recent years, however, the number of Ethiopian universities realizing the potential of the language and offering related courses is increasing. This facilitates the cooperation between scholars of the modern education and the church education. In addition, the use of local languages could address education quality issues caused by students' lack of adequate proficiency in the English language, the medium of instruction in the Ethiopian higher education system. An earlier study identified language limitation to be one of the factors affecting the quality of education at Addis Ababa University (Demssie, 2012).

Valuing and utilizing local content are also important features of the church education system. Examples of revered Ethiopian scholars whose works are used as core contents of the EOTC include the sixth century Ethiopian saint Yared, known as the creator of Ethiopian music and music notation, and Zara Yaacob, a seventeenth century Ethiopian philosopher (Isaac, 1971). The important lesson for sustainability competence development is the recognition and utilization of local content. Focusing on local opportunities and local levels facilitates progress towards a more sustainable world. Lotz-Sisitka, Wals, Kronlid, and McGarry (2015) explain the benefit of local level sustainability endeavors. They note that "transformations to sustainability occur in 'niches' at local level, and it is from this level that wider social changes and regime shift transformations can be driven/emerge" (p. 77). The absence of this feature from the Ethiopian education system was identified as the major limitation that created an education–reality gap.

Another aspect of the EOTC education is group learning. It facilitates peer support and collaboration. The benefit of cooperative and collaborative learning for sustainability is recognized in the literature as well (Crofton, 2000).

Ways of Utilizing Indigenous Knowledge to Foster Sustainability Competencies

To utilize IK and make modern education relevant, exploring the former and integrating the two is key. Hewitt (2000) explains the benefits of integrating indigenous worldviews as follows.

> "Our global perspectives would gain immeasurably if we could incorporate some elements of this holistic worldview into our interpretation and understanding of the world we all inhabit. The outcome could be a less aggressive and combative lifestyle that is in tune with the natural world. The world we hold in trust for future generations could be given time for regeneration." (p. 117)

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There are education programs that have integrated indigenous and modern education in areas related to sustainability. Here we mention two of them. The first one is a minor program in Forestry, Natural Resources, and Environmental Programs at California Polytechnic State University (Verma et al., 2016). The researchers who studied the minor program vis-à-vis its curriculum and student feedback determined that integrating modern education and IK, traditional ecological knowledge in this case, "can provide a more rounded preparation for students in forestry, natural resources, and other professional areas . . ., the opportunity to study and gain experience in diversity learning and understanding of other perspectives . . . " (Verma et al., 2016, p. 654). The other example is a study conducted in Indonesia using a learning approach that combined IK and modern education in chemistry. Specifically, it focused on pesticide use. The researchers conclude that "learning by integrating perspectives of indigenous and Western science aided students' insight. It showed them that chemistry learning can be enriched by an interconnected system of worldviews in order to find solutions to sustainability issues"(Zidny & Eilks, 2020, p. 1).

Participants suggested possible ways of incorporating IK in the modern education so that the two knowledge systems could complement each other (Section 3.5). One among these is involving local people with IK as guest lecturers in sustainability learning, such as indigenous weather forecasting, medical practices, and natural resource management. Thus, for local people to contribute to sustainability, they should be involved "in the core function of higher education, i.e., teaching and research..." (Kaya & Seleti, 2014, pp. 41–42).

Apprenticeship opportunities for students to explore and practice IK relevant to SCs were suggested by participants. One such indigenous practice is the integrated approach of the Konso people in Ethiopia, a UNESCO World Heritage. It involves, among others, population control, water and soil conservation using stone terraces, and the mobilization of labor (Beshah, 2003).

Launching university programs in IK is another means suggested to utilize IK. For instance, the higher levels of the EOTC education are suitable for higher education study (Isaac, 1971). Glasson, Mhango, Phiri, and Lanier (2010) point out that IK systems and Eurocentric knowledge systems should complement each other and suggest the inclusion of IK in the modern curriculum.

3.5.3   Build on Students' Local Experiences

Students' experiences from diverse cultures are important assets that need to be utilized in sustainability education. Hence, capitalizing on learners' IK complements and contextualizes modern education. As such, students become active contributors and their level of engagement is taken to a higher level in the process of fostering their SCs. Lozano et al. (2017) state that "by highlighting indigenous knowledge systems and values, instructors and students can also help to sustain threatened cultural diversity and heritage . . ., This can be especially beneficial for students from indigenous communities, who may feel alienated or unrepresented" (p. 9).

Apart from being disconnected from Ethiopian worldviews, the learning environment in Ethiopia is confined to classrooms and dominated by lectures. Hence, utilizing students' experiences helps to deal with this situation by extending learning to society. Participants stressed the need for students to explore their environment and make sense of the content. In sustainability education, pedagogies "that directly involve students in learning and practicing transdisciplinary engagement in service to sustainability" are relevant to foster SCs (Evans, 2019, p. 1).

3.5.4   Provide Engagement Opportunities

The current situation in the context under study deprives learners of the opportunity to meaningfully engage in the learning process. Students depend on the teacher and are given little time as the focus is on knowledge transmission. Previous studies questioned the effectiveness of learning approaches that make students passive recipients in fostering SCs (Figueiró & Raufflet, 2015; Hesselbarth & Schaltegger, 2014). To develop SCs, students need to explore their environment and contribute to knowledge creation. Figueiró and Raufflet (2015) suggest that learners should be "active knowledge producers instead of passive recipients . . ." (p. 28). Accordingly, several of the pedagogies recommended for sustainability learning are those that provide engagement opportunities for students (Eilam & Trop, 2010; Evans, 2019; Kioupi & Voulvoulis, 2019; Molderez & Fonseca, 2018; Sinakou et al., 2018).

3.5.5   Utilize Sustainability-Oriented Pedagogies

Participants recommended pedagogies that help students acquire SCs through meaningful engagement. These include field trips, cooperative, practice-based, place-based, and real-world learning. These are consistent with the pedagogies suggested in the literature to foster SCs (Evans, 2019; Molderez & Fonseca, 2018; Sinakou et al., 2018). Earlier researches also identified action-oriented learning as effective and relevant to develop SCs (Sinakou et al., 2018). Place-based learning and field trips were suggested by participants because these approaches give students real-world experience and the opportunity for meaningful engagement. These are crucial for developing SCs (Molderez & Fonseca, 2018). Participants also recommended cooperative learning to foster social sustainability, specifically social justice and inclusion competence. This competence was identified in an earlier study as important for sustainable development professionals (Demssie et al., 2019).

The five learning design principles discussed above are interrelated. The achievement of one facilitates the achievement of the other. For instance, defining the worldviews of a certain context helps to identify relevant

IK and possible ways of integrating IK with the modern education. The use of sustainability-oriented pedagogies facilitates the engagement of students. Engagement opportunities enable the utilization of students' experiences, and so on.

Wesselink, Biemans, Mulder, and Van den Elsen (2007) developed principles of competence-based vocational education. Among others, the principles they identified include the need to define competencies, learning in authentic situations, and the self-responsibility of learners (p. 8). The current study focuses mainly on developing SCs and its findings agree with the principles listed above.

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3.6   Conclusions

This study aimed to achieve three objectives. The first one was to explore what IK can be utilized to enhance SCs. In this regard, some features of the indigenous Ethiopian Orthodox Tewahedo Church education system were recommended. These include collaborative learning in a form of peer support, the use of local languages and content, and respect for local scholars. In addition, the Konso people's integrated natural resource management knowledge and other IK related to weather forecasting and traditional healthcare practices were identified as potential means of enhancing education for sustainability.

The second objective is related to the modern education system in Ethiopia. Currently, the relevance of the imported modern education is questioned as its underlying worldview and content were not meaningfully contextualized to the Ethiopian reality. We explored how to enhance the relevance of this system to the Ethiopian context and facilitate its contribution to fostering SCs. Major points such as reorienting learning to fit relevant worldviews; extending learning to society; meaningfully engaging learners; utilizing students' experience; and using appropriate sustainability-oriented pedagogies were found to be important.

The modern education system introduced in Ethiopia did not appreciate its predecessor, i.e., a seventeen centuries-old Ethiopian indigenous education system. The thousands of years old knowledge was deprived of the chance, at least, to be meaningfully explored for its merit. The modern education considered it irrelevant and excluded it. Hence, the two education systems are not benefiting from each other. To address this situation, valuing, exploring, and defining Ethiopian worldviews was suggested. Once this is done, the IK relevant to sustainability could be identified and incorporated in the modern education to help make the latter more holistic and relevant to the context where education happens. This concerns our third objective, i.e., identifying possible ways of incorporating relevant IK in modern education to enhance SCs. According to the findings, this can be facilitated by, among others, utilizing local languages and content, and involving local people with relevant IK as guest lecturers. Utilizing IK and indigenous education systems should not mean avoiding knowledge from other contexts. Rather, it should mean respecting multiple worldviews and openness to capitalize on them where appropriate.

Overall, the results of this study indicate that ESD should not begin from pedagogies; it should start from the worldviews on which the pedagogies are based. It is important to link education to the cultural, traditional, and historical identity of learners and the context at large. Without this link, the relevance of education is jeopardized.

Our study contributes to theory by showing the connections among SCs, ESD, and IK. The findings may serve as a starting point for designing education for sustainability, especially in contexts where both Western education and IK exist.

Sustainability is a complex field related to several social, environmental, and economic aspects. Hence, efforts to foster SCs should not depend only on Eurocentric worldviews and pedagogies. Disregarding time-tested IK that enabled societies to survive various social and environmental challenges means missing opportunities for more perspectives to deal with a complex normative issue such as sustainability. More space for various worldviews facilitates global solutions to global problems.

CHAPTER 4

Fostering students' systems thinking competence for sustainability by using multiple real-world learning approaches[3]

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[3] This chapter is submitted as:

Demssie, Y. N., Biemans, H.J.A., Wesselink, R., & Mulder, M. (submitted). Fostering students' systems thinking competence for sustainability by using multiple real-world learning approaches.

Abstract

To contribute to a more sustainable future and to deal with pressing global challenges, such as poverty, climate change, and inequality, equipping future sustainability change agents with relevant competencies is crucial. Several studies have identified key sustainability competencies. Among these is systems thinking competence, which facilitates the understanding of the impact of human activities on the different dimensions of sustainable development. Innovative learning approaches relevant to fostering such sustainability competencies have been studied. However, there has been limited research into the contribution of multiple learning approaches in fostering systems thinking competence in authentic environments. To address this gap, we conducted a pre-test–post-test exploratory experimental study involving 36 students of a Bachelor of Arts program in Geography and Environmental Studies, at Addis Ababa University, in Ethiopia. The participants were randomly assigned to a mobile phone group and paper-and-pencil group of 18 members each.

Using real-world learning environments, the study explored the contribution of field trips and collaborative learning in combination with mobile learning for one group, and with paper-and-pencil note taking for another. The intervention provided participants with the opportunity to meaningfully engage in the learning process. The combined use of these learning approaches in a real-world context helped to foster the systems thinking competence of participants in both groups. It seems that the mobile group gained more in one of the key components of systems thinking: appreciation of system complexity.

Our findings indicate that more room for students to meaningfully engage in the learning process is important in sustainability courses focusing on systems thinking competence. It is further shown that real-world contexts facilitate learners' collaboration with peers and their appreciation of the complexity of social, environmental, and economic systems. The findings suggest that education for sustainable development discourses should focus more on combinations of multiple innovative learning approaches and authentic environments to enhance systems thinking competence for sustainability.

4.1 Introduction

Sustainability issues are global challenges that need to be addressed by – among other actions, identifying competencies for future sustainability change agents. This helps them to contribute towards a more socially, environmentally, and economically sustainable world. These competencies include – inter alia – systems thinking competence (STC) (Demssie et al., 2019). Exploration of what learning approaches foster these competencies is also crucial for responding to sustainability issues (Demssie et al., 2020). In the effort to foster sustainability competencies (SCs), previous studies focused on recommending certain pedagogical approaches. Combinations of innovative learning approaches (i.e., different from traditional, less relevant, but dominant ones, such as lectures) are important to foster SCs. However, the practice of employing such approaches is not common (Demssie et al., 2020; Lozano et al., 2019). Studies that investigate the practical implementation of combinations of innovative learning approaches in authentic environments to foster STC are lacking. This study addresses this gap by exploring the contribution of implementing a set of learning approaches (i.e., field trips, collaborative learning, and mobile learning) in fostering the STC of students in higher education.

Demssie et al. (2019) identified 15 competencies required for sustainability change agents in the Ethiopian context. Among these, STC gained the highest rating from sustainability experts. This competence is elaborated in Section 4.2.1 below. Demssie et al. (2019) concluded that STC can help sustainability change agents to realize the complexity of the social, environmental, and economic environments in which their organizations function. They also suggest that this competence helps leaders of organizations to realize that an action by an organization affects others and that the competence helps leaders to act responsibly and sustainably. Because of the significance of the competence, several other studies have also identified systems thinking as one of the key sustainability competencies (Heiskanen et al., 2016; Lozano et al., 2017; Osagie et al., 2014; Roorda, 2013; Wiek et al., 2011). Accordingly, this competence was selected for the current study.

Various studies indicate the importance and challenge of developing STC for sustainability. Molderez and Ceulemans (2018b) describe STC as "one of the most difficult competencies for students to acquire. Nevertheless, it is one of the key competencies of education for sustainable development" (p.758). Remington-Doucette, Connell, Armstrong, and Musgrove (2013) note that "[u]nlike other types of cognitive activity, systems thinking is not intuitive or innate. When thinking about a problem, we do not naturally think about all things connected to it and their interrelationships." They also emphasize that "it is necessary to cultivate this skill explicitly" (p.410). Because of its importance, developing students' STC is key, and because of the difficulties involved in fostering it, the use of a combination of innovative learning approaches in authentic environments is important.

Demssie et al. (2020), identified field trips, real-world learning, collaborative learning, and information and communication technologies (ICT) as learning approaches that facilitate the engagement of learners and are relevant to enhance SCs. These pedagogies and their relevance are discussed in the theoretical framework. A combination of these learning approaches was utilized in the current exploratory intervention study. This intervention was connected to the authentic problem of Addis Ababa's waste management system (WMS).

4.1.1 A short introduction to the research context

Addis Ababa is the capital city of Ethiopia. With an average altitude of 2,300 meters above sea level, it is one of the highest capital cities in the world. The area of the city is 540 square kilometers (Melaku & Tiruneh, 2020). The population of Addis Ababa city is about 4.8 million (Central Intelligence Agency, 2020). The city government is divided into 10 sub-cities. It is the seat of multiple significant international organizations, including the United Nations Economic Commission for Africa and the African Union.

The waste management activities in Addis Ababa, from the generation of waste to its disposal at the major landfill, called Koshie, have significant social, economic, and environmental implications on residents and workers in the WMS, among others. These include health risks and related expenses, the risk of landslides, plastic waste that is harming animals, and liquid waste contaminating rivers. Because the complex issues present in the WMS relate to the three dimensions of sustainable development (people, planet, and profit), it was used to contextualize the study.

The importance of utilizing learning approaches that facilitate the active engagement of learners – such as mobile learning, field trips, and collaborative learning – is emphasized by previous studies (Demssie et al., 2020; Monroe et al., 2019). Moreover, some studies recommend a combination of learning approaches to foster SCs (Lozano et al., 2019). However, we have not come across any studies that have investigated the implementation of a combination of the aforementioned learning approaches in authentic environments to foster STC. Hence, the purpose of this study is to explore the contribution of using a combined set of learning strategies in fostering STC.

In the remainder of the paper, we present the theoretical framework, methods, results, discussion, limitations of the study, suggestions for future research, and conclusions.

4.2 Theoretical framework

In this section, we introduce systems thinking competence, followed by the learning approaches for SCs in general and STC in particular. These include collaborative learning, field trips, and mobile learning.

4.2.1 Systems thinking competence

The origin of systems thinking is related to several disciplines. Córdoba-Pachón (2011) notes that it is "a body of knowledge that initially emerged in biological investigations has spread to other areas like physics, psychology, cybernetics, information technology, community development, and management" (p.43). The ability to identify the elements of a system, to recognize interconnections among between them (i.e., the ability to appreciate the complex nature of systems), and to analyze a system across different levels are the key components of STC (Chiu et al., 2019; Plack et al., 2018; Warren et al., 2014).

Based on several studies (Barile et al., 2018; Chiu et al., 2019; Giangrande et al., 2019; Kay & Foster, 1999; Nguyen et al., 2012; Osagie et al., 2014; Sipos et al., 2008; Wiek et al., 2011), we operationalized STC in terms of these three abilities. In the context of SCs, Wiek et al. (2011) define STC as "the ability to collectively analyze complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global)" (p.207). Based on this and other definitions, we define STC as 'the ability to recognize the elements in and complexity of a system, to understand the interrelationships of the elements, and to appreciate the impacts of the interrelationships at local, national, and global levels.' This definition of competence is based on the cognitive and affective dimensions. As such, it is different from other definitions that conceptualize competence as a performance requirement (Mulder, 2014, 2019). The features of STC in the above definition make it relevant to sustainability, as the competence enables understanding of the impact of human activities on the different dimensions of sustainable development. These abilities are crucial for progress towards a more sustainable future (Demssie et al., 2019; Williams et al., 2017).

4.2.2 Learning approaches to foster systems thinking competence

Conventional, knowledge-oriented learning approaches confined in classrooms and dominated by lectures give little opportunity for students to meaningfully contribute to the learning process. As a result, the relevance of such learning approaches in fostering sustainability competencies, including STC, is questioned (Lozano et al., 2019). Innovative pedagogical approaches that engage learners in authentic learning environments and facilitate exchanging ideas (Vare et al., 2019) – such as field trips, collaborative learning, and mobile learning – are recommended to enhance learners' SCs (Demssie et al., 2020; Molderez & Ceulemans, 2018b). The promising nature of these learning activities in the framework of STC is described below.

Field trips

Field trips enhance STC because they take learners out of the confinement of the classroom and into the real world. In real-world contexts, learners get exposed to complex realities and realize that social, environmental, and economic phenomena are not isolated or independent of each other (Vare et al., 2019). As such, field trips help learners to appreciate complex interrelationships among different dimensions of systems. Keynan et al.(2014) remark that outdoor learning helps "contextualizing learning in real, complex, world environments, engaging students in particular environments that are meaningful and relevant to them, and triggering

learners' phases of processing and reflection, from which new conceptualizations may evolve" (p.103). Field trips are effective in fostering STC (Assaraf & Orion, 2005; Keynan et al., 2014).

Collaborative learning

Evans (2019) describes collaborative learning as "learning that involves active collaboration with classmates, community members, and/or others to generate/explore/analyze/interpret/apply ideas/practices" (p.15). Because of these features, collaborative learning has the potential to meaningfully engage learners. It facilitates the construction of knowledge by learners (Moore, 2005). Demssie et al. (2020) identified a lack of opportunities to engage learners as a limitation of lecture-based, traditional learning approaches and recommended sustainability-oriented learning approaches, including collaborative learning, to foster SCs.

The use of collaborative learning is recognized as being appropriate in education for sustainability because it facilitates the meaningful engagement of learners (Cotton & Winter, 2010; Crofton, 2000; Demssie et al., 2020; Evans, 2019). Moore (2005) supports this: "[c]ollaborative approaches encourage a shared construction of knowledge by a group of learners" (p.80). Learning approaches aimed at fostering STC should help students to get an overview of all elements involved and appreciate interconnections among different elements or systems. This, according to Warren et al. (2014), helps the learners to "realize how these systems often directly impact one another." The authors note that, when learning to foster systems thinking, "students should actively share findings with their peers" (p.9).

Collaboration facilitates the exchanging of different ideas among students and helps them to identify elements of a system and their interrelationships. This allows learners to explore and appreciate the complex nature of systems (Scheer & Plattner, 2012). In other words, when collaborating students generate and share diverse ideas, their ability in the main features of systems thinking – i.e., recognizing elements of a system and interrelationships among them – is enhanced.

Mobile learning

Mobile learning has been defined in several ways. Mcconatha et al. (2008) define mobile learning as "learning accomplished with the use of small, portable computing devices. These computing devices may include smartphones, personal digital assistants (PDAs) and similar handheld devices" (p.15). Mobile learning is used for different types of learning activities, including the creation of learning content in the forms of multimedia (Wing & Khe, 2009). In this study, mobile learning to enable learners to create content – in the forms of videos and pictures – was used to facilitate learning in an authentic environment. Mobile learning activities relating to recording videos and taking pictures are appealing to students. Pimmer, Mateescu, and Gröhbiel (2016) found that students are interested in using the camera function of mobile phones in mobile learning. They also indicate that the camera function "supported information collection and knowledge construction" (p.496). Molnar (2017) explains that "video based learning is increasing in popularity" and that it "is considered to be the most effective way of delivering the educational content to mobile devices" (p.21,614).

Mobile learning can take different forms and has various benefits. These include content creation (e.g., recording audio and taking pictures) and sharing (Wing & Khe, 2009). It also facilitates the active contribution of learners through their meaningful engagement in the learning process, collaborative learning, and field trips for real-world learning (Gikas & Grant, 2013; Heflin et al., 2017; Pimmer et al., 2016; Sung et al., 2016, 2019; Vázquez-Cano, 2014). As such, it has the potential to address the limitations of learning approaches confined in classrooms and to connect learning to the outside world (Ekanayake & Wishart, 2014).

Depending on the purpose and type of mobile learning, it can be related to different theoretical underpinnings. For instance, Pimmer et al. (2016) describe the use of mobile phones "to test vocabulary" as an "instructionist sense of learning", while describing their use "to create video materials", as a "constructionist approach" (p.491). A study by Zahn et al. (2014) shows that the use of learner-generated videos helped learners to gain "new and more complex knowledge" (p.618). This is relevant to STC because understanding complexity is a key component of the competence. As discussed above, enhancing the motivation of learners, facilitating real-world learning, and meaningful engagement of learners as content creators are among the strengths of mobile learning. These features of mobile learning have the potential to enhance STC by enabling collaboration among learners. Additionally, mobile learning facilitates authentic learning (Gikas & Grant, 2013; Kearney & Schuck, 2006). These contributions of mobile learning, in a form of learner-generated videos and pictures, help learners to appreciate the complexity of systems; a key feature of STC.

In our study, collaborative learning and field trips were used in two conditions: combined with mobile learning and with paper-and-pencil note taking approach. We included the mobile learning condition as one condition because of its potential. It can also be used to enhance learning – including environmental education – in several ways (Wing & Khe, 2009). The use of mobile phones for video recording is one of the effective mobile learning approaches (Ferry, 2008).

Mobile learning has the potential to engage learners and facilitates collaborative learning. Furthermore, it is appealing to learners (Gikas & Grant, 2013; Heflin et al., 2017; Pimmer et al., 2016; Sung et al., 2016, 2019; Vázquez-Cano, 2014). The other reason to use mobile learning in our study is the existence of more than 44 million mobile users in the context under study: Ethiopia (Ethio Telecom, 2020).

The paper-and-pencil approach is the standard approach in the Ethiopian higher education. Therefore, exploring its relevance in relation to pedagogies suggested for sustainability competencies has important implications. Because of its wide application, exploring its effectiveness in fostering systems thinking is crucial. Additionally, this notetaking method does have advantages in the learning process. According to Mueller and Oppenheimer (2016), studies that compared the conceptual understanding of students who took notes using laptops with those who used paper and pencil found out that the latter performed better. The authors state that the explanation for the better performance was that "handwriting is slower, pen and paper note-takers are not able to transcribe the content verbatim and are forced to selectively rephrase the material; doing so helps them process and understand the material more deeply and gain better conceptual mastery" (p.141).

As discussed above, several studies suggest different learning approaches and recommend a combination of learning approaches to foster SCs (Lozano et al., 2019). However, we have not come across any studies that implemented a combination of collaborative learning, mobile learning, and field trips in an authentic context to foster STC. Hence, it is unclear whether the combined use of these learning approaches facilitates the fostering of students' STC. The purpose of this study is to explore the effect of using a combined set of learning strategies in fostering STC. Accordingly, it was guided by the following two research questions:

1. Does the use of a combined set of learning strategies, (i.e., collaborative learning, field trips, mobile learning/paper-and-pencil approach) enable fostering systems thinking competence?

2. How does the use of mobile phones (to make multimedia content) compare to the use of paper-and-pencil in the effectiveness of the learning approaches listed in research question 1 vis-a-vis fostering systems thinking competence?

4.3 Methods

4.3.1 Design of the study

We used a pre-test–post-test exploratory experimental design to explore the contribution of the combination of the above-mentioned learning approaches in fostering STC of higher education students.

4.3.2 Participants

The participants were 36 graduating class bachelor's students in the Department of Geography and Environmental Studies at Addis Ababa University, Ethiopia, enrolled for the course Environmental Studies and Sustainable Development. Of these, 16 were female and 20 were male. Their average age was 22. Participants were randomly divided into a mobile phone group (MPG) and a paper-and-pencil group (PPG). Furthermore, each of these was randomly subdivided into three subgroups of six members each.
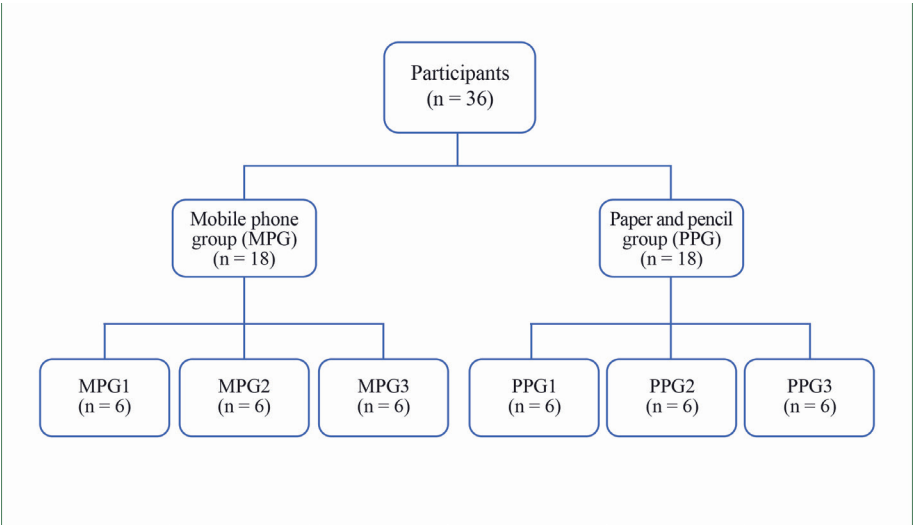
Figure 4.1. Groups and subgroups of participants

4.3.3 Ethics

We informed participants that participation was optional, had no consequences for the grading in the course they were taking. They were also informed that the participation would involve visiting a landfill, making street observations, interviewing people, collaborating with students, preparing a report, and attending a closing session. The participants were assured that the data of this study would be kept anonymous and used only for a study intended for publication. They signed a consent form and provided their contact details.

Permission to visit the Koshie landfill was secured from Addis Ababa City Solid Waste Management Agency. There are dangerous objects among the waste items, the landfill is not protected, and two years before the participants' visit, there was a landslide accident that claimed lives. Therefore, the safety of the participants was taken seriously. To understand the kinds of preparation required to protect the wellbeing of participants, the first author visited all the places that would be visited by the participants.

4.3.4 The intervention

The final product that participants had to deliver was a report on the strengths and weaknesses of the waste management system (i.e., creation, collection, transportation, storage, recycling, or disposal) of Addis Ababa, and to suggest possible improvements to this system. This had to be done in relation to the environmental, social, and economic components of sustainable development. Participants were also instructed to identify interrelationships among the three components of sustainable development and relevant stakeholders in the WMS.

Before the participants went to the field, they were given an orientation on how to safely and ethically undertake their tasks. Tips for recording videos and taking pictures with mobile phones were given to members of the MPG in order to prevent common technical issues. Participants were informed that they would be free to decide what content would be relevant to waste management practices that have implications on the three dimensions of sustainable development. The participants in both groups were given similar tasks with the only difference being the means of creating content, i.e., mobile phones and paper-and-pencil. Hence, they were advised to take pictures/videos (for the MPG) and take notes (for the PPG) of anything that they thought was related to the assignment.
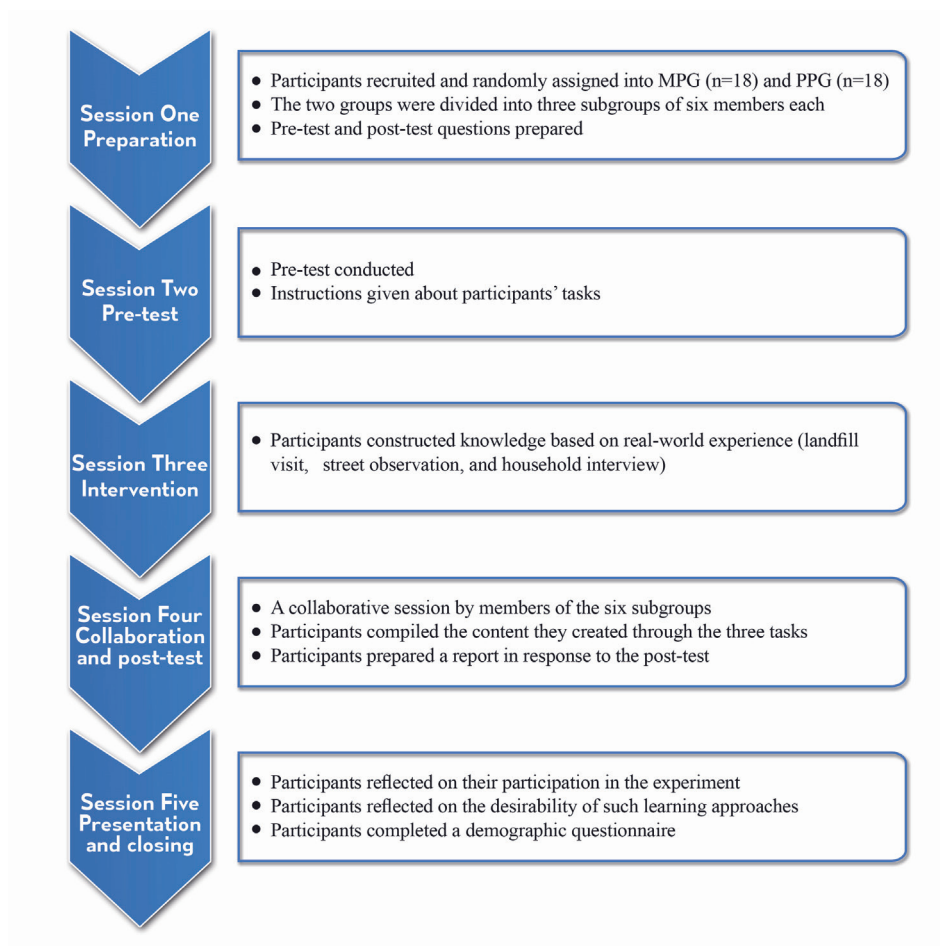
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Figure 4.2 Procedural steps in the intervention

4.3.5 Procedure

The study involved the following five sessions. The sessions, excluding preparations, took place from May to July 2019.

1. Session One – Preparation

Participants were recruited and randomly assigned into MPG (n=18) and PPG (n=18). Next, as depicted in Figure 4.1, both groups were randomly subdivided into three subgroups of six members each. This was done to facilitate the collaboration of the group members and the three tasks. That is, from each subgroup of six members, two members visited a landfill, two engaged in street observation, and two in household interviews. In the preparation phase, we prepared questions for pre-test and post-test.

2. Session Two – Pre-test

All participants (n=36) were given a pre-test. They did the test in their separate subgroups. In this session, we also gave participants specific instructions regarding each of the tasks (i.e., landfill visit, household interview, and street observation). Participants were free to take their time to complete the pre-test. The longest a group took was 40 minutes.

3. Session Three – Intervention

The decision to involve participants in these tasks was made to expose them to the complex, real-world case of the Addis Ababa WMS, starting from the source of waste to the landfill. Each participant had to engage in one of the three tasks in a collaborative session and the closing session. The decision of who would participate in one of the three tasks (i.e., landfill visit, household interview, and street observation) was made by the subgroup members themselves.

Following the instructions they were given, the members of the MPG used mobile phones while the members of the PPG used paper and pencil to create content based on their participation in the three tasks described below. The intervention, including the mobile learning, was entirely offline. This was intended to make participants responsible for their learning and help them develop systems thinking, by constructing knowledge themselves based on their first-hand experience in the real-world. Offline approaches prevented the possibility of depending too much on others' works available on the internet.

4

Landfill visit

The participants who visited the Koshie landfill observed (informal) garbage pickers, the waste disposal process, nearby residents, relationships among the garbage pickers, types of waste on the landfill, talked to the garbage pickers, and created content.

Participants visiting the Koshie landfill, Addis Ababa

Street observation

The participants went to selected streets in Addis Ababa to observe different waste management activities related to their tasks.

A truck loaded with waste. Picture taken by a street observation group.

Household interview

The participants went to six neighborhoods of Addis Ababa and interviewed 24 households. The neighborhoods were purposely selected to include residents of diverse economic status. The specific households were selected by participants based on their availability. The interviews focused on the waste management process, from creation to disposal, and the implications of these on the three dimensions of sustainability.

4. Session Four – A collaborative session and post-test

The members of the six subgroups came together and repeatedly watched the videos they made, viewed the pictures, and read the notes they took. In this collaborative session, participants were instructed to compile and make sense of the content they had created throughout the three tasks. They did the same and prepared a report, the final product of their participation, in a form of responses to the post-test. The longest a group took to complete the post-test was nearly two hours.

Members of a group in a collaborative session.
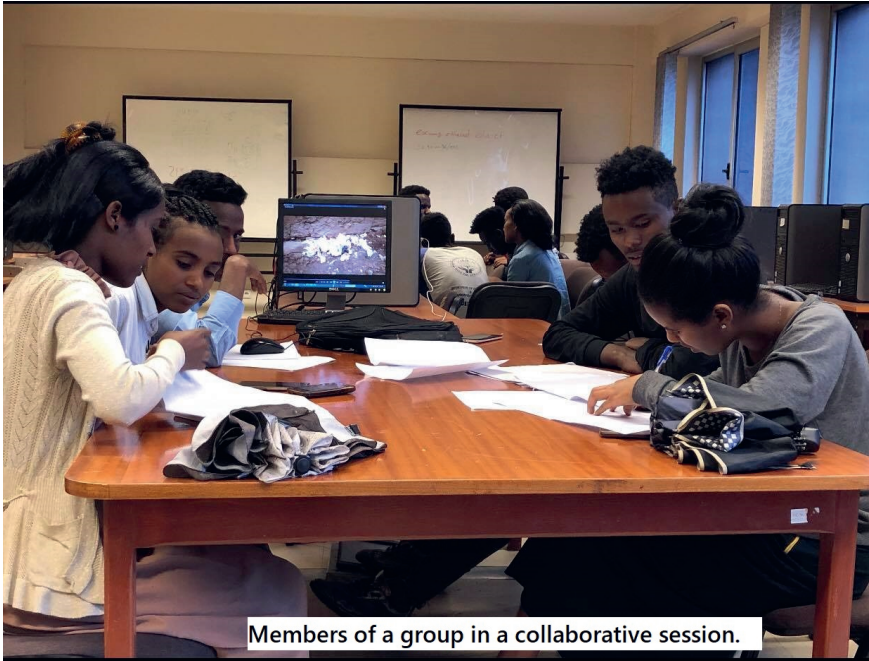
5. Session Five – Presentation and closing

During the closing session, each group presented how they evaluated the experience and what they learned from participating in the study. In this session, participants discussed the desirability of such learning approaches in their bachelor's program (Geography and Environmental Studies) and completed a demographic questionnaire.

4.3.6 Pre-test, post-test, and analysis of participants' reports

Pre-test and Post-test questions

We used the following two questions for the pre-test and post-test.

1. Identify strengths and weaknesses in the waste management system and suggest possible solutions to improve the system.

2. Identify interrelationships among the dimensions of sustainable development and stakeholders in the waste management system. Do both questions 1 and 2 from the point of view of the three dimensions of sustainable development.

Analysis

The analysis of participants' reports started with operationalizing STC in terms of its three key components. Next, participants' performance in these components was evaluated following the steps explained in points A to C below.

A. Ability to identify the dimensions of a system – the ability to identify social, environmental, and economic dimensions of sustainable development was evaluated by using indicators for each of the three dimensions (see Appendix II). We prepared these indicators from sources in the literature (Ajmal et al., 2018; Dempsey et al., 2011; Kates et al., 2005; Mahdei et al., 2015; UN DESA, 2007). For instance, to accept a point by participants as a social dimension of sustainable development, it had to be related to one of the indicators of the social dimension mentioned in Appendix II and to the WMS. The same was considered for the environmental and economic dimensions.

B. Ability to appreciate the complex nature of a system – this was assessed as the ability to identify interrelationships among the dimensions and the ability to recognize relevant stakeholders in the WMS. Here, the identified interrelationships were also analyzed on whether they were between two dimensions or among all three dimensions of sustainable development. We considered interrelationships that involved the three dimensions to be higher-level interrelationships, as they show a better understanding of system complexity.

C. Ability to analyze a system across different levels/spatial scales (local, national, and global). This was evaluated based on the levels the participants' reports addressed. That is, whether the identified points concerned only sub-cities in Addis Ababa, Addis Ababa as a whole, Ethiopia, or were on a global scale. To determine what scale the points addressed, the contents of the participants' points were examined. For instance, if a group made a point regarding the need for a government policy with a national significance, we considered this to be on the national/Ethiopian scale.

To evaluate the participants' reports as objectively and transparently as possible, the indicators explained above were prepared by the first author and used after being reviewed and improved by two of the co-authors. Furthermore, after the first author graded all the reports of the two groups, two of the co-authors reviewed the analysis against the aforementioned indicators.

4

4.4 Results

In this section, the findings of the study regarding the three defining features of systems thinking competence are presented. These are the ability to identify dimensions of a system, the ability to appreciate the complexity of a system, and the ability to analyze elements of a system across local, national, and global scales. In this study, these abilities are contextualized in the WMS and related to the social, environmental, and economic dimensions of sustainable development.

Because of limited student numbers, the results were not analyzed statistically (i.e., in terms of comparisons of conditions). Instead, patterns of results in the various conditions were described.

4.4.1 Ability to identify the elements of a system

In their pre-intervention test, members of both the PPG and the MPG were able to identify elements of the WMS that related to the social, environmental, and economic dimensions of sustainable development. This could be because of their background in Geography and Environmental Studies.

The number of elements identified before and after the intervention by both groups for each of the three dimensions is almost comparable. Details of the findings are presented in Table 1.

Table 4.1

Number of social, environmental, and economic elements of the waste management system identified by the two groups before and after the intervention

Sustainable development dimension	Mobile phone group Pre-intervention	Mobile phone group Post-intervention	Paper and pencil group Pre-intervention	Paper and pencil group Post-intervention
Economic	9	17	11	15
Social	9	21	7	20
Environmental	13	18	10	16
Total dimensions	31	56	28	51

Both groups were able to identify more points related to the three dimensions of sustainable development after the intervention. Below are three examples of the points identified by the members of the MPG and the PPG for the three dimensions of sustainable development.

1. Social: Poorly managed landfill pollutes the air and people are forced to leave their residences.

2. Economic: Waste is being used as a source of energy.

3. Environmental: Biodiversity can be negatively affected because of river contamination.

4.4.2 Ability to appreciate the complex nature of a system

This aspect of systems thinking (i.e., appreciating the complexity of a system) consists of two components. One is the ability to identify interrelationships among the dimensions of sustainable development (as specified

in Appendix II). The other is the ability to recognize relevant stakeholders that affect and are affected by the system. Here, participants' reports were assessed to see whether they identified interrelationships. The interrelationships were also examined further to check whether they addressed two or all the three dimensions.

Identification of interrelationships

Participants identified strengths, weaknesses, and suggested solutions regarding the waste management system in Addis Ababa about the three dimensions of sustainable development.

Table 4.2

Number of interrelationships among the social, environmental, and economic dimensions of the waste management system identified by the two groups before and after the intervention

	Mobile phone group Pre-intervention	Mobile phone group Post-intervention	Paper and pencil group Pre-intervention	Paper and pencil group Post-intervention
Interrelationships	0	9	0	7
Stakeholders	5	13	5	5

Table 4.2 shows that, in the pre-intervention test, neither of the two groups was able to identify any interrelationships between the elements of sustainable development. In the post-intervention, however, both groups were able to identify interrelationships. Regarding the number and complexity of the identified interrelationships, members of the MPG performed better than their PPG counterparts.

A detailed explanation of this is given in the discussion section. Below is an example of an identified interrelationship from each group.

1. *Example by the MPG*

   The waste management system creates jobs (Economic). The people who get the jobs manage the waste and contribute to a clean environment (Environmental). A clean environment enhances motivation to work (Social).

2. *Example by the PPG*

   Poor waste management causes pollution-related problems (Environmental). This displaces people (Social). Displaced people move to new locations. This increases pressure on the environment (Environmental).

Identification of stakeholders

Table 2 shows that before and after the intervention, the MPG and PPG identified stakeholders (i.e., people and organizations whose actions affect others and are affected by others' actions) in the WMS. Members of the MPG identified more stakeholders after the intervention. Examples of the stakeholders identified by both groups include waste management workers, residents, and the government. The additional stakeholders

identified by members of the MPG include future generations, factory representatives, and garbage collectors' associations.

The findings related to stakeholder identification are interpreted in the discussion section.

4.4.3 Ability to analyze a system across different scales

The participants' reports were also examined to see the spatial scales (i.e., sub-cities in Addis Ababa, the whole Addis Ababa city, Ethiopia, or global) addressed by the points they identified as social, environmental, and economic elements of the WMS. Accordingly, with the increase in the number of the three elements identified by both groups, the variety of levels also increased after the intervention.

Table 4.3

Dimensions of sustainable development identified by participants categorized by spatial scale (local to global)

	Social, environmental, and economic elements of the waste management system		
	Level (local to global)	Pre-intervention	Post-intervention
Mobile phone group	Sub city	13	15
	Addis Ababa city	15	35
	Ethiopian	0	2
	Global	3	4
	Total	31	56
Paper-pencil group	Sub city	5	12
	Addis Ababa city	21	38
	Ethiopian	1	0
	Global	1	1
	Total	28	51

Below are examples of quotes, one from each group about the points they made concerning Ethiopian and global scales.

- *Ethiopia – The WMS facilitates for different government agencies to work together. (PPG)*

- *Global – Proper waste management contributes to the prevention of climate change. (MPG)*

4.5 Discussion

In this section, we discuss the main findings regarding participants' ability to identify elements of a system, ability to appreciate the complex nature of a system, and their ability to see implications of interrelationships among the elements on different spatial scales.

4.5.1 Ability to identify the elements of a system

Participants' STC was assessed in terms of the core components of the competence. The first of these is the ability to identify elements of a system. In this regard, before the intervention, members of both the MPG the PPG were able to identify elements of the waste management system regarding the social, environmental, and economic dimensions of sustainable development. This could be because of their background as final year bachelor's students of the Geography and Environmental Studies program. In addition, it is important to note that all participants were motivated as they got voluntarily involved in this study. The higher education system in Ethiopia is dominated by knowledge-oriented approaches (Demssie et al., 2020). Such approaches could be adequate in enabling participants to identify the dimension of sustainable development. The intervention enabled both groups to identify more elements of the waste management system than they did in the pre-intervention test. Compared to the PPG, the MPG performed better in identifying elements of the WMS.

4.5.2 Ability to appreciate the complexity of a system

The other key component of systems thinking – i.e., the ability to appreciate the complexity of a system – was operationalized as the ability to identify interrelationships among elements of a system and the ability to recognize stakeholders in the WMS. Interrelationships and interdependence could be among different systems/ dimensions, or "between humans and non-humans" (Molderez & Ceulemans, 2018b, p. 760). According to Nguyen, Graham, Ross, Maani, and Bosch (2012), "systems thinking skills are important in helping younger students understand many complex relationships that exist in the natural and social world" (p.15). Therefore, students developing STC are equipping themselves with a crucial set of knowledge, skills, and attitudes to contribute to a more sustainable future. This is so because they understand interrelationships, the potential impacts of an action on another system, on the environment, or people. This could lead to informed and responsible decisions, and actions related to sustainability (Demssie et al., 2019).

Among the three key components of STC, the ability to appreciate the complexity of a system seems to be the most difficult to foster using traditional learning approaches. In this study, none of the participants could identify any interrelationship before the intervention. Sources in the literature also focus on the appreciation of complexity. For instance, York, Lavi, Dori, & Orgill (2019) note that "[s]ystems thinking is a holistic approach for examining complex, real-world systems, in which the focus is not on the individual components of the system but on the dynamic interrelationships between the components" (p.2,742).

Unlike in the identification of elements of a system, the previous knowledge that our participants gained from knowledge-oriented approaches could not help them to see interrelationships among the dimensions they identified. They considered the dimensions as isolated elements. This could be one of the limitations of knowledge-oriented and simplistic learning approaches, confined in classrooms. As such, neither of the two groups could recognize any interrelationship during the pre-intervention test. They were, however, able to identify a few stakeholders in the waste management system. After the intervention that facilitated meaningful engagement through collaboration in authentic contexts, both groups' STC was enhanced. In particular, their ability to appreciate system complexity. This is because the learning approaches implemented

as an intervention helped to facilitate learning topics with complex objectives. For instance, if we take one of the components of the intervention – i.e., collaboration among participants – it was among a small group of six people that consisted of participants who created content from a landfill visit, household interviews, and street observations. Hence, it was an opportunity for them to learn about the WMS from the different perspectives of their group members. This facilitates understanding of a system's complexity. Scheer and Plattner (2012) explain the mechanism by which team-based (in our case collaborative) learning facilitates learning complex topics, "a team-based learning method helps to deal with complex problems by sustaining in-depth learning processes on problem perception and diverse solution paths" (p.9).

After the intervention, members of both the MPG and the PPG identified interrelationships and more stakeholders than they did before the intervention. As such, they were able to identify possible ways in which decisions or actions in one of the dimensions of sustainable development could affect one or more other dimensions. This result agrees with the findings of previous studies that when learners collaborate and work together, they learn interrelationships among different topics. This approach helps to foster learners' STC (Sherman & Burns, 2015).

Another reason for all participants' improvement in their STC is likely related to the real-world context of the intervention (Kay & Foster, 1999). The authentic environment may have given participants the motivation and the sense of urgency. A study in the same context indicated the importance of meaningfully relating education to the real-world if sustainability competencies are to be fostered (Demssie et al., 2020). Similarly, Cotton and Winter (2010) note that for sustainability education, in general, focusing on "real issues" instead of "knowledge and a content orientation" is crucial (p.5).

Difference between the Mobile phone group and Paper-and-pencil group in appreciating the complexity of systems

The major difference in the performance of the two groups was the ability to appreciate the complexity of a system. In this regard, it seems that the MPG got more out of the intervention. This difference was twofold: first, in the number of identified interrelationships and stakeholders, and second, in the number of high-level interrelationships they identified. We considered interrelationships that involve all the three (i.e., environmental, social, and economic) dimensions of sustainable development to be high-level interrelationships.

After the intervention, members of the MPG identified more interrelationships than their PPG counterparts. The MPG was also able to identify twice the number of high-level interrelationships the PPG identified. The better learning result of participants using mobile phones to create multimedia content in understanding complexity is consistent with findings of earlier studies. For instance, Zahn et al. (2014) conducted a quasi-experimental study into the effect of learner-generated videos on causes of obesity and stigmatization. They had an experimental group that created YouTube videos and a "control group that read a newspaper article on the topic". They found that unlike the participants who read a newspaper article, the students who created videos gained "new and more complex knowledge" (p.618). Another reason for the better performance of the MPG could be because students are usually interested in using mobile phones (Pimmer et al., 2016).

Compared to information kept on paper by the PPG, using video was an opportunity for the MPG to keep the authenticity of what participants observed in the field. The participants in the PPG had to remember the reality (i.e., in the landfill, the streets, and households), based on the notes they took, and interpret that based on their understanding of those notes. This may leave room for different interpretations. On the other hand, members of the MPG watched the videos they recorded and viewed the pictures they took. This could give them an advantage in readily relating to the authentic context. The application of mobile learning, as used in our study – i.e., to facilitate learning through learner-generated videos and pictures – enables authentic

learning (Gikas & Grant, 2013). Kearney and Schuck (2006) conclude that "student generated digital video projects can be used to develop authentic learning" (p.206). They also note that opportunities for collaboration contribute to learners' motivation and authentic learning. The benefit of the camera function of learning with mobile phones related to learners' motivation has been indicated by several studies (Ekanayake & Wishart, 2014; Molnar, 2017; Pimmer et al., 2016).

The combination of learning approaches used in our study facilitated for learners to play an active role in deciding what content is important and what deserves to be captured as multimedia content or notes on paper, to discuss it in groups, and to organize the content into a report. Mobile learning, used to make learner-generated videos, enables constructionist learning through the meaningful engagement of learners (Pimmer et al., 2016). Mayer (2003) explains how learning happens when learners are actively engaged as follows.

> "The active learning assumption is that meaningful learning occurs when learners engage in active cognitive processing including paying attention to relevant incoming words and pictures, mentally organizing them into coherent verbal and pictorial representations, and mentally integrating verbal and pictorial representations with each other and with prior knowledge" (p.129).

4.5.3 Ability to analyze a system across different scales

The other feature of STC we looked at in the reports of participants was their ability to recognize different scales (from local to global) of the elements of a system. Accordingly, the results of the analysis showed that participants identified different issues with implications for sub-cities in Addis Ababa, the whole city, Ethiopia, and global scales. The intervention enabled participants to recognize more elements of sustainable development. With this increase in the number of elements identified by participants of both groups, there was an overall increase in the number of issues that concern different levels. While most of the issues identified after the intervention by both groups concern Addis Ababa city, there were also differences between the two groups. For instance, members of the MPG identified more sub-city, Ethiopian, and global issues than their PPG counterparts. On the other hand, members of the PPG identified more Addis Ababa city issues than the MPG members. This ability to see the elements of a system concerning different scales helps a person to appreciate the possible impacts of an action somewhere on different elements of sustainable development somewhere else.

Members of the MPG identified more elements related to the three dimensions of sustainable development. Similarly, they were able to identify more issues related to three of the four scales. As such, it seems that mobile learning facilitated authentic learning (Gikas & Grant, 2013; Kearney & Schuck, 2006) for this group.

As indicated earlier, the camera function of mobile phones was used in this study to facilitate the learning of participants following their field visits in the real world. The offline nature of the interventions facilitated constructivist learning by providing participants with the opportunity to meaningfully engage in collaboration and knowledge construction. While the lack of opportunities to learn from online resources can be considered a limitation of offline mobile learning, this same feature is a strength of this learning approach. That is, unlike learning involving connection to the internet, offline learning does not allow learners to copy from or depend too much on others' works. Additionally, no internet-related costs are involved. The advantages of the offline approach could be especially relevant to resource-constrained environments, such as the context under study. Furthermore, telecom services are a government monopoly in Ethiopia. As a result, the government in Ethiopia – and some other countries for that matter – may limit or shut down the internet whenever there is a political problem (Rydzak et al., 2020).

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Scheer and Plattner (2012) state that the design of competence-based constructivist learning needs "to be constructed, situated in context, self-regulated by the learner and collaborative" (p.10). All these conditions were fulfilled by the combination of learning approaches used in this study.

4.5.4 Limitations of the study and possible lines of future research

The objective of this study was to explore whether a combination of learning approaches in an authentic context would help with fostering systems thinking competency, which is one of the most important parts of sustainability competence. The results indicate that the intervention, the combined use of multiple learning approaches, helped participants of both groups to enhance their systems thinking competence. However, the study did not show which specific learning approach contributed more than others. Furthermore, the study did not include a control group who took this course without a combination of learning approaches. Therefore, the learning gain of the research groups cannot be compared with their counterparts in traditional classrooms. Future studies should ideally indicate the relative importance of learning approaches and the underlying mechanisms that make the interventions effective. The other limitation of the study is that it was conducted with a limited number of participants in Ethiopia. To get insights into the effectiveness of a combination of learning approaches across contexts, we suggest that future studies be conducted in multiple countries with different socioeconomic contexts involving a larger number of participants.

4.6 Conclusion

The study implemented a combination of multiple learning approaches at the same time to enhance learners' systems thinking competence. Usually, in theory, studies recommend certain pedagogies to foster sustainability competencies without evidence in implementing multiple pedagogies. This study took the sustainability pedagogies-related discourse a step further by practically testing a set of learning approaches in a real-world environment. The combined use of field trips and collaborative learning helped with fostering the STC of both the mobile phone group and the paper-and-pencil group. The most notable difference between the two groups was the better performance of the mobile group in appreciating system complexity. This approach facilitates the enhancement of STC by providing learners with the opportunity to actively engage in the learning process and facilitating the exchange of ideas among collaborating participants. In this study, this opportunity was taken to a level where participants were free to decide what learning content to create. This facilitated a constructivist learning approach that required the learners to meaningfully engage to construct knowledge.

Theoretically, the findings suggest that education for sustainable development discourses should focus on combinations of multiple learning approaches to enhance systems thinking competence.

Hence, designing courses involving sustainability competencies, particularly STC could benefit from meaningfully engaging learners in the learning process. This may include providing them with only overall guidance and allowing them to decide the content of knowledge they are supposed to create, facilitating their collaboration with peers, and contextualizing learning in authentic/real-world cases that involve several interrelationships. This allows learners to see interrelationships among social, environmental, and economic systems, and appreciate the complexity of sustainability-related issues.

Our study contributes to the constructivist learning literature in the context of sustainability competence development. The findings indicate that the systems thinking competence of learners is enhanced when learner-generated content is created through the provision of opportunities for students to meaningfully engage, freely decide the content they want to create, collaboratively make sense of the content, organize it, and present it. The major contribution of this study is related to the real-world context and the combined use of multiple learning approaches to foster one of the sustainability competencies, systems thinking.

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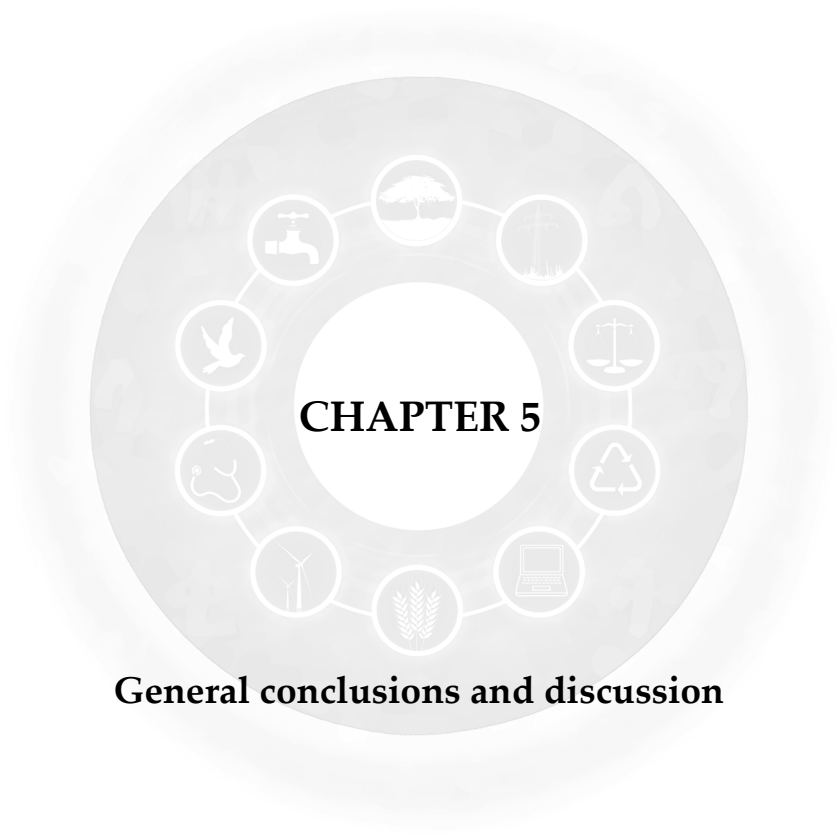
CHAPTER 5

General conclusions and discussion

5.1 Introduction

This final chapter discusses the main conclusions and offers reflections on the major findings. Besides, it discusses the implications of the findings for theory and practice. Next, the chapter presents the limitations of the studies and provides suggestions for future studies. Furthermore, Chapter 5 proposes ideas on how to conduct the suggested follow-up studies.

5.2 Main conclusions

The key conclusions are highlighted given the two overarching research questions of this dissertation. These are "What sustainability competencies are required for a base of the pyramid (Ethiopian) context to contribute toward a more sustainable world?" and "How can relevant sustainability competencies be fostered in higher education students, as future sustainability change agents?"

5.2.1 Sustainability competencies

The Ethiopian context has the defining features of BoP contexts. These features include low income, a larger rural population, and limited infrastructure (Goyal et al., 2016; Halme et al., 2015; Prahalad, 2012; Prahalad & Hart, 2002). These characteristics set the BoP context apart from Western contexts. However, seven SCs frequently identified as relevant in the context of the latter were found to be important for the Ethiopian context as well:

1. Systems thinking competence
2. Disciplinary competence
3. Interpersonal competence
4. Action competence
5. Anticipatory competence
6. Strategic competence
7. Normative competence

Additionally, the following eight SCs were identified as relevant to the Ethiopian context, as a case of a BoP country:

1. Transdisciplinary competence
2. Flexibility and continuous learning competence
3. Communication and information acquiring competence
4. Stakeholder and policy coordination competence
5. Resource utilization competence
6. Social justice and inclusion competence
7. Competence to balance sustainable development dimensions
8. Competence to utilize indigenous resources

The SCs identified from the literature and the additionally suggested ones are not isolated. They are interrelated and complement each other. For example, systems thinking competence and competence to balance sustainable development dimensions complement each other. Systems thinking competence entails realizing interrelationships among systems and subsystems in a holistic way (Roorda, 2013). Competence to

balance sustainable development dimensions is about prioritizing the three dimensions (People, Planet, Profit) or subsystems of sustainable development. This competence helps to balance the focus on these different (sub)systems. In the Ethiopian context, there are practical situations that call for both SCs. The findings in Chapter 2 indicate that in the Ethiopian context, little attention is given to the social and environmental impacts of economic activities. For example, in the floriculture industry, the focus is predominantly on financial gains. Hence, there is a need for systems thinking competence. This competence helps people to appreciate how the economic, social, and environmental dimensions affect each other. This in turn helps to challenge the attitude of too much focus on the economic dimension, at the expense of society and the environment. To move toward a more sustainable future, considering the impacts of development on societies and the environment is important (Gast et al., 2017).

Based on the findings in Chapter 2, the following two conclusions are made regarding SCs. The first is that different contexts may share some SCs as important. The other is that some competencies are more relevant to certain contexts than to others.

For instance, competence to utilize indigenous resources for sustainability was identified as relevant for the Ethiopian context. In contexts that possess indigenous knowledge (IK) and have limited formal institutions, IK plays a significant role (Scott, 2017b). For example, in the Ethiopian context, a significant majority of the human population and livestock rely on indigenous medical practices and medicines (Demie et al., 2018). Thus, the role of IK is making up for the limited modern healthcare infrastructures. IK could play a role in the Western educational context as well. Suggestions of how this can be achieved are given in the section on the possible means of utilizing IK at universities.

The importance and possible means of utilizing IK in the context of university education are elaborated on in the next section.

The findings of this dissertation show the relevance of some SCs in different socioeconomic contexts. This has the theoretical implications discussed in Section 5.3.

5.2.2 The role of modern education and indigenous knowledge in fostering sustainability competencies

The studies in Chapters 3 and 4 explored how SCs can be developed in students using various worldviews and authentic learning contexts. The findings of the study in Chapter 3 underline the importance of utilizing diverse worldviews and IK. The results also suggest pedagogies in modern higher education systems that engage learners as relevant to enhancing SCs. Furthermore, different ways of combining IK and modern education are proposed.

The findings of this dissertation described in Chapter 4 concern systems thinking competence. The results show that multiple learning approaches (i.e., collaborative learning, field trips, and mobile learning) in real-world contexts help to foster learners' systems thinking competence. In subsequent sections, the findings on fostering SCs are further discussed.

Both modern higher education and IK in Ethiopia can contribute to foster SCs of students as future sustainability change agents. To realize the contributions of both systems, they need to be intentionally designed for this purpose, as discussed below.

Limitations of the Ethiopian modern higher education

To be effective and relevant in fostering SCs of learners, the Ethiopian modern higher education system needs reorientation. That includes consideration of the worldviews and socioeconomic features of the learners'

contexts when designing education for sustainable development. Wesselink et al. (2015) reinforce this as they underline the importance of considering specific contexts in teaching SCs.

The Ethiopian modern education system is imported from Western countries without a meaningful contextualization. Hence, the system is dependent on content and ways of knowing from Western contexts. This undermines the learners' opportunities to learn from diverse worldviews and contexts, including their own. Kebede (2006) explains this in the context of the history subject in Ethiopia. He notes that the significant Ethiopian victory over invading colonial forces enabled Ethiopia to keep its status as an independent country. He explains that this victory and related topics would be expected to be the focus of history courses. However, this was not the case. The contents of other courses in the higher education curriculum also lack contextualization. Given its current content, the relevance of the Ethiopian modern higher education to the reality in the country is questioned. As a result, the education system makes little contribution to addressing the country's development challenges (Asgedom, 2005; Woldeyes, 2017).

In addition to the lack of contextualization, limited opportunities for students to engage in knowledge construction, domination of the lecture method, and confinement of learning in classrooms are among the limitations of the higher education system in Ethiopia.

To address the above shortcomings, several points are suggested. These include employing learning approaches that engage and extending it to societies. Apart from the limitations of the modern education system specific to Ethiopia, there are other shortcomings of this system. A frequently discussed limitation of modern education is its reductionist nature (Johnson, 1992; Mazzocchi, 2006; Zidny et al., 2020). This may limit its contributions to addressing complex sustainability challenges. As Mazzocchi (2006) notes, "an approach based on reductionism—as helpful as it has been in the past—might no longer be sufficient to analyse and understand higher levels of complexity" (p.466).

A detailed discussion of the recommended changes in the higher education system is given in Section 5.4. In addition to the modern higher education system, IK also contributes to enhancing the SCs of learners. A discussion of the relevance of IK and possible means of integrating it with modern education follows in the subsequent sections.

In addition to the modern higher education system, IK also contributes to enhancing the SCs of learners. A discussion of the relevance of IK and possible means of integrating it with modern education follows in the next sections.

The potential of indigenous knowledge

IK is holistic, an important feature of sustainability concepts (Johnson, 1992; Mazzocchi, 2006; Zidny et al., 2020). In the context of Ethiopia as well, it is argued that IK is holistic. A participant in the study described in Chapter 3 mentioned the monolithic rock-hewn churches of Lalibela- a UNESCO world heritage site in Ethiopia - as an example. The participant argued that the IK used in building this church enabled keeping nature and building infrastructure at the same time. This example is mainly relevant to a specific context. Yet, it gives an important lesson - the need to live in harmony with the natural environment, even when building infrastructures. The findings of Chapter 3 indicated several means of enhancing the contributions of IK in fostering learners' SCs. According to these findings, IK facilitates the development of SCs in two ways. The first is by providing content (local knowledge) that can be included in a curriculum. The other is by contributing local resources (languages and indigenous experts) that can be used in the learning processes. To realize the benefits of IK, two points are proposed for the Ethiopian context.

The first point is the use of local content from specific IK of certain communities in Ethiopia. Specific examples of IK in Ethiopia include natural resource management practices and traditional health care knowledge. Among others, the two types of IK are recommended as having content relevant to sustainability. These are discussed in more detail in the next section.

The other point suggested in order to take advantage of IK in the context under study relates to the lessons from the indigenous Ethiopian Orthodox Tewahedo Church education system. This system regards and uses local resources (i.e., languages, content, and scholars). Utilizing these resources facilitates access to and exploration of Ethiopian IK. Ge'ez is the major Ethiopian language, in which the Ethiopian IK has been documented for several centuries. Because of its value, several universities in different parts of the world offer courses related to this language. Numerous Ethiopian manuscripts written mainly in Ge'ez and to a limited extent in Amharic are kept in different countries. Among these, the Ethiopian collection of the British Library and the Ethiopic Manuscript Collections of the Princeton University library are notable. Although the subjects of the Ge'ez literature in their possession are mainly religious, their collections also include secular subjects such as law, medicine, and philology (British Library, 1973; Princeton University Library, 2008). Demoz (1972) indicated that the Ge'ez literature includes manuscripts on history and philosophy subjects as well. The diversity of the Ge'ez literature indicates its possible relevance to researchers in different fields.

Integrating modern education and indigenous knowledge

The findings of this dissertation indicate that exploring and utilizing IK helps enhance the holistic nature of sustainability-related higher education curricula. Addressing the complex sustainability challenges requires the use of diverse knowledge systems. Goal 17 of the UN SDGs focuses on Global Partnership for Sustainable Development. This goal underlines the importance of multi-stakeholder partnerships to achieve the SDGs, which in turn include the need for knowledge sharing (United Nations, 2015). This requires readiness to acknowledge and learn from different worldviews. One possibility of achieving this is integrating IK and modern higher education. Among others, this dissertation explored the possibility of utilizing diverse worldviews and approaches to address global sustainability issues.

The findings indicate that in Ethiopia, the modern higher education system and the IK can be integrated. As such, they can complement each other. The need for and means of integrating the two knowledge systems are elaborated on in subsequent sections.

In different parts of the world, there are diverse indigenous communities. The IK of a certain community can benefit that specific community, and possibility others. In this dissertation, when speaking of including IK in the modern higher education curriculum, the recommendation is to include Ethiopian IK in the higher education curriculum of the same context. This is because of two reasons. First, the local knowledge is relevant to the communities in the specific context as they developed and used it for centuries. Second, the stakeholders in the higher education system are somehow familiar with and can relate to the IK in their context. In the long run, the contributions of the IK to different contexts could be evaluated and documented. This may facilitate the introduction of the IK to a wider context.

The main message in the recommendation of integrating IK in the modern higher education curriculum is the need to explore content and ways of knowing that are different from the dominant Western ones.

The findings of this dissertation underscored the need to integrate the modern higher education and IK. Possible means of improving the modern higher education system and incorporating IK are also indicated. In education for sustainable development, enhancing the holistic thinking of learners is important (Remington-Doucette et al., 2013). The use of IK in combination with the dominant Western education is an opportunity

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to gain diverse perspectives and develop holistic thinking. Reinforcing this, Hewitt (2000) remarks that, there is so much to learn from the holistic feature of IK worldviews. He explains that integrating IK contributes to a harmonious relationship of people with the natural environment. Integrating IK in modern education systems contributes to dealing with sustainability challenges (Zidny et al., 2020). Hence, including such IK-related content and examples that promote holistic approaches are suggested. This helps to complement the higher education curricula.

Given its current content, the relevance of the Ethiopian modern higher education to the reality in the country is questioned. Hence, including such IK-related content and examples that promote holistic approaches are suggested. This helps to complement the higher education curricula. Currently, the higher education system is dependent on content, examples, and ways of knowing from Western contexts. This situation undermines opportunities to learn from diverse worldviews and contexts. Therefore, exploring and utilizing IK helps to enhance the holistic nature of higher education curricula.

Usually, it is the environmental contributions of IK that are widely covered in the literature. Among these, the value of traditional ecological knowledge for environmental sustainability has gained considerable recognition (Berkes et al., 2000; Boiral et al., 2020; Guerrero-Gatica et al., 2020; Rist et al., 2010). In addition to its environmental values, IK has a significant economic value. In the next sections, the economic value of IK is discussed. Furthermore, the need to integrate IK into the modern higher education system is elaborated from an economic point of view.

The economic relevance of indigenous knowledge and its integration in the higher education system

IK has a considerable economic value. Several studies indicate that corporations such as pharmaceutical companies exploit IK for economic benefits. The challenge is that such multinationals take advantage of IK without acknowledging and benefiting the communities from where they source the knowledge (Garcia, 2007; Havemann, 2015; Reid, 2009; Wyatt & Brisman, 2017). According to the World Intellectual Property Organization (WIPO) (2012), IK "may be associated with agricultural, environmental, healthcare and medical knowledge, biodiversity, traditional lifestyles and natural and genetic resources, and know-how of traditional architecture and construction technologies." (Annex, p. 2). Among others, these aspects of IK have considerable economic value. Blackwell et al. (2019) note that "the commercial use of IK in natural and genetic resources has tended to fall into one of three categories: medicinal use; cosmetic use; and food use" (p.49).

Because of this potential, various organizations exploit indigenous communities. Wyatt and Brisman (2017) indicate that such organizations "have significant vested economic interests in continuing to do exploit and appropriate indigenous knowledge in the case of biopiracy" (p.338). Reid (2009) defines biopiracy as "the process of taking indigenous peoples' knowledge without compensation" (p.77).

The economic value of IK in some parts of the world is estimated by different researchers. Garcia (2007) notes that "traditional knowledge has the potential to earn billions." (p.5). Blackwell et al. (2019) estimate the "annual market value for medicines derived from medicinal plants discovered using IK" to be about 43 billion USD. They also state the estimated market value of IK in the areas of agriculture, pharmaceuticals, and biotechnology "to be $500 billion - $800 billion USD" (p.43).

Among others, these points indicate the significant economic value of IK.

The inclusion of IK in the modern higher education system may enhance the exploration, advancement, and positive impact of IK. As such, the inclusion of IK in higher education systems may facilitate a wider section of the world's population to benefit from IK. This could be in a form of offering the world healthy food

alternatives. One such example is teff, the nutritious and gluten-free Ethiopian grain which is gaining popularity as the new "superfood" (Gizaw et al., 2018; Lee, 2018).

Furthermore, the inclusion of IK in the higher education system may contribute to preventing the exploitation of IK. After graduation, higher education students will assume different positions in different sectors. Therefore, the inclusion of IK in higher education curricula helps the learners to understand the potential of IK. Additionally, learners may recognize indigenous communities for their knowledge. As such, the inclusion of IK in the higher education system may help learners to realize the need for fair and ethical use of IK. This inclusion may facilitate indigenous communities to benefit from their IK.

Below, an Ethiopian case is given to illustrate the economic value of IK beyond the context of its origin. The case further strengthens the rationales to integrate IK into the modern higher education system. Next, a discussion on the importance of including IK (related to teff farming) in the modern higher education follows.

The teff case from Ethiopia is the controversy between the Ethiopian Institute of Biodiversity Conservation and the Dutch company Health and Performance Food International (HPFI) over the ancient Ethiopian grain called teff. Before presenting a summary of this case, a short introduction of the teff grain is given below.

Petruzzello (n.d.) notes that "teff is an ancient crop and was likely domesticated more than 6,000 years ago in Ethiopia." The majority of Ethiopians consume teff as their staple food (Gizaw et al., 2018; Lee, 2018). Lee (2018) indicates that "teff contains high and unique nutritional values, which will meet the need of health-conscious consumers" (p.185). She further explains that teff is becoming increasingly popular for several reasons. The "grains are low on the glycemic index, which makes them suitable for people with Type 2 diabetes. The grains are also gluten-free. This, in particular, attracts individuals who suffer from gluten intolerance or celiac disease." (p.185-186).

Concerning this grain, an agreement was signed between the Ethiopian Institute of Biodiversity Conservation and HPFI. The Fridtjof Nansen Institute produced a comprehensive report on the issue, that is, "The Access and Benefit-Sharing Agreement on Teff Genetic Resources Facts and Lessons" (Andersen & Winge, 2012). The document gives a detailed account of the Teff Agreement. The content includes the controversial patenting of teff by HPFI and the resulting challenges Ethiopia got itself into. The "conclusions and recommendations" section of the report summarizes the case with details adequate for this dissertation. This section of the report is given below as Illustrative Case 1.

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Illustrative Case 1. The Ethiopian Teff Agreement

In this report, we have analyzed the Agreement on Access to, and Benefit-Sharing [ABS] from, Teff Genetic Resources (Teff Agreement). This agreement attracted considerable attention when it was signed in 2005, and gave rise to great expectations for its potential to spearhead how future ABS agreements could be, not least in terms of benefit-sharing. However, on the whole these expectations did not materialize. Whereas Ethiopia complied with the agreement and provided access to the teff genetic resources in question, the Dutch commercial counterpart, Health and Performance Food International BV (HPFI), failed in large part to comply with its obligations under the agreement. The company was declared bankrupt in 2009, by which time its directors had already established other companies and transferred values to these companies. These companies continued to produce and sell teff flour and teff products, and to expand their activities to other countries and continents. Since it was HPFI that had been the party to the agreement, and HPFI was now bankrupt, these new firms, even though operating under the same directors and partly the same owners, could continue selling teff flour and teff products without being bound by the obligations of HPFI toward Ethiopia. A patent on the processing of teff flour – which in practice covered all ripe teff grain, fine flour made of that grain, dough or batter made of the flour as well as a long range of non-traditional products – made the situation particularly difficult for Ethiopia. The company argued that such a broad patent was necessary in order to secure the investments in teff and thereby also the prospects of benefit-sharing with Ethiopia. In fact, the teff patent excludes all others, including Ethiopia itself, from utilizing teff for most forms of relevant production and marketing in the countries where it is granted. Thus, Ethiopia found itself squeezed out of a position to utilize its own teff genetic resources – for example, through collaboration with other foreign companies – in Europe and wherever else the teff patent might be granted, while at the same time losing all prospects of sharing the benefits from the use of these genetic resources in these countries.

Source: The report "The Access and Benefit-Sharing Agreement on Teff Genetic Resources Facts and Lessons" by the Fridtjof Nansen Institute (Andersen & Winge, 2012, p. 140).

This Teff Agreement case indicates the relevance of exploring IK as part of the higher education system in Ethiopia, for economic reasons among others. Furthermore, it is to be noted that Ethiopian farmers domesticated and are producing the grain using their IK. Gizaw et al. (2018) note that the "teff based farming system is an indigenous and sustainable agricultural system in Ethiopia" (p.139). They emphasize the need to explore the Ethiopian IK on different aspects of teff farming. The authors indicate that exploring this IK "has tremendous contribution for cultivar development; improved management practices and develops teff genetic resources conservation strategies, as well as biofertilizer development for present and future generations." (p.140) Hence, there is much to learn from this IK related to different aspects of farming. The findings of the study presented in Chapter 2 indicate that currently, the content of modern higher education in Ethiopia is imported without a meaningful contextualization. As a result, it does not build on Ethiopian IK.

The findings also emphasize the need to use content and examples of Ethiopian IK. Among other things, the economic relevance of IK further strengthens the argument for its inclusion in the modern higher education system. The inclusion of IK raises awareness among students about the genetic and other resources of Ethiopia.

This helps the realization of the economic and cultural potential of the country's IK. This could be a contribution of genetic resources and the related IK for health and food industries to the world.

Specific examples of indigenous knowledge and means of integrating them in higher education systems

Below are given two specific examples of integrating Ethiopian IK in the country's modern higher education system. The potential benefits and possible use of two types of IK (i.e., natural resource management and health care) in a non-BoP context (i.e., Wageningen University and Research (WUR), in the Netherlands) are also discussed next.

Using indigenous knowledge in the Ethiopian higher education context

To realize the benefits of IK in the Ethiopian context, the following two points are proposed.

The first is the use of local content from specific experiences of certain communities in Ethiopia. For example, the Geography and Environmental Studies programs in Ethiopian universities could include content from the Konso peoples' indigenous natural resource management practices. These practices are widely recognized in the literature and registered as a UNESCO world heritage. Utilizing this IK can help learners to grasp an important aspect of environmental sustainability, natural resources management. There are several means of utilizing this IK in the Ethiopian higher education system. Field trips to the Konso area to let students explore the indigenous practices and involving persons with expertise in IK as guest lecturers are among the possibilities (see Chapter 3 for details of this IK).

Another Ethiopian IK that can be integrated with the modern higher education system relates to health care. In Ethiopia, IK in healthcare supports the majority of the livestock. Hence, lessons could be learned from this knowledge system. For example, one possibility is for veterinary studies in Ethiopian universities to explore the IK in different communities. Based on the results of their study, veterinary programs can include relevant content from the IK in their curricula. Next, different learning approaches can be used to help students learn from the IK in animal health care this IK. These may include field visits to local healthcare practice centers and invitation of indigenous healthcare providers to share their experience on relevant topics.

Possible means of utilizing indigenous knowledge at Wageningen University and Research

Wageningen University and Research is one of the top-ranking universities in the world. It ranked 62 in the Times Higher Education World University Rankings 2021. In the same ranking, WUR was ranked 18th in life sciences subjects (Times Higher Education, 2021). Sustainability is one of the focus areas of WUR. The university states that its mission is "to explore the potential of nature to improve the quality of life." On its website, WUR indicates that "the domain of Wageningen University & Research consists of three related core areas: food, feed, & bio-based production; natural resources & living environment; society & well-being." Both the mission and the core areas of the university are directly related to sustainable development. Among others, the above points reflect the status of WUR and its attention to sustainability. Furthermore, WUR is the university for which the author of this dissertation worked as a PhD candidate. The possible relevance and application of Ethiopian IK at WUR are discussed, because of the above reasons, as well as others.

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IK is usually described as being relevant to specific communities where it originates and develops. However, among others, multinational companies' exploitation of IK in different parts of the world indicates its wider relevance. Two examples of IK from Ethiopia that could be relevant to higher education programs in different contexts are the Konso IK on natural resource management and the indigenous animal healthcare knowledge. For instance, the Animal Sciences and Veterinary Medicines programs of WUR may find the healthcare IK relevant. Similarly, WUR courses related to natural resource management may be enriched by including non-Western worldviews and practices as well. In this regard, the indigenous natural resource management knowledge of the Konso people in Ethiopia can contribute. Using these two types of IK could be an opportunity for the students at WUR to learn from a different context where the knowledge is not based on Western education. As such, the students may be exposed to diverse worldviews regarding the same subject they are studying. Furthermore, the holistic nature of IK could help learners to see issues in their fields of study from environmental, social, and economic perspectives. However, because of the difference in geographical location, different approaches may need to be followed than those for the Ethiopian universities' context. Among the possible means of utilizing the two types of IK in the context of WUR is using learning approaches such as virtual reality, documentaries followed by group discussions, and knowledge clips of the indigenous natural resource management and animal healthcare practices. Such approaches may help make the content appealing to students at WUR. Furthermore, these approaches provide the learners with opportunities to observe the indigenous practices as performed by the indigenous experts. A more preferred means of utilizing Ethiopian IK in a different context, such as WUR, is to establish exchange programs with similar universities in Ethiopia and sending interested students there. Their stay can be an opportunity to get firsthand experience of the indigenous natural resource management and healthcare practices. The task for WUR students in their exchange programs could be an MSc thesis project in which they explore relevant topics of their interest from the Ethiopian IK. As such, in addition to learning from one's own context, exploring others' worldviews may help learners to view complex sustainability issues through diverse lenses. Exchange programs may also benefit students from Ethiopia to get different social and academic experiences abroad.

The successful use of the two examples of Ethiopian IK at Ethiopian or other universities depends on several factors. These include the attitude of relevant stakeholders (i.e., policymakers and implementers in the education sector and students) toward IK and their commitment to creating enabling conditions.

It is usually those contexts with limited modern infrastructure that mainly use IK. However, other (e.g., Eurocentric) contexts could benefit from their own and others' IK. Higher education and research organizations in such contexts may explore the IK in their location that did not make it to their formal educational systems. Alternatively, they could learn from IK of different contexts. The above examples indicate some of the possible means of achieving this. Among the lessons that can be learned from IK are diverse worldviews related to environmental stewardship (Havemann, 2015). Besides, holistic perspectives that contribute to sustainability can be learned from IK (Mazzocchi, 2006; Zidny et al., 2020).

In addition to the need for the inclusion of IK, identifying the means of integrating it in the higher education curricula is important. The above examples indicate that specific contents of IK can benefit relevant fields of study in modern higher education systems. Furthermore, the examples suggest some means of integrating the IK in higher education programs. The different means of integrating IK and modern education discussed in the preceding sections mainly concern the Ethiopian context. The findings of this dissertation also propose general educational design principles that can be used in the effort to integrate IK in modern higher education systems. Possibly, these general principles may work in different contexts as well. These are discussed in the next section.

Educational design principles to integrate indigenous knowledge and modern education

The findings in Chapter 3 suggest the following five educational design principles to facilitate the combination of IK and modern higher education in the Ethiopian context. These principles are proposed as a means of utilizing IK in higher education sustainability programs. Specifically, they are intended to develop learner SCs. In Chapter 3, each principle is presented in further detail.

1. Define worldviews – this helps to understand the worldviews of a context where learning happens. The worldviews can be used to (re)design the higher education programs focusing on preparing sustainability change agents.

2. Utilize indigenous knowledge – this entails the use of local content, languages, and examples. Possible means of achieving these include student apprenticeships to explore IK, involving local experts as guest lecturers, and offering IK courses in modern education.

3. Build on students' local experiences – take advantage of the diverse interests, backgrounds, experiences, and cultural resources students bring from their localities.

4. Provide engagement opportunities – create an enabling environment for learners to play active roles in the learning process.

5. Utilize sustainability-oriented pedagogies – use pedagogies that are relevant in fostering SCs including field trips and cooperative, practice-based, and place-based learning.

The findings suggest the importance of realizing that sustainability challenges are complex. They also show that the approaches to deal with these challenges should not depend only on the dominant Eurocentric worldviews. Instead, pluralistic approaches are suggested. The combined use of IK and modern education facilitates such pluralism, which requires readiness to learn from and collaborate with diverse stakeholders. Several steps are required to use diverse worldviews and IK in the higher education curriculum of the context under study. First, the diverse IK in different communities in Ethiopia needs to be explored. As such, the IK that is relevant to sustainability can be identified. Then, the five learning design principles discussed above can facilitate the integration of IK in modern education. Introducing innovative changes in the higher education system requires the concerted effort of several stakeholders. Such changes are likely to face resistance. Addressing the possible challenges is important for the suggested changes to take effect. These changes, based on the results of the studies presented in Chapters 2 to 4, may enhance the relevance of the higher education system and its contribution to fostering SCs of learners. The possible challenges of introducing the changes are discussed in the implications of the findings for policy and practice in Section 5.4.

5.2.3 Fostering systems thinking competence

The other findings of this dissertation described in Chapter 4 concern systems thinking competence. The results show that multiple learning approaches in real-world contexts help to foster learners' systems thinking competence, that is, their ability to recognize the elements of sustainable development, to understand the complex interrelationships among them, and to appreciate the impacts of the interrelationships. Specifically, field trips, collaborative learning, paper-and-pencil note-taking, and creating multimedia content were used as interventions. How each of these learning approaches contributed to fostering the systems thinking competence of participants is briefly discussed below.

The field trips took learners out of confinement in classrooms. As they were exposed to real complex realities, the learners realized that social, environmental, and economic phenomena are not isolated or independent of each other (Vare et al., 2019). The collaborative learning facilitated the exchange of different ideas among

participants and helped participants to appreciate the complex nature of elements of a system and their interrelationships (Scheer & Plattner, 2012).

The other learning approach that helped participants' systems thinking competence is mobile learning, in a form of learner-generated videos and pictures. This approach facilitated real-world learning and enhanced the motivation of learners and their meaningful engagement as content creators. These features of mobile learning have the potential to enhance systems thinking competence by enabling collaboration among learners (Gikas & Grant, 2013; Heflin et al., 2017; Pimmer et al., 2016; Sung et al., 2016, 2019; Vázquez-Cano, 2014). The paper-and-pencil approach also helped in enhancing participants' systems thinking competence. This approach facilitates conceptual understanding of learners, as they purposely choose what notes to take and when to take the notes (Mueller & Oppenheimer, 2016).

These learning approaches and the real-world environment enabled learners to collaborate and learn from each other's diverse ideas. The intervention was also an opportunity to meaningfully engage in the learning process. This helped the learners to appreciate the complex nature of social, environmental, and economic systems. The intervention helped in fostering the systems thinking competence of the participants. See Chapter 4 for a detailed discussion of how the use of the combined learning approaches helped to enhance the systems thinking competence of participants. Systems thinking is an important competence. It enables the realization that an action - for instance, an economic activity - can impact society and/or the environment. Hence, systems thinking competence stimulates the learners' sensitivity and responsibility toward sustainability issues. It is crucial for sustainability change agents to possess this competence. However, it is difficult to foster systems thinking competence using traditional learning approaches (Molderez & Ceulemans, 2018a). Therefore, in higher education programs focusing on enhancing systems thinking competence, it is crucial to use multiple learning approaches. The learning approaches complement each other. Furthermore, using real-world settings and issues is crucial. This allows learners to appreciate the complex interrelationships among society, the environment, and the economy.

Overall, the findings of this dissertation have implications for theory and practice in sustainable development, competence, and education for sustainable development fields. These implications are discussed in the following sections.

5.3 Theoretical contributions of the findings

The findings of this dissertation contribute to theory in different ways. The next sections discuss the contributions related to the SCs framework, education for sustainable development, the role of IK in fostering SCs, and systems thinking competence.

5.3.1 Sustainability competencies framework

Chapter 2 identified SCs that are relevant to a BoP context, an area of the SCs literature where little is known. Noting that the SCs literature is dominated by Eurocentric discourses, Rieckmann (2012) emphasized the need to identify SCs in the context of the global south as well. Sterling et al. (2017) also share this concern. They indicated that studies in the SCs literature are rare in the context of the global south. Studying SCs in the BoP context is important, as it has different socioeconomic features. These features differentiate it from Western contexts that dominate the SCs discourse. As such, the findings of this dissertation extend the SCs literature by exploring it from the perspective of differences in socioeconomic contexts.

A related contribution of the dissertation is an indication of the possibility that some SCs could be universally relevant, regardless of differences in economic and social features of contexts. This was implied by the results in Chapter 2. The seven SCs taken from mainly Western contexts were found to be relevant in the Ethiopian context as well. Furthermore, among the eight additional SCs suggested by Ethiopian experts for the Ethiopian context, some were also later found in the literature. These include social justice and inclusion competence, and stakeholder and policy coordination competence. Hence, the findings indicate that contexts with different socioeconomic features may not necessarily require different sets of SCs. Brundiers et al. (2020) explored agreement on the relevance of the most frequently cited sustainability competencies framework developed by Wiek et al. (2011). In this study too, the people who got involved as experts reviewing the relevance of the SCs were almost all from Western contexts. This was a point noted by the authors as a limitation. The findings about the possible relevance of some SCs across contexts are not supported by some authors. For instance, Leal Filho et al. (2021) observe that there are attempts to come up with widely accepted SCs. They argue that "attempts at creating a definitive list have proved to be very difficult (if not impossible) to achieve, primarily because of different ideologies, perspectives, contexts, and priorities." (p.104) There is a possibility, however, that some SCs are relevant across contexts. Yet, the findings of this dissertation indicate that some SCs are more relevant in certain contexts than in others. For example, among the SCs identified in this dissertation is the *competence to utilize indigenous resources for sustainability*. The competence is relevant in contexts where society depends mainly on IK. Still, other contexts may also benefit from IK if they recognize its value. These findings related to SCs and the difference in context could be taken as a first indication of the possibility of a wider relevance of some SCs. As such, the findings could be a starting point for future research to explore which SCs are relevant in specific contexts and which are relevant across contexts. The possible relevance of some SCs across contexts has implications on competence theory, as well. The implications of a wider relevance of SCs on competence are elaborated on in the next section.

5.3.2 Competence theory

Competence is considered context-specific (Mulder, 2014). If SCs are found to be widely relevant regardless of differences in contexts, this could stimulate context-related discourse in the competence field. That is, the findings of this dissertation challenge the conclusion that all competencies are context-specific. In other words, though how they manifest themselves might be context-specific, certain competencies may have general value, regardless of context.

The findings regarding the wider relevance of some SCs may have implications on the possibility of international standardization of the SCs. A closer example of international standardization of SCs is the global competence framework by the Organization for Economic Co-operation and Development (OECD). In this framework, global competence is defined as "the capacity to examine local, global and intercultural issues, to understand and appreciate the perspectives and world views of others, to engage in open, appropriate and effective interactions with people from different cultures, and to act for collective well-being and sustainable development" (OECD, 2018, p. 7). In other words, if some of the SCs are found to be universally relevant, this may have implications for future studies on the possibility and desirability of international standardization of the SCs.

The dissertation addressed the competencies required by sustainability change agents in different sectors. These competencies facilitate their efforts in dealing with global sustainability problems. As such, the findings contribute to the theory of professional competence. The results show that certain SCs - for example, the seven SCs taken as starting points in Chapter 2 - can be generic and independent of socioeconomic context, whereas others, such as competence to utilize indigenous resources for sustainability, are context-specific. The findings relate to the comprehensive view on competence.

This approach sees competence as integrated skills, knowledge, and attitudes (Mulder, 2014; Wiek et al., 2011). Hence, the findings show that certain combinations of knowledge, skills, and attitudes are required to address sustainability challenges. This also indicates that education for sustainable development curricula should focus on enhancing the integrated skills, knowledge, and attitudes of learners. As such, the findings contribute to identifying SCs required by sustainability change agents.

The core of this dissertation - sustainable development - is a future-oriented concept. Among others, it focuses on the need to enable current and future generations to meet their needs (WCED, 1987). Hence, the findings contribute to the future-oriented competence framework. Mulder (2019) emphasized the importance of future-oriented competence "not only for being able to function in tomorrow's society and to cope with the challenges ahead but also for shaping that society." (pp. 1185–1186) He discusses a model of future-oriented competence. The model comprises five components: integrative learning competence, disciplinary and interdisciplinary competence, self-management and career competence, personal-professional competence, and social-professional competence. While the focus of this dissertation (i.e., SCs) is related to all the competences of this model, the relevance of some of the components is even stronger. For example, the personal-professional competence comprises competencies related to sustainable development. These include "ambiguity and uncertainty handling, complex problem-solving, sustainability, and action competence". The findings of this dissertation on SCs are also closely related to another component of this model - integrative learning competence. Mulder states that "this symbolizes the key role learning competence plays in human existence. Without learning competence humans would not be able to solve the current complex questions and future challenges." (p.1186) Among the SCs identified in this dissertation are flexibility and continuous learning competence for sustainability and anticipatory competence to predict future sustainability issues. Hence, the findings of this dissertation contribute to the future-oriented competence framework. They confirm the importance of future-oriented competencies. Besides, they show which specific SCs are important to address current and future sustainability challenges in a BoP context. The discussion of future-oriented competence by Mulder (2019) emphasizes the importance of future-oriented competence and the learning thereof. However, it does not cover how these competences should be fostered particularly in a BoP context. The findings of this dissertation extend the future-oriented competence framework by indicating how the competencies can be developed.

The next section focuses on how to enhance SCs of future sustainability change agents. The section discusses education for sustainable development in relation to learning environments, learning approaches, and IK. Besides, the section proposes different means of integrating IK with modern higher education.

5.3.3 Education for sustainable development

The studies in Chapters 3 and 4 addressed several issues related to education for sustainable development in Ethiopia. That is, higher education focusing on fostering SCs of learners. Below, the implications of the findings on the role of IK in enhancing SCs are discussed. Next follows a discussion on the contributions of using multiple learning approaches to foster systems thinking competence.

5.3.4 The role of indigenous knowledge in fostering SCs

The findings of the study presented in Chapter 3 indicate the importance of IK in the context of education for sustainable development. Specifically, the results suggest that IK in the study context of Ethiopia can and should be used in the effort to foster SCs of students. In this regard, the potential contribution of some features of the indigenous Ethiopian Orthodox Tewahedo Church education system was noted. The features recommended to enhance the effectiveness of education programs include the use of local languages and content and respect for local scholars. Utilization of these local resources contributes by enabling access to knowledge preserved for centuries in local languages. This also helps in perpetuating cultures. As such, it has a direct contribution to the social dimension of sustainable development. Besides, the use of local resources helps in enhancing the relevance of learning. This is achieved as the use of local resources connects learning with the priorities and reality of a certain context. A related finding of the dissertation is the need to consider the worldviews and reality of the learners' environment when enhancing these competencies through education. Furthermore, the findings suggest the use of specific local content (i.e., IK). These include natural resource management, weather forecasting, and indigenous healthcare practices. Several authors note that natural resource conservation and indigenous ecological knowledge are among the specific areas of contributions by IK (Berkes et al., 2000; Boiral et al., 2020; Guerrero-Gatica et al., 2020; Rist et al., 2010). The findings of this dissertation add to the literature on sustainability education and IK in different ways. One contribution is indicating the importance of valuing IK and the means of utilizing it in the effort to foster SCs. The findings emphasize the importance of utilizing local resources such as languages, scholars, and content. In addition, the results suggest the use of pluralistic approaches to education for sustainable development. Diverse ways of knowing as well as worldviews could be brought together and complement each other to help in enhancing learners' SCs. Opstal and Huge (2013) strengthen this argument as they note that "it is of major importance that SD [i.e., sustainable development] acknowledges that different worldviews co-exist and are dynamic and that these different visions are not isolated." (p.692) Reed et al. (2007) studied adaptation to land degradation. They concluded that by integrating IK and knowledge from the scientific literature "it was possible to produce more relevant results than either approach could have achieved alone" (p.264). In addition to indicating the need to use IK, the findings of this dissertation propose possible means of applying IK in combination with modern education. The lessons from this can be relevant mainly to contexts where both IK and modern education exist. Agrawal (2009) indicates that there are several ways of knowing. Recognizing diverse worldviews as an opportunity could help in addressing the limitations of the dominant modern higher education system. For instance, holistic views of IK could complement what some authors refer to as the reductionist feature of Western/modern education (Haigh, 2005). Kaya and Seleti (2014) describe (African) IK as holistic. Johnson (1992) explains the holistic feature of IK (Traditional Ecological Knowledge, or TEK) as follows:

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"TEK is holistic; Western science is reductionist. Western science deliberately breaks down data into smaller elements to understand whole and complex phenomena. For TEK, all elements of matter are viewed as interconnected and cannot be understood in isolation." (p.7)

Among others, the value of IK for sustainability lies in its holistic nature. In the modern sustainability (education) discourse, the drawbacks of reductionist approaches and the importance of holistic approaches, e.g. systems thinking, are increasingly recognized. Hence, integration of the two knowledge systems could enrich education for sustainable development. Based on the findings, the recommendation in this dissertation is to follow an inclusive approach where diverse worldviews and learning approaches are utilized to foster learners' SCs. Though the potential of IK and the benefits of utilizing it in combination with modern education are recognized, realizing the integration of the two systems may not be straightforward. There may be resistance to change from the status quo. The resistance may come from students, teachers, policymakers, or other stakeholders. This resistance is discussed in Section 5.4.3. Despite the possible challenges, there are also opportunities that may facilitate the integration of IK and modern education. Among these opportunities are the increasing recognition of IK and the recommendation to capitalize on this knowledge system. For instance, participants in the study described in Chapter 3 of this dissertation insist on the need to explore and utilize IK in Ethiopia to foster SCs of higher education students.

The findings of this dissertation contribute to education for sustainable development by indicating that modern higher education can learn from the holistic nature of IK. Furthermore, the findings propose the means of benefiting from integrating IK with modern education. As indicated in Chapters 1 and Chapter 3, characterizing all Western contexts as homogenous is problematic. The same is true with BoP contexts. Hence, it is important to note that the terms "Western" and "BoP" only indicate general trends in those contexts. That is, the points referring to the two terms discussed in this dissertation are not intended to make conclusions about each country in the Western or BoP contexts.

5.3.5 Fostering systems thinking competence

The study described in Chapter 4 explored the contributions of simultaneously implementing a combined set of innovative learning approaches to fostering systems thinking competence. The combination of various learning approaches was applied in real-world settings. In this section, the contributions of these learning approaches to enhancing participants' holistic/systems thinking competence are discussed.

The main contributions of the studies in this dissertation include the identification of SCs in relation to (the BoP) context and the means of fostering the competencies. Regarding the latter, the need to use holistic approaches through the combination of diverse worldviews including IK, and the importance of utilizing relevant learning approaches for competence development are emphasized.

The findings in Chapter 4 extend the constructivist learning theory in the context of developing SCs. Constructivism in this context relates to learning approaches and environments that facilitate meaningful engagement of learners in "knowledge co-creation…, and development of the students' creative thinking" (Dziubaniuk & Nyholm, 2020, p. 178). Chapter 4 contributes by indicating specific learning approaches - field trips, mobile learning, collaborative learning, and paper-and-pencil note taking – and authentic environments help in enhancing learners' systems thinking competence. The combined learning approaches and the real-world environment enhance the motivation of learners and facilitate their meaningful engagement in knowledge co-creation and in generating collective solutions to sustainability challenges. Furthermore, the learning approaches and the authentic settings helped participants to realize that social, environmental, and economic issues are not isolated – rather, these issues are interrelated. Hence, the findings in Chapter 4 show the connections between SCs and constructivist learning approaches that are effective in fostering SCs.

Dealing with complex sustainability issues requires, among others, systems thinking competence. That is, the ability to appreciate the elements involved in a system and how these elements interact with and affect each other. Hence, the findings contribute to the systems thinking discourse in the context of sustainable development.

Leal Filho et al. (2021) indicated that in education for sustainable development, teachers who participated in their study considered "student encouragement…, and application of concepts to real-world problems…" as important (p.107). Similarly, the findings in Chapters 3 and 4 of this dissertation emphasize the importance of learners' motivation and engagement in education for sustainable development. Furthermore, the findings of these chapters identified learning approaches and real-world environments that motivate and meaningfully engage learners. These findings add to the education for sustainable development literature by indicating the importance of using real-world environments. Furthermore, the findings show specific learning approaches that motivate learners. For instance, two of the learning approaches used in the study described in Chapter 4 were mobile learning and collaborative learning. These learning approaches are appealing to learners (Ekanayake & Wishart, 2014; Molnar, 2017; Pimmer et al., 2016).

As a normative concept, sustainability requires values that facilitate actions toward a more sustainable future. The real-world contexts and the learning approaches mentioned above help to foster these values. Unlike learning methods confined in classrooms and dependent on textbooks, the above approaches and the real-world context expose learners to the complex systems that involve issues related to social, environmental, and economic dimensions of sustainable development. The combination of the aforementioned learning approaches and the real-world context helps learners to appreciate that all the dimensions are relevant, but solutions do not serve all elements. Hence, learners better understand the need to make (difficult) choices and that makes their values more explicit. As such, these approaches help learners develop pro-sustainability values. Concern for sustainability, in turn, helps learners realize the urgency to act for a sustainable future.

In general, the findings of this dissertation contribute to theoretical discourses on sustainable development, competence, SCs, education for sustainable development, and IK. In addition to these theoretical contributions, the findings have implications on policy and practice in sustainable development, education, and training. These contributions are discussed in Section 5.4.

5.4 Implications of the findings for policy and practice in sustainable development education and training

The results of this dissertation inform policy and practice in training and higher education for sustainable development. The findings may help the training of future sustainability change agents. To produce change agents who facilitate progress toward a more sustainable future, the contributions of several stakeholders are crucial.

Among others, stakeholders in higher education and training institutions should realize the urgency to address sustainability issues. Stakeholders also need to commit to implementing the recommendations in this dissertation. The findings also address how higher education for sustainable development can contribute to the achievement of the UN SDGs. For the higher education system to meet this demand and train students to become (future) sustainability change agents, the system needs to undergo several changes. The implications of such changes and suggestions of how to get stakeholders on board with the changes are discussed in the subsequent sections.

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5.4.1 Implications of the findings for the sustainable development goals

Chapter 1 of this dissertation presented a recent report by the United Nations that the world is not on track to achieve the SDGs by 2030. One of the possible factors for this unsatisfactory performance could be the underperformance of universities. Because of its potential, the higher education sector could contribute more to the achievement of the SDGs. Leal Filho et al. (2021) agree with this as they state that "if universities play a leading educative role in this agenda, the SDGs are more likely to be achieved, particularly as higher education underpins the development targets..." (p.288).

Similarly, the UN's Agenda 2030, which is aimed at achieving the SDGs, recognizes the role of education in achieving the goals. Goal 4 specifically states the need to equip all learners with SCs. This goal has an important implication that all learners need to possess certain competencies to help them facilitate sustainable development (United Nations, 2015). This implication supports the argument in this dissertation that higher education students of all fields should be educated to become future sustainability change agents (Walter Leal Filho et al., 2019, 2021). Besides, this has practical implications for education for sustainable development. These implications are elaborated in the next section.

5.4.2 Implications of the findings for education and training in sustainable development

As discussed in the previous section, the need to consider higher education students of all fields as potential sustainability change agents is crucial. Realizing this need has important implications for policymakers and other relevant stakeholders in education for sustainable development to prepare the necessary policy and implementation frameworks. Among others, the stakeholders need to collaboratively review and revise all higher education programs. Such revisions are important so that the course contents and learning approaches in higher education programs help the preparation of sustainability change agents. In other words, the SCs identified in this dissertation as relevant to the Ethiopian context should be included in the higher education curricula of the country. The changes required of different stakeholders including teachers and students, possible challenges of implementing the changes, and tentative means of addressing these changes are discussed in Section 5.4.3.

Chapter 2 identified SCs that are relevant for a BoP, Ethiopian, context. The set of SCs identified in this dissertation can be used in higher education sustainability programs. Also, training programs aimed at enhancing the competence of sustainability change agents such as corporate social responsibility officers can use the SCs. These education and training programs may focus on equipping their students/trainees with the SCs. In other words, the SCs framework could serve as intended learning and training outcomes for higher education and training programs in sustainable development. Relevant stakeholders including decision-makers from national to school levels, students, teachers, and the industry should work together on how to foster these competencies.

Identification of the relevant SCs is one of the factors required to foster these competencies in learners. Other important factors include the acceptance of the SCs by key stakeholders including policymakers, teachers, and students. The next section presents the roles of the key stakeholders in defining the required SCs and why their roles matter. In addition, the possible means of fostering such competencies are elaborated.

5.4.3 The role of stakeholders

Chapters 3 and 4 addressed an important issue of learning approaches that are relevant and effective in developing SCs of sustainability change agents. The findings indicate that when designing education and training for sustainability, carefully reviewing its relevance to the worldviews and priorities of a context is crucial.

Assuring the relevance of an education system enhances its contribution to producing change agents who are aware of societal priorities. Furthermore, the findings suggest that sustainability education programs should help in realizing the potential of IK in developing SCs of learners. Such programs should explore possible ways of utilizing diverse worldviews including local knowledge. Utilizing IK facilitates for local languages, content, and scholars to be esteemed and indigenous practices perpetuated.

The results of this dissertation emphasize the need for higher education sustainability programs to meaningfully engage learners in the learning process. The findings also underline the need to use real-world learning environments. Enhancing the relevance and effectiveness of higher education sustainability programs requires a shift from the business as usual approach. This includes moving away from the domination of lectures and confinement in classrooms. Innovative learning approaches based on diverse worldviews and the use of real-world environments are crucial. Thus, the higher education system needs to make the necessary adjustments starting from legislating policy to the practice of teaching in the sense of stimulating students' learning processes. It is important that these changes focus on creating enabling learning environments for the educational system to play its role in the effort toward a more sustainable future. For instance, the higher education system should be innovative in a way that equips all higher education students with SCs, regardless of their field. Acquiring SCs may help students in their future job positions to positively contribute to a more sustainable world. Introducing all students of higher education institutions to sustainable development or the SDGs is also supported by Leal Filho et al. (2019).

Change in different aspects of higher education systems is required if the SDGs are to be achieved. Leal Filho et al. (2019, p. 288) argue that the SDGs bring opportunities and challenges regarding curriculum. They indicate that such transformations "may challenge existing ways of thinking and organizing." This statement has implications for practice in the Ethiopian context as changing the status quo may cause resistance from diverse stakeholders. Different factors may cause resistance. These factors may include any of the several reasons for resistance to change in higher education systems identified by Chandler (2013). These reasons include concern that the change causes time pressure, interest to maintain the status quo, and leaders' lack of skills to manage the intended change.

Damawan and Azizah (2020) identified seven strategies to deal with resistance to change. Brief descriptions of three of these strategies are given here. "Introducing the changes slowly" is one of the strategies. The authors note that this strategy gives time to the people that may be affected by the changes to digest information about the desired change and adjust accordingly. Another strategy the authors identified is the participation of the people that may be affected by the change. The authors indicate that involving these people in the change process is "the most effective solution to overcome or reduce resistance to change" (p.51). "Facilitation and education" of the concerned people about the desired change is also among the means identified to deal with resistance to change.

Each environment and the nature of resistance may require different approaches. Still, consideration of strategies such as the ones identified by Damawan and Azizah (2020) may be useful to overcome resistance to change. Furthermore, in Section 5.4.3 the role of stakeholders, the possible challenges of integrating IK and modern education, and the possible means of dealing with the resistance from some of the stakeholders are discussed.

In the introduction and implementation of the required changes in higher education, utilizing the contribution of the industry sector is important. This sector has considerable resources. The sector may give learners the opportunities to get exposed to real-world sustainability issues. Hence, the industry sector could contribute to creating enabling environments for higher education sustainability programs.

One of the challenges in the education for sustainable development is the assumption that Western education is the "standard and the only" approach. Challenging this assumption and creating more space for plural worldviews and IK is one of the required changes in the higher education system. Higher education institutions and other relevant stakeholders such as training and research centers should consider utilizing local knowledge, languages, and scholars. Among others, the five principles suggested in Section 5.2.2 and Chapter 3 facilitate the use of IK. However, the implementation of the suggested changes may not be straightforward as challenges including the ones discussed below could be faced.

How motivated are the key stakeholders including decision-makers, teachers, and students in sustainability and education for sustainable development? To what extent are the stakeholders ready to shift from the traditional learning approaches and embrace diverse worldviews, innovative learning approaches, and IK?

How these questions are answered determines whether the findings of this dissertation can be practically implemented in higher education sustainability programs and result in societal benefits.

Fullan (2007) asks "what "theories of action" really get results in education reform" and emphasizes that motivation of stakeholders is crucial if desired changes are to be achieved. He explains that "if one's theory of action does not motivate people to put in the effort individually and collectively that is necessary to get results, improvement is not possible." (p.8) Hence, it is crucial to challenge the key stakeholders to see the urgency to contribute toward a more sustainable future. It is also important to encourage learners to be committed to creating enabling environments. Without these contributions from the key players, the implementation of the suggested approaches and transformations would be difficult, if not impossible.

The stakeholders in the higher education system including the national-level decision-makers who legislate sustainable development and education policies, teachers, and students have important roles. Next, the possible implications of changes in the higher education system on the key stakeholders and the importance and means of motivating a major stakeholder group, i.e., students, are discussed.

Policymakers

Policymakers should have intrinsic motivation to address sustainability issues. They should be convinced of the importance of preparing change agents to deal with sustainability challenges. It is also important that policymakers understand the significance of IK and strive to take the necessary steps to include IK in the higher education system. Implementing these changes may take time and require the concerted efforts of different stakeholders. Among these stakeholders, researchers have a significant role in indicating the importance of the recommended changes. Researchers can also contribute by pointing out how higher education systems can facilitate social, environmental, and economic development. Furthermore, future studies on stakeholder analysis are important to identify and involve the key players in education and sustainable development.

Teachers

Most of the studies on the identification of SCs and education for sustainable development fields focus on students. However, the competence of teachers is also crucial. If competent, teachers can help their students as coaches in acquiring SCs and facilitate the achievement of development goals, such as the SDGs. Recognizing the knowledge gap regarding SCs of teachers, recent studies are emerging to address it (Corres et al., 2020; Walter Leal Filho et al., 2021; Scherak & Rieckmann, 2020). For instance, Leal Filho et al. (2019) note that, among others, "the most common reasons for not integrating the SDGs in the curricula are related to lack of [staff] training." (p.292)

As suggested in Chapter 3, one of the means of integrating modern higher education and IK to foster SCs of learners is engaging local people with IK. Among the possibilities is the use of experts in IK as guest lecturers. There are examples of the practice of integrating IK in the key functions of education (teaching and research). Among these examples is the North-West University in South Africa (Kaya & Seleti, 2014). At this university, the integration of IK in modern education took different forms. These forms include the use of local languages, indigenous practices, and content relevant to the context.

The teachers who incorporated IK in their lessons indicated that "when AIKS [African Indigenous Knowledge Systems] was systemically and holistically included into the curriculum, student achievement improved." The teachers explained the reason: "students could relate what was taught with their own home and community experiences."

Similarly, the students at this university gave positive feedback on their experience of learning with IK integrated with modern education. Students specified what they gained from the integrated learning approach. These gains include "new multi- and transdisciplinary knowledge and skills, especially cultural skills..., helped them to increase self-esteem or self-worth. It also made them sensitive to the challenges of community livelihood and development" (p.39).

Overall, several stakeholders indicated the positive outcomes of integrating IK in modern education at the North-West University in South Africa. The results from the practical application of IK at this university support the claims in this dissertation. That is, the use of IK in combination with the modern higher education system enhances the relevance of the content and effectiveness of learning approaches. For additional examples of using IK with modern education, see Chapter 3.

When involving people with IK in the modern higher education system, respect and sensitivity to the IK experts and their worldviews are important. In this regard, Leal Filho et al. (2019) note the importance of developing learners' "worldview and values sensitivity" so that they can contribute to the achievement of the SDGs (p.286). Enhancing students' value sensitivity requires that the teachers in the modern higher education system first develop sensitivity to diverse worldviews. Teachers also need to be aware of the potential contributions of IK. These contributions could be important steps to properly communicate with IK experts and collaborate with them. Hence, the other implication of the need for modern higher education teachers to enhance their SCs is that the focus of teachers' continuous professional development should also include relevant elements of IK and communication with IK experts.

In the efforts to incorporate IK in modern education, one issue is consideration of IK as less important than the dominant Western education (Briggs, 2013; Magni, 2017). Briggs (2013) notes that "it would seem, although often quite implicitly, that indigenous knowledge can only be taken seriously if it has the approval of science." (p.235) He indicates that this is one of the factors that hinders institutionalizing IK, which implies that policymakers' and implementers' attitudes toward IK are important if the higher education system is to benefit from it.

5

Students

Another important factor in the effort to incorporate IK in modern higher education is the attitude of students, arguably the most important stakeholder group. This factor has an important implication for education for sustainable development practice. That is, before implementing such initiatives, education policymakers and implementers need to encourage and enable students to learn IK or the combination of IK and Western education starting from lower grades. In this regard, creating awareness among students about the worth of Ethiopian IK is important. Among others, showing learners practical experiences of Ethiopian IK used in Ethiopia and abroad could help them value IK. For example, one possibility is indicating the value of the ancient Ethiopian language Ge'ez and the IK preserved in it. One option is informing students that, cognizant of the importance of this language and the knowledge preserved in it, several universities in Europe and North America offer Ge'ez-related courses. Another possibility is asking students intriguing questions like "Why did NASA, the National Aeronautics, and Space Administration name the constellations Cassiopeia and Cepheus after the ancient Queen and King of Ethiopia in Greek mythology?" Such approaches could be possible means of creating awareness about and triggering learners' curiosity and interest in IK such as ancient Ethiopian astronomical knowledge. Furthermore, historically, as indicated in Chapter 3, modern education in Ethiopia did not build on the Ethiopian indigenous education system, nor did it encourage students to value their culture. Rather, the modern educational system considered indigenous Ethiopian education to be "irrelevant". Hence, the findings of this dissertation have practical implications related to policymakers, teachers, and students. It is important to draw lessons from these implications. That is, the higher education system should recognize the role and interest of the stakeholders and embrace diverse worldviews.

Despite the potential contributions of this dissertation by indicating the theoretical and practical implications of the findings, this dissertation also has limitations, as discussed in the next section.

5.5 Limitations and suggestions for future research

The findings of the studies in this dissertation are intended to contribute to the efforts of addressing a major global challenge – unsustainability. However, there are several limitations in the studies. Pinpointing and discussing these limitations may help to indicate what future studies could address. The limitations also indicate how future studies may complement the findings of this dissertation.

To identify important SCs for the Ethiopian context, experts who are familiar with the context and who have expertise in sustainable development contributed to the research described in Chapter 2. Therefore, the nature of the study in this chapter does not lend itself to the generalization of the findings to other contexts. Hence, the findings concern what SCs are relevant mainly in the Ethiopian context. To conclude whether these SCs are relevant to other contexts, further research involving multiple countries is required. However, two factors indicate that it could be possible for some of the identified SCs to be relevant to other BoP and non-BoP contexts as well. First, the Ethiopian experts who participated in the study confirmed that the seven SCs taken from the mainly Western contexts are important for the Ethiopian context as well. Second, some countries are rather similar to Ethiopia and share the socioeconomic features of BoP contexts. Thus, these similarities may call for a comparable set of SCs. However, whether such a call for comparable SCs exists cannot be concluded without further studies that involve sustainability experts from several contexts. The other important implication of the findings, discussed in Section 5.4, is the possibility of a wider/universal relevance of some SCs. Based on this clue, future research should be conducted in multiple countries with different socioeconomic features. In this regard, the SCs literature is dominated by Western contexts. There is limited research on SCs in other contexts. Hence, future studies into identifying widely/universally relevant SCs could focus more on non-Western contexts, without ignoring the Western context. Such studies could start with identifying SCs that are relevant in multiple BoP contexts. This identification will help reveal whether countries with BoP features need a comparable set of SCs. Following this step, similar studies conducted in multiple non-BoP contexts could be identified. Finally, comparing the results of the studies in the two contexts may help with exploring the universal relevance of SCs.

The studies in this dissertation also have the following limitations related to the methods used.

To identify Ethiopian IK relevant for being combined with modern higher education, directly studying the IK possessed by communities in the country would be ideal. However, the study on IK in Chapter 3 depended on the suggestions of participants - that is, people with expertise in the fields of modern education and sustainability. In other words, the study did not directly explore the Ethiopian indigenous education system and the contents of IK in different communities. To complement the findings of this dissertation, future studies are suggested. It is recommended that such studies examine IK and sustainable development by directly involving the experts in the Ethiopian IK as key informants in the studies. One possibility of realizing this involvement could be using ethnographic methods.

Ethnographic methods mainly use data gathering techniques such as participant observation. Hence, the methods enable the engagement of researchers with the community they study (Morgan-Trimmer & Wood, 2016). Such methods help researchers to gain firsthand experience of the indigenous communities and document their IK that is relevant to sustainable development.

Another limitation of this dissertation relates to the study described in Chapter 4. This chapter explored the contributions of a combination of multiple innovative learning approaches to enhancing systems thinking competence. As participants, the study included only 36 students of the Bachelor of Arts program in Geography and Environmental Studies at Addis Ababa University, in Ethiopia. Hence, the results of the study cannot be generalized to students in all fields at the University.

As elaborated in Section 1.2, attaching the sustainability change agent role only to students of certain fields may be problematic and could create a wrong assumption that students of other fields do not play a role in sustainability. Therefore, higher education students of all fields should be introduced to the basics of sustainable development as future sustainability change agents. Students with an interest in the SD field may further their sustainability studies. Hence, it is recommended that future studies on the effectiveness of learning approaches in fostering SCs include students from multiple disciplines. Furthermore, it is important that stakeholders in the higher education system work together to convince the students of the need to get introduced to the basics of sustainability.

The other limitation in Chapter 4 is the short duration (i.e. about two months) of the intervention. The results in Chapter 4 do not tell whether the impact of the intervention could be different if the intervention covered a longer period. Studies with extended duration of interventions may help to examine whether the length of the intervention period affects participants' systems thinking competence. The short time between the intervention and the post-test is also another limitation. As such, the results may not tell whether the impact of the intervention could be lasting or not. Future studies on a similar area could focus on interventions that cover a longer period. It is also recommended to conduct a post-test shortly after the intervention. It then may be useful to follow up with post-tests after longer periods since the time of the intervention.

To conclude, the sustainability experts from academia and the industry who participated in the study presented in Chapter 1 of this dissertation indicated the relevance of 15 SCs. These experts consider that the SCs help sustainability change agents to play their role toward a more sustainable future. To prepare future sustainability change agents, the SCs identified in this dissertation are recommended to be included in higher education programs. Stakeholders in the higher education system may consider the SCs when preparing and revising curricula. This preparation and revision could be guided by the five learning principles suggested in Section 5.2. Furthermore, in their effort to prepare sustainability change agents, other governmental and non-governmental organizations with a focus on sustainable development could pay attention to the identified SCs.

The objective of identifying and fostering SCs is to facilitate the decisions and actions of different professionals to promote sustainability. However, this dissertation did not examine the impact of possessing SCs on professional practice. Hence, future studies should explore the relationship between the possession of the identified SCs and sustainability performance in different sectors.

Appendices

Appendix I

Ge'ez language teaching is conducted in the following academic institutions by the following faculties around the world (as of Spring 2017). Prepared by Eyob Mengesha Bekele 7 February 2018

1. Abilene Christian University, Curt Niccum
2. Addis Ababa University, Zelalem Meseret, Sirgiw Gelaw, Yikunnoamlak Zerabiruk
3. Bahir Dar University, Muluken Andualem
4. Cambridge University Faculty of Divinity, Ralph Lee
5. Catholic University, Aaron M. Butts
6. Dabra Markos University, Be'aman Girum, also Hiruyan Tegbaru Adane, at the Haddis Alemayehu Institute of Cultural Studies
7. Florida State University, Matthew Go_
8. Frei University Berlin, Stefanie Rudolf, Klaus Geus
9. Göttingen University, Michael Kleiner
10. Hamburg University, Alessandro Bausi, Maija Priess
11. Heidelberg University, Andreas Fink
12. Ludwig-Maximilians-Universität München, Loren Stuckenbruck
13. Mekelle University, Hagos Abrha Abay
14. Oriental University Naples, Gianfrancesco Lusini
15. Paris, Institut Catholique, ELCOA, Jacques-Noël Peres
16. Philipps-Universität Marburg, Stefan Weninger
17. Pontifical Oriental Institute in Rome, Tedros Abraha
18. Russian State University of Humanities (Moscow), Maria Bulakh
19. SOAS, University of London, Ralph Lee

20. St Petersburg University, Sergei Frantsouzo_
21. St Tichon University in Moscow, Iosif Fridman, Oleg Davydenkov
22. Saint Mary Theological College and Ethio-American Cultural Institute, Houston, Texas, online learning
23. University of Chicago, Rebecca Hasselbach-Andee
24. University of Texas, Austin, John Huehnergard (retiring)
25. University of Toronto, Robert Holmstedt
26. University of Vienna, George Hatke

27. University ofWashington, Seattle, Hamza Zafer

28. Uppsala University, Witold Witakowski (retiring)

This source notes that several terms are used to refer to Ge'ez language courses: "Ethiopic language teaching, Ge'ez language teaching, Ge'ez courses, Geez language courses, Ethiopian language courses, Gi'iz language courses."

Accessed on 8 August 2020 from

https://www.quora.com/What-are-the-names-of-universities-that-give-Geez-language-courses

Appendix II

Indicators for the social dimension of sustainable development

1. Attractive public realm/ Sustainable urban design
2. Decent housing
3. Local environmental quality and amenity
4. Social capital & network/ Social involvement
5. Accessibility (e.g. to local services and facilities/employment/
6. Abiding by law/ Social order
7. Social cohesion & inclusion/ social and local group interactions/ social solidarity/ Sense of community and belonging/ Residential stability (vs turnover)
8. Social justice: inter- and intra-generational
9. Civil society and effective civil institutions/ Active community organizations
10. Engaged government/ responsibility/Participation and local democracy
11. Education & training/ human resource development/ Human skills
12. Social inclusion (eradication of social exclusion)/ obstruction of racialism/ social dignity
13. Employment/Job security/ poverty eradication/ food security/ social security/ self-reliance
14. Good governance/participatory decision making/ people empowerment
15. Cultural heritage/ respecting indigenous knowledge and culture
16. Human rights/citizenship rights/ women and children rights/ respect to social minority groups/
17. Consumer/product responsibility
18. Labor practices
19. Fair practices/ equal distribution of resource and facilities/ Equal opportunities/ equity/ Fair distribution of income
20. Health & safety/ human safety/ life expectancy/quality of life and well-being
21. Walkable neighborhood: pedestrian friendly

Compiled from (Ajmal et al., 2018, p. 333; Dempsey et al., 2011, p. 291; Mahdei et al., 2015, p. 14651)

Indicators for the Economic dimension of sustainable development

1. Resource exploitation costs
2. Social costs
3. Distribution of income and wealth in society
4. Promotion of resource efficiency/ sustainable production opportunities
5. Popularization of investment
6. Tourism
7. Employment

8. Gross domestic product (GDP) per capita

9. Transportation

10. Consumption and production patterns/ Material consumption

11. Waste generation and management/ Generation, treatment and disposal

12. Share of renewable energy sources in total energy use

13. Share of women in wage employment in the non-agricultural sector

14. Labor productivity and unit labor costs

15. Economic and investment safety

16. Valuation of resources and environment

17. Sustainable employment

18. Generating sustainable technology

Compiled from (Mahdei et al., 2015, p. 14651; UN DESA, 2007, p. 14)

Indicators for the Environmental dimension of sustainable development

1. Clean air

2. Optimization of resource

3. Clean water

4. Clean land/land productivity

5. Biodiversity

6. Climate- stabilizing the climate at safe levels Reduced consumption of raw materials

7. Open green space/ aesthetics/ Preserving beauties of the earth

8. Reduced emissions of environmental contaminants from production/ reducing toxic emissions

9. Maintaining the world's ecosystem diversity and quality- its capacity to support life and its potential to adapt to change and provide a wide change of choices and opportunities for the future

10. Healthy environmental systems are maintained – they are improving rather than deteriorating

11. Levels of anthropogenic stress are low enough to engender no demonstrable harm to its environmental systems

12. Sustaining energy, materials, and water resources

13. Environmental protection

14. Desertification; deforestation

15. Transition to energy systems with minimum pollutant effects

16. Systemic use of resources

17. Generating clean energy

Compiled from (Kates et al., 2005, p. 14; Mahdei et al., 2015, p. 14651)

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English summary

Introduction

Humanity is facing major challenges, including climate change, inequality, poverty, conflict, lack of access to shelter, water, food and nutrition, medication, and sanitation. Addressing these challenges requires concerted efforts of diverse stakeholders from different contexts. In the scientific literature, these challenges are identified as sustainability issues (Katundu, 2019; Rieckmann, 2012; Wiek et al., 2011).

Similarly, major international organizations such as the United Nations identify these problems as global sustainability challenges and put in place international strategic frameworks to address them. Preparation of the UN sustainable development goals (SDGs) is an important case in point. The SDGs comprise 17 goals and their 169 targets, which address social, environmental, and economic issues. The goals are intended to be achieved by 2030 (United Nations, 2015). Another major international initiative intended to prevent climate change is the Paris Agreement, which aims at keeping global warming below 2°C.

Recent reports on the progress of the SDGs and the Paris Agreement indicate that the world is not on track to achieve these important global initiatives by the intended time (United Nations, 2020; United Nations Environment Programme, 2020). These progress reports indicate that much more remains to be done by all stakeholders to move toward a more sustainable future.

Studies in the sustainable development literature and international initiatives such as the SDGs recognize the importance of certain competencies in facilitating efforts toward a future where the social, environmental, and economic needs of current and future generations could be met. These are sustainability competencies (SCs), i.e., integrated knowledge, skills, and attitudes. This dissertation addresses sustainable development from the point of view of competence. Specifically, it focuses on identifying and enhancing the competencies that individuals in corporations, academia, and governmental and non-governmental organizations need in order to boost their contribution toward a more sustainable future.

In the SCs literature, several attempts have been made to identify competencies needed for change agents (i.e., people who initiate and facilitate progress toward a more sustainable future) to effectively contribute to sustainable development. However, most of the studies on the identification and fostering of SCs take Western worldviews and contexts for granted. Therefore, it is unclear if a base of the pyramid context would require a different set of competencies (Rieckmann, 2012; Sterling et al., 2017). This context refers to mainly developing countries with certain socioeconomic characteristics including low per capita income, limited infrastructure, and rural population. This limitation of excluding other perspectives such as indigenous knowledge (IK) is also observed in major global initiatives, for instance, during the preparation of the SDGs (Cummings et al., 2018). This limits the potential contributions of non-Western worldviews, IK, and pedagogies to sustainability.

Equipping higher education students, future sustainability change agents, with SCs helps in facilitating positive changes toward a more sustainable world. The role of education in preparing sustainability change agents is recognized. As a result of this recognition and in response to the pressing global sustainability challenges, an increasing number of sustainability-related programs are emerging in higher education systems of different countries (Brundiers et al., 2020; Salovaara et al., 2020; Wiek et al., 2011).

Among the competencies relevant to sustainability is systems thinking competence. This competence facilitates the understanding of the interrelationships among the social, environmental, and economic dimensions of sustainable development.

Innovative learning approaches relevant in fostering SCs of students have been studied. However, there has been limited research into the contributions of multiple learning approaches and authentic environments in fostering systems thinking competence.

To address the gaps discussed above, this dissertation conducted empirical studies that built on the literature dominated by Western contexts and complimented this with IK and experiences from a non-Western context, Ethiopia. The dissertation has two major objectives: identifying SCs for a base of the pyramid context and exploring the means of fostering SCs. To achieve these objectives, the following research questions were specified:

1. What sustainability competencies are required for a base of the pyramid (in this case Ethiopian) context to contribute toward a more sustainable world?

    1.1 To what extent are the sustainability competencies identified in non- base of the pyramid contexts relevant in a base of the pyramid context as well?

    1.2 What competencies are relevant for sustainability professionals in a base of the pyramid context?

2. How can relevant sustainability competencies be fostered in higher education students, as future sustainability change agents?

    2.1 What indigenous knowledge can be utilized to enhance the sustainability competencies of higher education students?

    2.2 How can indigenous knowledge be included in modern higher education systems to enhance sustainability competencies?

    2.3 What learning approaches foster sustainability competencies in higher education?

    2.4 To what extent does the use of a combined set of learning strategies, (i.e., collaborative learning, field trips, mobile learning/paper-and-pencil approach) in an authentic context enable fostering systems thinking competence?

Main findings

Using a Delphi study, Chapter 2 answered the first research question by focusing on what SCs are required in the Ethiopian context. In this study, a SCs framework was prepared by using Heiskanen et al. (2016), Osagie et al. (2014), Roorda (2013), and Wiek et al. (2011) as a starting

point. This SCs framework comprised seven SCs:

1. Systems thinking competence
2. Disciplinary competence
3. Interpersonal competence
4. Action competence
5. Anticipatory competence
6. Strategic competence
7. Normative competence

The relevance of these SCs to sustainability change agents in the Ethiopian context was rated by Ethiopian sustainability experts from academia and the industry. The findings of this Delphi study indicated that the seven SCs are relevant to the Ethiopian context.

Furthermore, the experts suggested the following eight additional SCs for the Ethiopian context:

1. Transdisciplinary competence
2. Flexibility and continuous learning competence
3. Communication and information acquiring competence
4. Stakeholder and policy coordination competence
5. Resource utilization competence
6. Social justice and inclusion competence
7. Competence to balance sustainable development dimension
8. Competence to utilize indigenous resources

In total, 15 SCs were identified as relevant to the Ethiopian context. Among these, systems thinking competence and transdisciplinary competence gained the highest ratings.

The study in Chapter 2 adds to the SCs literature by showing which SCs are relevant to a BoP context, where there is limited research. Furthermore, the findings indicated the possibility that some SCs could be universally relevant regardless of social and economic characteristics of different contexts.

Chapters 3 and 4 addressed the second research question and its sub-questions, which focus on how to foster SCs of future sustainability change agents.

In Chapter 3, a qualitative study was conducted in Ethiopia by involving people with expertise in sustainable development and education. The chapter focused on how to foster SCs and answered the second research question and sub-questions 2.1-2.3. In this chapter, the potential contributions of using IK in combination with the modern education in Ethiopia were explored. The chapter investigated what IK can be used and how it can be included in modern higher education systems to develop SCs of learners. The chapter also examined the learning approaches and environments required to enhance the effectiveness and relevance of the Western-style/ modern higher education system to develop SCs of learners.

The findings indicate that for an education system to succeed in preparing future sustainability change agents by fostering their SCs and to enhance effectiveness and relevance, it is crucial to value and utilize the IK and diverse worldviews of the societies where the learning happens. Participants in the study emphasized that an education system that ignores the worldviews and the priorities of a given context has little relevance.

The findings in Chapter 3 indicate that the modern education system in Ethiopia was imported without adequately contextualizing it to Ethiopian worldviews and IK in different societies in the country. This created an education-reality gap, where what students learn in schools is hardly related to the reality in their environments. Taking lessons from the IK and indigenous education systems in different communities are suggested to enhance the relevance of the modern education system. Specifically, the strong features of the indigenous education system of the Ethiopian Orthodox Tewahedo Church were recommended. These features include collaborative learning/peer support, respecting and utilizing local languages, content, and scholars. In addition, the importance of utilizing content from IK of different communities such as the holistic and indigenous natural resource management competence of the Konso people was emphasized.

The findings in Chapter 3 indicate that in the modern education system of Ethiopia, learning is mainly characterized as being confined to classrooms with limited connection to societies and dominated by lectures. These situations limit learners' opportunities to meaningfully engage in the learning process. To deal with these limitations, it is crucial to have learning approaches that enable collaboration and provide opportunities for learners to meaningfully engage in the knowledge construction process and to extend learning to society.

Furthermore, to take advantage of IK and education systems in Ethiopia, five education design principles were suggested: define worldviews, utilize indigenous knowledge, use sustainability-oriented pedagogies, engage learners, and build on students' experiences. The findings suggest that these design principles facilitate the inclusion of IK in the modern higher education system and enhance the relevance of the education system in fostering SCs.

Building on the results of Chapters 2 and 3, Chapter 4 addressed research question 2, sub-question 2.4. Using an exploratory experimental study, the chapter investigated the contributions of multiple learning approaches in a real-world environment to fostering systems thinking competence of learners. Graduating class bachelor's students in the Department of Geography and Environmental Studies at Addis Ababa University, Ethiopia participated in this study. As an intervention, field trips and collaborative learning were used in combination with mobile learning for one group, and paper-and-pencil note taking for another. The intervention provided participants with the opportunity to meaningfully engage in the learning process. The combined use of these learning approaches in a real-world context helped to foster the systems thinking competence of participants in both groups. In addition, the findings showed that real-world contexts facilitate collaboration with peers. This helped in enhancing learners' appreciation of the complex interrelationship among social, environmental, and economic systems.

Theoretical contributions

Sustainability competencies framework

The findings of this dissertation contribute to theoretical discourses on sustainable development, competence, SCs, education for sustainable development, and IK.

Sterling et al. (2017) indicated that studies in the SCs literature are rare in the context of the global south. The SCs literature is dominated by Eurocentric discourses and studies into SCs in the context of the global south are rare (Rieckmann, 2012).

The study in Chapter 2 identified SCs that are relevant to a base of the pyramid context, an environment with different socioeconomic features than that of Western contexts. Hence, this dissertation extends the SCs literature by exploring competencies from point of view of the context-specificity feature of competence. The findings of Chapter 2 indicated the possibility that some SCs could be universally relevant, regardless of social and economic differences in socioeconomic features of different contexts. Furthermore, as competence is considered to be context-specific, this finding has an implication for competence theory.

Education for sustainable development and fostering sustainability competencies

The findings of the studies presented in Chapters 3 and 4 have theoretical implications for IK, sustainability, and education for sustainable development. The findings of the study described in Chapter 3 indicate that modern education can benefit from including relevant content of IK from different communities in Ethiopia, for instance, the natural resource conservation and indigenous ecological knowledge. These findings strengthen the IK and sustainability-related literature that recognizes the potential of IK in the aforementioned areas (Berkes et al., 2000; Boiral et al., 2020; Guerrero-Gatica et al., 2020; Rist et al., 2010). Furthermore, the findings suggest that to enhance the relevance and effectiveness of education for sustainable development,

valuing and utilizing languages, content, and scholars from the local environment can be learned from the features of the indigenous Ethiopian Orthodox Tewahedo Church education system. As such, the findings add to the IK and education for sustainable development discourse by suggesting more pluralistic approaches in which diverse worldviews are embraced and utilized to enhance the SCs of learners. These findings confirm propositions by previous studies that it is important to use diverse worldviews in the endeavor toward a more sustainable world (Reed et al., 2007; Van Opstal & Hugé, 2013). The study in Chapter 3 proposes possible means of using IK in combination with modern education aimed at developing SCs of students. Identifying the means of incorporating elements of IK in modern education facilitates utilization of the former. IK is recognized to be holistic as compared to Western/modern education which is described as reductionist (Haigh, 2005; Johnson, 1992; Kaya & Seleti, 2014).

The study in Chapter 4 explored the contributions of the combined use of field trips, mobile learning, collaborative learning, and paper-and-pencil note taking in authentic environments in fostering systems thinking competence. The findings indicate that the above learning approaches and the real-world environment facilitate the meaningful engagement of learners and contribute to enhancing learners' systems thinking competence. Such approaches create enabling environment for collaboration and collective solutions to pressing global sustainability challenges. These findings extend the constructivist learning literature in the context of developing SCs by calling for the simultaneous use of a combination of innovative learning approaches in real-world environments. The findings also have implications for the systems thinking discourse by indicating the learning approaches and environments that help to enhance this competence.

Implications for policy and practice

In addition to the above theoretical implications, the findings of this dissertation contribute to policy and practice in sustainable development and education areas. The dissertation is hoped to help relevant stakeholders to realize the urgency of global sustainability issues. Specifically, the findings have implications for the SDGs, for education and training in sustainable development, the role of stakeholders including policymakers, teachers, and students.

The SCs identified in this dissertation may serve as a starting point in designing education and training in sustainability. The SCs may serve as intended learning outcomes of education and training and development programs for sustainability.

Regarding the SDGs, reports indicate that the world is not on track to achieving these global goals. Among the different factors for this unsatisfactory performance could be the underperformance of the education sector. If this sector is to contribute to a more sustainable future, focusing on the preparation of future sustainability change agents by equipping all higher education students with SCs is crucial. This new focus requires the higher education system to devise and implement several changes. Hence, policymakers and other stakeholders should recognize the urgency of sustainability issues, the potential role of the education sector, and make the necessary policy and implementation frameworks to create an enabling environment to achieve national and global sustainability goals.

Among the policy and practice implications of the findings is the importance of carefully reviewing the relevance of an education system to the worldviews and priorities of the society where the learning happens. A relevant education system contributes to helping societies achieve their social, environmental, and economic priorities. Such an education system contributes by producing people who are aware of the priorities and equipped with the relevant skills, and attitude, i.e., sustainability change agents.

The findings of the study in Chapter 3 suggest the importance of utilizing IK to develop SCs of learners. The use of IK also helps in perpetuating IK-related practices. Furthermore, the recognition of IK has a positive psychological contribution to the respective communities as their local languages, content, and scholars are valued and utilized.

However, the successful integration of IK and modern education requires anticipating and preparing for possible challenges. The assumption that IK is less important than the dominant Western/modern education is one of the challenges that hinder institutionalizing and utilizing IK. Therefore, the readiness of sustainable development and education stakeholders to challenge such assumptions and embrace IK is an important factor if an education system is to benefit from IK.

The thesis proposes possible ways of addressing these challenges and integrating IK and modern education to enhance the relevance and effectiveness of education in enhancing the SCs of learners.

Limitations and suggestions for future research

The findings of the studies in this dissertation are intended to contribute to the efforts of addressing major global challenges such as climate change, inequality, and poverty. However, there are several limitations in the studies. The dissertation pinpoints and discusses the limitations to indicate what future studies could address and how they may complement the findings of this dissertation. Hence, this section discusses the limitations of the studies related to the identification and fostering of SCs.

Chapter 2 identified SCs required for the Ethiopian context. In this study, experts who are familiar with the context and who have expertise in sustainable development participated. The nature of the study in this chapter does not lend itself to the generalization of the findings to other contexts beyond the Ethiopian context. Further research involving multiple countries is required to come up with SCs that are relevant in different contexts. Yet, as the SCs taken from mainly Western contexts were found to be relevant to the Ethiopian context, the findings indicate the possibility of a wider relevance of some SCs. Further research in multiple countries with different socioeconomic features is recommended to determine whether (or which) SCs have universal/wider relevance.

In Chapter 3, which explored the contributions of identifying and integrating IK in modern education focusing on sustainability, the IK and education systems were not directly studied. The study depended on the inputs from participants in the study (i.e., people with expertise in the fields of modern education and sustainability). To address this limitation, future studies that examine IK and sustainable development by directly involving experts in the Ethiopian indigenous education system and IK are recommended.

Chapter 4 explored the contributions of a combination of multiple innovative learning approaches in fostering systems thinking competence of learners. Only 36 students of the Bachelor of Arts program in Geography and Environmental Studies at Addis Ababa University, in Ethiopia, participated in the study. Hence, the results cannot be concluded about all fields at the University. As students of all fields should be prepared to become future sustainability change agents, future studies that include students from multiple disciplines are recommended.

To conclude, sustainability challenges are complex. The collaboration of several stakeholders and the use of diverse worldviews are required to address them. Identifying and fostering SCs is important to facilitate the decisions and actions of different professionals to promote sustainability. The studies in this dissertation identified 15 SCs for the Ethiopian context. Enhancing SCs of higher education students, future sustainability change agents, is crucial to help them to play their role toward a more sustainable future. In this regard, improvements of modern education systems and integration of IK are recommended in this dissertation.

Nederlandse samenvatting

Introductie

De mensheid staat voor veel en veelomvattende uitdagingen. Voorbeelden daarvan zijn klimaatverandering, ongelijkheid, armoede, conflicten en gebrek aan onderdak, water, voedsel, voedingsstoffen, medicijnen en sanitaire voorzieningen. Het werken aan oplossingen voor deze uitdagingen vraagt om de inzet van diverse groepen stakeholders met verschillende achtergronden. In de wetenschappelijke literatuur worden deze uitdagingen wel duurzaamheidsvraagstukken genoemd (Katundu, 2019; Rieckmann, 2012; Wiek et al., 2011).

Ook grote, internationale organisaties, zoals de Verenigde Naties (VN), wijzen op bovenstaande wereldwijde uitdagingen. Derhalve ontwikkelen zij internationale strategische raamwerken om deze uitdagingen te adresseren. Zo heeft de VN de duurzame ontwikkelingsdoelen, ofwel de Sustainable Development Goals (SDGs) opgesteld. Deze SDGs omvatten 17 doelen en 169 doelstellingen, die gaan over zowel sociale, omgevingsgerichte en economische vraagstukken. Vastgesteld is dat de doelen in 2030 moeten zijn bereikt (United Nations, 2015). Een andere internationale uitdaging betreft de klimaatverandering. In dat kader is het klimaatakkoord van Parijs opgesteld. Volgens dit akkoord mag de aarde niet meer dan 2°C opwarmen.

Recente onderzoeksrapporten tonen echter aan dat noch de voortgang van de SDGs, noch het klimaatakkoord van Parijs, op schema liggen om de gestelde doelen op tijd te halen (United Nations, 2020; United Nations Environment Programme, 2020). Deze rapporten laten zien dat alle stakeholders harder moeten werken om de doelstellingen te halen, ofwel een meer duurzame toekomst te realiseren.

Zowel in wetenschappelijk onderzoek als internationale initiatieven op het gebied van duurzame ontwikkeling, zoals de SDG's, wordt het belang van het hebben van bepaalde individuele competenties onderkend. Deze competenties faciliteren de inzet van mensen om te leren omgaan met genoemde sociale, omgevingsgerichte en economische vraagstukken van de huidige en toekomstige generaties. Dit zijn zogenaamde duurzaamheidscompetenties (DCs), waarbij een competentie wordt gezien als een integratie van kennis, vaardigheden en houding. Dit proefschrift benadert duurzame ontwikkeling vanuit het oogpunt van competenties en focust derhalve op het identificeren en ontwikkelen van duurzaamheidscompetenties die individuen in bedrijven, wetenschap, overheid en non-gouvernementele organisaties (NGO's) moeten bezitten om te kunnen bijdragen aan duurzame ontwikkeling.

In de literatuur zijn voor zogenaamde change agents verschillende lijsten met DCs ontwikkeld. Met change agents worden mensen bedoeld die initiatieven nemen en voortgang realiseren als het gaat om duurzame ontwikkeling. Echter, de meeste studies over DCs hebben een Westerse oriëntatie. Derhalve is het onduidelijk in hoeverre landen aan de onderkant van de inkomenspyramide andere competenties vereisen (Rieckmann, 2012; Sterling et al., 2017). De onderkant van de inkomenspyramide verwijst naar landen met bepaalde socio-economische kenmerken, zoals een laag inkomen per inwoner, een beperkte infrastructuur en een relatief hoog percentage van de bevolking dat in rurale gebieden woont. Verder schieten genoemde internationale raamwerken, zoals de SDGs, vaak te kort als het gaat om het opnemen inheemse kennis (IK) (Cummings et al., 2018). Dit beperkt de potentiële bijdrage van niet-Westerse oriëntaties, IK en duurzaamheidspedagogiek aan de discussie over DCs.

Studenten in het hoger onderwijs (HO), ofwel de toekomstige change agents, kunnen helpen om stappen te zetten naar een meer duurzame ontwikkeling als zij DCs ontwikkelen. Onderwijs speelt een belangrijke rol bij het ontwikkelen van deze change agents. In navolging van deze constatering en als reactie op de huidige

wereldwijde duurzaamheidsuitdagingen, is in verschillende landen een groeiend aantal duurzaamheidsgerelateerde programma's ontstaan in het HO (Brundiers et al., 2020; Salovaara et al., 2020; Wiek et al., 2011).

Een van de competenties die belangrijk is voor duurzame ontwikkeling is 'systeemdenken'. Deze competentie faciliteert het begrip van de complexe relaties tussen de sociale, omgevingsgerichte en economische dimensies van duurzame ontwikkeling.

Innovatieve leerbenaderingen zijn bestudeerd die zijn gericht op het ontwikkelen van DCs. Echter, er is slechts in beperkte mate aandacht voor in hoeverre deze leerbenaderingen, waaronder authentieke leeromgevingen ook daadwerkelijk systeemdenken bevorderen.

Om de leemtes, zoals hierboven beschreven, te adresseren, bevat deze dissertatie empirische studies die voortbouwen op de Westerse georiënteerde literatuur, aangevuld met IK en ervaringen uit een niet-Westerse context, namelijk Ethiopië. De dissertatie heeft twee belangrijke doelen: ten eerste het identificeren van DCs voor een land aan de onderkant van de inkomenspyramide en ten tweede verkennen hoe deze competenties het beste kunnen worden ontwikkeld. Om deze doelen te bereiken, staan de volgende onderzoeksvragen centraal in deze dissertatie:

3. Welke duurzaamheidscompetenties zijn vereist in een land aan de onderkant van de inkomenspyramide (in dit geval Ethiopië) om bij te dragen aan een duurzamere wereld?

   3.1 In hoeverre zijn de duurzaamheidscompetenties, zoals vastgesteld in Westers georiënteerd onderzoeken ook relevant voor landen aan de onderkant van de inkomenspyramide?

   3.2 Welke specifiek duurzaamheidscompetenties zijn relevant voor duurzaamheidsprofessionals in landen aan de onderkant van de inkomenspyramide?

4. Hoe kunnen studenten, de toekomstige *change agents*, relevante duurzaamheidscompetenties ontwikkelen?

   4.1 Welke inheemse kennis kan worden benut om studenten in het hoger onderwijs duurzaamheidscompetenties te laten ontwikkelen?

   4.2 Hoe kan inheemse kennis worden opgenomen in het moderne hogere onderwijssysteem om duurzaamheidscompetenties te bevorderen?

   4.3 Welke leerbenaderingen bevorderen duurzaamheidscompetenties in het hoger onderwijs?

   4.4 In welke mate ondersteunt een combinatie van leerstrategieën (zoals samenwerkend leren, excursies, leren m.b.v. mobiele telefoons en/of pen-en-papier) in een authentieke context de ontwikkeling van de competentie 'systeemdenken'?

Belangrijkste resultaten

In Hoofdstuk 2 is met behulp van een Delphi-studie antwoord gegeven op de eerste onderzoeksvraag die gaat over welke duurzaamheidscompetenties belangrijk voor *change agents* zijn in de context van Ethiopië. Een eerste stap in deze studie is de ontwikkeling van een raamwerk voor DCs en dit is gedaan met behulp van Heiskanen et al. (2016), Osagie et al. (2014), Roorda (2013), and Wiek et al. (2011). Dit raamwerk omvat zeven DCs:

1. Systeemdenken
2. Disciplinaire competentie
3. Interpersoonlijke competentie
4. Actie-competentie
5. Anticiperen
6. Strategische competentie
7. Normatieve competentie

Door middel van Ethiopische duurzaamheidsexperts vanuit zowel de wetenschap als de industrie is de mate van relevantie van deze competenties voor *change agents* in de Ethiopische context bepaald. De resultaten van de Delphi-studie laten zien dat de zeven genoemde competenties relevant zijn in de Ethiopische context. In aanvulling daarop stelden de experts acht DCs voor die specifiek zijn voor de Ethiopische context op het gebied van:

1. Transdisciplinariteit
2. Flexibiliteit en continu leren
3. Communicatie en het verkrijgen van informatie
4. Stakeholder- en beleidscoördinatie
5. Bronnengebruik
6. Sociale gelijkheid en inclusie
7. Balanceren tussen de duurzaamheidsdimensies
8. Inheemse bronnen benutten.

In totaal zijn er 15 DCs vastgesteld die relevant zijn voor de Ethiopische context. Van deze competenties zijn systeemdenken en transdisciplinariteit door de experts aangemerkt als de meest belangrijke.

De studie zoals beschreven in Hoofdstuk 2 laat zien welke DCs relevant zijn voor een land aan de onderkant van de inkomenspyramide. In dergelijke landen vindt over het algemeen maar weinig onderzoek plaats. Bovendien laat Hoofdstuk 2 zien dat er universele DCs zijn. Ongeacht de sociale en economische kenmerken van een land zijn er DCs die overal van belang zijn.

Hoofdstuk 3 en 4 gaan in op de tweede onderzoeksvraag, inclusief de bijbehorende subvragen. Deze hoofdstukken richten zich op de vraag hoe toekomstige duurzame *change agents* DCs kunnen ontwikkelen.

Hoofdstuk 3 beschrijft een kwalitatieve studie met Ethiopische experts op het gebied van duurzame ontwikkeling en onderwijs. Dit hoofdstuk richt zich op de ontwikkeling van DCs en geeft antwoord op de tweede onderzoeksvraag en de subvragen 2.1-2.3. In dit hoofdstuk wordt de potentiële waarde van IK in combinatie met modern onderwijs in Ethiopië verkend; het gaat in op welke IK kan worden gebruikt en hoe

het kan worden geïntegreerd in het moderne hogere onderwijssysteem om DCs bij studenten te ontwikkelen. Verder verkent dit hoofdstuk leerbenaderingen en leeromgevingen die nodig zijn om de effectiviteit van DC-ontwikkeling bij studenten in een Westers geöriënteerde/moderne hoger onderwijs systeem te vergroten.

De resultaten van Hoofdstuk 3 laten zien dat het voor een onderwijssysteem dat toekomstige duurzame *change agents* op een effectieve en relevante manier wil opleiden, cruciaal is om IK en de diversiteit aan wereldbeelden op waarde te schatten en te gebruiken. De deelnemers aan de studie benadrukken dat een onderwijssysteem dat de wereldbeelden en de contextuele prioriteiten niet meeneemt, heel weinig relevantie heeft.

Verder laten de resultaten van Hoofdstuk 3 zien dat het moderne onderwijssysteem is geïmporteerd in Ethiopië, zonder dat het adequaat is gecontextualiseerd naar de relevante wereldbeelden en IK in de diverse Ethiopische gemeenschappen. Dit creëert een afstand tussen het onderwijs en de realiteit. Dat wat studenten leren in school is niet of nauwelijks verbonden met de realiteit in hun omgeving. Op basis van de lessen van IK en inheemse onderwijssystemen in de verschillende gemeenschappen, wordt gesuggereerd om de relevantie van het moderne onderwijssysteem te vergroten. Vooral de sterke kenmerken van de Ethiopische Orthodoxe Tewahedo Kerk worden aanbevolen. Deze kenmerken omvatten samenwerkend leren/peer support en het respecteren en gebruiken van de lokale taal, kennis en onderzoekers. Om het belang van de lokale gemeenschap te benadrukken wordt het voorbeeld van de Konso-gemeenschap genoemd. Deze gemeenschap heeft waardevolle holistische en inheemse competenties op het gebied van natuurbeheer, die nu niet of nauwelijks in moderne onderwijsprogramma's aan bod komen.

Het huidige moderne onderwijssysteem in Ethiopië bestaat voornamelijk uit klassikaal en frontaal onderwijs met weinig verbinding met de samenleving. Dit beperkt de studenten in hun kansen om betrokken te zijn in betekenisvolle leerprocessen. Om deze kansen te vergroten, is het cruciaal dat studenten gaan samenwerken met de lokale gemeenschappen om op deze manier betrokken te raken bij betekenisvolle kennisconstructie en zo hun leren te verbreden naar en verbinden met de samenleving.

Bovendien moet het moderne hoger onderwijssysteem de IK en onderwijssystemen in Ethiopië beter benutten. Derhalve zijn vijf onderwijsontwerpprincipes geformuleerd: 1) benoem de wereldbeelden, 2) gebruik inheemse kennis (IK), 3) gebruik een pedagogiek die gebaseerd is op duurzaamheid, 4) betrek studenten bij de ontwikkeling en 5) bouw voort op de ervaring van studenten. De resultaten laten zien dat de ontwerpprincipes de inclusie van IK faciliteren en de relevantie van het onderwijssysteem om DCs te ontwikkelen, vergroten.

Voortbouwend op de resultaten van Hoofdstuk 2 en 3, komt in Hoofdstuk 4 onderzoeksvraag 2 en subvraag 2.4 aan de orde. In dit hoofdstuk is met behulp van een experiment onderzocht welke leeractiviteiten in een authentieke context goed werken als het gaat om het ontwikkelen van de competentie 'systeemdenken' bij studenten. Derdejaars BSc studenten van de afdeling Geografie en Omgevingswetenschappen van Addis Ababa Universiteit uit Ethiopië namen deel aan de studie. De interventie bestond uit een excursie in combinatie met samenwerkend leren. Een groep van studenten maakte gebruik van mobiele telefoons, de andere groep werkte met pen en papier. De interventie stelde de studenten in staat om betrokken te zijn in een betekenisvol leerproces. De combinatie van leeractiviteiten in een authentieke context ondersteunt de ontwikkeling van systeemdenken bij studenten, zowel in de groep die werkte met mobiele telefoons als de groep die werkte met pen en papier. De authentieke leeromgeving maakte dat de studenten meer gingen samenwerken. Dit versterkte vervolgens de erkenning van de complexe relaties tussen sociale, omgeving- en economische systemen.

Theoretische bijdrage

Raamwerk voor duurzaamheidscompetenties

De resultaten van het onderzoek in dit proefschrift dragen bij aan het theoretische debat over duurzame ontwikkeling, competenties in het algemeen, DCs in het bijzonder en de rol van IK.

Sterling et al. (2017) geven aan dat er een schaarste is aan studies over DCs in ontwikkelende economieën. Het debat over DCs wordt gedomineerd door Westerse of Eurocentrische studies (Rieckmann, 2012).

Hoofdstuk 2 identificeert DCs die relevant zijn voor landen aan de onderkant van de inkomenspyramide ofwel landen waar andere socio-economische kenmerken gelden dan in de Westerse context. Dit proefschrift vult de literatuur over DCs aan met het verkennen van de mate van context-specificiteit van competenties. De resultaten zoals gepresenteerd in Hoofdstuk 2 laten zien dat er DCs zijn die universeel zijn, ongeacht de sociale of economische verschillen tussen contexten. Aangezien competenties worden gezien als context afhankelijk, heeft deze bevinding ook implicaties voor de competentietheorie.

Onderwijs voor duurzame ontwikkeling en het ontwikkelen van DCs

De resultaten uit Hoofdstuk 3 en 4 hebben implicaties voor de kennis over IK, duurzaamheid en onderwijs voor duurzame ontwikkeling. De resultaten laten zien dat modern onderwijs kan profiteren van de IK van de verschillende lokale gemeenschappen in Ethiopië. Zoals het voorbeeld van de kennis over natuurbeheer en inheemse ecologische kennis. Deze resultaten bevestigen de opvattingen in de duurzaamheidsliteratuur die erkennen dat IK invloed heeft op duurzame ontwikkeling (Berkes et al., 2000; Boiral et al., 2020; Guerrero-Gatica et al., 2020; Rist et al., 2010). Bovendien suggereren de resultaten dat om de relevantie en de effectiviteit van educatie voor duurzame ontwikkeling te vergroten, het waarderen en benutten van de lokale talen, kennis en onderzoekers goed kan worden geleerd van het onderwijssysteem van de inheemse Ethiopische Orthodoxe Tewahedo Kerk. Als zodanig verrijken de resultaten het discours over IK en educatie voor duurzame ontwikkeling door te suggereren dat competentie-ontwikkeling wordt versterkt door het omarmen van pluralistische benaderingen waarin ruimte is voor diverse wereldbeelden. Deze bevindingen bevestigen eerdere onderzoeken dat het belangrijk is om wereldbeelden de ruimte te geven als het gaat om educatie voor duurzame ontwikkeling (Reed et al., 2007; Van Opstal & Hugé, 2013). Hoofdstuk 3 gaat verder in op manieren om IK te integreren in het moderne onderwijssysteem om DCs te ontwikkelen. Het laat zien dat als elementen van IK worden geïntegreerd in het moderne onderwijssysteem, het gebruik van IK wordt versterkt. In tegenstelling tot Westers of modern onderwijs wat veelal wordt gezien als reductionistisch, wordt IK gezien als holistisch (Haigh, 2005; Johnson, 1992; Kaya & Seleti, 2014).

In Hoofdstuk 4 is verkend in hoeverre de combinatie van samenwerkend leren, excursies, leren m.b.v. mobiele telefoons of pen en papier in authentieke contexten, bijdraagt aan de ontwikkeling van systeemdenken. De resultaten laten zien dat de combinatie van de genoemde leeractiviteiten in de authentieke omgeving betekenisvol leren bevordert en derhalve de ontwikkeling van de competentie systeemdenken. Deze combinatie van leeractiviteiten creëert een omgeving waarin studenten worden aangemoedigd om samen te werken aan oplossingen voor belangrijke duurzaamheidsuitdagingen. Deze resultaten bouwen de literatuur over het constructivisme en leren voor duurzame ontwikkeling verder uit door het belang te benadrukken dat innovatieve leeractiviteiten in combinatie met authentieke omgevingen bijdragen aan de ontwikkeling van systeemdenken. De resultaten hebben ook implicaties voor de discours omtrent systeemdenken, door te laten zien welke combinatie van leeractiviteiten werkt om deze competentie te ontwikkelen.

Implicaties voor beleid en praktijk

Naast theoretische implicaties, hebben de resultaten van dit proefschrift ook implicaties voor beleid en praktijk als het gaat om educatie voor duurzame ontwikkeling. Met dit proefschrift wordt gehoopt dat relevante stakeholders zich bewust worden van de noodzaak van de wereldwijde duurzaamheidsvraagstukken. In het bijzonder hebben de resultaten implicaties voor de SDGs, voor onderwijs voor en training in duurzame ontwikkeling en de rol van stakeholders waaronder beleidsmakers, docenten en studenten.

De DCs zoals vastgesteld in dit proefschrift kunnen dienen als uitgangspunt voor de ontwikkeling van onderwijs in en trainingen voor duurzame ontwikkeling. De DCs kunnen worden gebruikt als leerdoelen voor programma's die gericht zijn op duurzame ontwikkeling.

Voor wat betreft de SDGs en de constatering dat de wereld niet op schema ligt om de klimaatdoelstellingen te behalen, is het onderwijs een belangrijke factor om deze presentaties te verbeteren. Onderwijs kan bijdragen aan een meer duurzame toekomst als alle studenten worden opgeleid om hun rol als duurzame *change agent* te vervullen. Dit vereist dat het hoger onderwijssysteem veranderingen doorvoert. Beleidsmakers en andere stakeholders in en rond het hoger onderwijs moeten de urgentie van duurzame ontwikkeling onderkennen, moeten zich bewust worden van de cruciale rol van het hoger onderwijs om bij te dragen aan deze uitdagingen en het benodigde beleid opstellen om een omgeving te creëren waarin zowel nationale en wereldwijde duurzaamheidsdoelstellingen kunnen worden bereikt.

Naast deze praktische en beleidsmatige implicaties, moeten worden bekeken hoeverre onderwijssystemen ruimte laten voor de verschillende wereldbeelden en de prioriteiten die van belang zijn voor de lokale gemeenschappen waarin het leren plaatsvindt. Een relevant onderwijssysteem draagt bij aan het helpen van de (lokale) gemeenschap om hun sociale, omgevings- en economische doelen te behalen. Een dergelijk onderwijssysteem leidt mensen op die zich bewust zijn van de lokale prioriteiten en rust hen uit met kennis, vaardigheden en houdingen die een duurzame *change agent* nodig heeft.

De resultaten van Hoofdstuk 3 laten de belangrijke rol van IK zien als het gaat om het ontwikkelen van DCs. Het gebruik van IK helpt om IK en inheemse praktijken te laten voortbestaan. Bovendien heeft het erkennen van het nut van IK een positieve psychologische invloed op lokale gemeenschappen omdat zij zien dat hun lokale taal, kennis en deskundigheid worden gewaardeerd en benut.

Desalniettemin, moet bij de integratie van IK in het moderne onderwijs rekening worden gehouden met mogelijke uitdagingen. De stellige aanname dat IK minder belangrijk is dan de dominante Westerse of moderne aanpak in het onderwijs, hindert de institutionalisatie en het gebruik van IK. Daarom is het belangrijk dat stakeholders in het onderwijs voor duurzame ontwikkeling bereid zijn om dergelijke assumpties te weerleggen en IK te omarmen; dan krijgt IK een eerlijke kans in het onderwijssysteem. Dit proefschrift toont verschillende manieren om deze uitdagingen aan te gaan en IK te integreren in het moderne hoger onderwijssysteem met als doel om de relevantie en effectiviteit van DC-ontwikkeling te vergroten.

Beperkingen en aanbevelingen voor verder onderzoek

Dit proefschrift heeft de intentie om bij te dragen aan de wereldwijde duurzaamheidsuitdagingen zoals klimaatverandering, ongelijkheid en armoede. Natuurlijk kent dit proefschrift zijn beperkingen. Deze sectie beschrijft hoe deze beperkingen de resultaten van dit proefschrift bepalen en wat de adviezen zijn voor toekomstig onderzoek.

In Hoofdstuk 2 zijn de DCs voor de Ethiopische context vastgesteld. Deelnemers aan deze studie waren experts die bekend zijn met de Ethiopische context en/of die expertise hebben op het gebied van duurzame ontwikkeling. De opzet van deze studie leent zich er echter niet voor dat de resultaten kunnen worden gegeneraliseerd naar andere contexten dan de Ethiopische. Verder onderzoek waarin meerdere landen worden betrokken is nodig om vast te stellen welke DCs relevant zijn voor andere of meerdere contexten. De overwegend Westerse DCs blijken ook relevant voor de Ethiopische context en derhalve mag worden verwacht dat deze relevant zijn voor een bredere context dan Ethiopië. Echter, aanbevolen wordt om verder onderzoek te doen in landen met verschillende socio-economische kenmerken om vast te stellen of, en zo ja welke, DCs universeel zijn of in ieder geval relevant zijn in meerdere contexten.

In Hoofdstuk 3 waarin de bijdrage van het identificeren en integreren van IK in modern hoger onderwijs is verkend, zijn IK en het onderwijssysteem zelf niet bestudeerd. De studie leunt op de inbreng van de deelnemers aan het onderzoek. Deze deelnemers hebben expertise op het gebied van modern onderwijs en onderwijs voor duurzame ontwikkeling. Voor toekomstige studies is het aan te bevelen om experts te betrekken op het gebied van IK en Ethiopische inheemse onderwijssystemen.

Hoofdstuk 4 gaat in op de bijdrage die een combinatie van innovatieve leeractiviteiten kan leveren aan de ontwikkeling van de competentie systeemdenken. Slechts 36 studenten van de BSc Geografie en Omgevingswetenschappen van de Addis Ababa Universiteit in Ethiopië namen deel aan deze studie. De resultaten laten zich dan ook in beperkte mate generaliseren naar andere disciplines binnen de universiteit. En aangezien het doel is dat alle studenten zich ontwikkelen tot duurzame *change agents*, is het aan te bevelen dat toekomstige studies studenten includeren van verschillende disciplines.

Concluderend, duurzaamheidsuitdagingen zijn complex. Het werken aan deze uitdagingen vereist dat verschillende stakeholders samenwerken en dat uiteenlopende wereldbeelden worden omarmd. Het identificeren en ontwikkelen van DCs is belangrijk voor professionals om beslissingen en acties te kunnen nemen die de duurzaamheid een stap verder brengen. De studies in dit proefschrift stelden 15 DCs vast, die belangrijk zijn voor de hoger onderwijscontext in Ethiopië. Het ontwikkelen van deze DCs voor studenten in het hoger onderwijs, de toekomstige duurzame *change agents*, is cruciaal om hen te helpen deze rol op zich te nemen. Op basis hiervan wordt aanbevolen om het huidige moderne onderwijssysteem te verbeteren en IK te integreren.

ማጠቃለያ በአማርኛ

መግቢያ

ይህ ጥናት ያተኮረው ከምዕራባውያንና ከምዕራባውያን ውጪ የተገኙ ልምዶችን በማጣመር ዘላቂ ልማትን ለማረጋገጥ የሚያስፈልጉ ብቃቶችን ለይቶ ማውጣና ማዳበር ላይ ነው።

የሰው ልጅ በአየር ንብረት ለውጥ፤ በእኩልነት መጓደል፤ በድህነትና በግጭት እንዲሁም በማጠፋያ፤ በመጣጥ ውሃ፣ በተመጣጠነ ምግብ፤ በመድሃኒትና በግል ንጽህና መጠበቂያ እቃት ከባባድ ተግዳሮቶች እየገጠሙት ነው። ለእነዚህ ተግዳሮቶች መፍትሄ ለማበጀት ከልዩ ልዩ የሙያ ዘርፎችና የኗላፊነት ደረጃዎች የተውጣጡ ባለድርሻ አካላት የተቀናጀ ጥረት ያስፈልጋል። በሰፊንሳዊ ጥናትና ምርምሮች ከላይ የተዘረዘሩት የሰው ልጅን የገጠሙት ተግዳሮቶች የዘላቂ ልማት ጉዳዮች ተደርገው ተለይተዋል (Katundu, 2019; Rieckmann, 2012; Wiek et al., 2011)።

በተመሳሳይ መልኩ፣ እንደተባባሩት መንግሥታት ድርጅት (የተመድ) ያሉ ዋና ዋና ዓለም አቀፍ ድርጅቶችም እነዚህን ችግሮች ዓለም አቀፋዊ የዘላቂ ልማት ማነቆዎች ናቸው በማለት ተግዳሮቶቿን ለመቅረፍ ስትራቴጂያዊ ማዕቀፎችን ነድፈዋል። ከእንዲህ አይነት ማዕቀፎች መካከልም የተመድ የዘላቂ ልማት ግቦች ተጠቃሽ ናቸው። 17 ወሳኝ የዘላቂ ልማት ግቦች የተከተቡበት የተመድ ዝግጅት በውስጡ አካባቢያዊ ማሕበራዊና ምጣኔ ሀብታዊ ጥያቄዎችን የሚመልሱ 169 ተብተራ ዒላማዎችን ይዘዋል። ግቦቹ እንደ አውሮፓውያን አቆጣጠር በ2030 ዓ.ም ይደረስባቸዋል ተብለው የተነደፉ ናቸው (United Nations, 2015)። ሌላው ጉልህ የዓለም አቀፍ ማዕቀፍ የአየር ንብረት ለውጥን ለመከላከል የተወሰደውና የዓለም የሙቀት መጠን መጨመርን ከ2 ዲግሪ በታች እንዲገደብ ለማድረግ የታለመው የፓሪስ ስምምነት ነው።

የዘላቂ ልማት ግቦቹንና የፓሪስ ስምምነትን ክንውን የገመገሙ የቅርብ ጊዜ ዘገባዎች እንደሚያሳዩት ግን ዓለማችን አሁን በተያዘው አካሄድ ከቀጠለች በታሰበው ጊዜ ውስጥ እነዚህን ግቦች ለማሳካት የምትችልበት ጎዳ ላይ አይደለችም (United Nations, 2020; United Nations Environment Programme, 2020)። የቅንውን ዘገባዎቹ እንደሚያመለክቱት ወደፊት ወደ ተሻለ ዘላቂ ልማት ለመደረስ በሁሉም ባለድርሻ አካላት መከናወን የሚገባቸው ብዙ ቀሪ ሥራዎች አሉ።

የዘላቂ ልማት ጥናቶችና እንደ ዓለም አቀፍ የዘላቂ ልማት ግቦች ያሉ ጥረቶች እንደሚያስገነዝበን፣ የዘመኑንና የወደፊቱን ትውልድ ማኅበራዊ፣ አካባቢያዊና ምጣኔ ሀብታዊ ፍላጎቶች ለማሟላት የሚደረገውን ጥረት ለማሳለጥ ተለይተው የሚታወቁ ሰባባዊ ብቃቶች ወሳኝ ናቸው። እነዚህ ብቃቶች የዘላቂ ልማት ብቃቶች የሚባሉ ሲሆን ዕውቀትን፣ ክህሎትንና አመለካከትን አቀናጅተው የያዙ ናቸው። ይህ ጥናት ዘላቂ ልማትን ከእነዚህ ብቃቶች አንድር የመረመረ ነው። ጥናቱ በተለይም፣ በትልልቅ የንግድ ተቋማት፣ በትምህርት ተቋማት፣ በመንግሥታዊና መንግሥታዊ ባልሆኑ ድርጅቶች ውስጥ የሚሰሩ ግለሰቦች ዘላቂ ልማትን ለማረጋገጥ የሚያደርጉትን አስተዋጽኦ ከፍ ለማድረግ የሚያስችሏቸውን ብቃቶች መለየትና አንጥሮ ማውጣት ላይ ያተኩራል።

በዘላቂ ልማት ብቃቶች የምርምር ዘርፍ በርካታ ጥናቶች ለለውጥ ፈና ወጊዎች (ማለትም ለዘላቂ ልማት የሚያስፈልጉ ሃሳቦችን ለሚያመነጩና ለስኬታም የአስተባባሪነት ሚና ለሚጫወቱ ሰዎች) አስፈላጊ የሆኑ ብቃቶችን ለመለየት በርካታ ጥረቶች ተደርገዋል። ሆኖም፣ የዘላቂ ልማት ብቃቶችን በመለየትና በማጐልበት ላይ የተደረጉ አብዛኞቹ ጥናቶች የምዕራባውያን ንጽረተ ዓለም እና አውድ መሠረት በማድረግ የተሠሩ ናቸው። በመሆኑም በመደ ላይ ባሉ ሀገራት አውድ ዘላቂ ልማትን ለማረጋገጥ ምዕራባውያን ከሚያስፈልጓቸው የብቃት አይነቶች የተለዩ የብቃት ስብጥሮች ይኑሩ ወይም አይኑሩ ግልፅ አይደለም (Rieckmann, 2012; Sterling et al., 2017)። በመደ ላይ ያሉ ሃገሮች ዋና ዋና ማኅበራዊና ምጣኔ ሀብታዊ መገለጫዎች መካከል ዝቅተኛ አማታዊ የነፍስ ወከፍ ገቢ፣ ውስን የመሠረተ ልማት መዋቅር እና አብዛኛው የሕብረተሰቡ ክፍል የገጠር ነዋሪ መሆኑ ተጠቃሽ ናቸው። ከምዕራባውያን ዕውቀት የተለዩ እንደ ሀገር በቀል ዕውቀቶች ያሉ ሌሎች ጉዳዮችን ገሸሽ ማድረግማ የዘላቂ ልማት ግቦች ዝግጅትን በመሳሰሉ ዋና ዋና ዓለም አቀፍ የልማት

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ውጥኖች ላይ   የተተወዋሉ ውስንነቶች ናቸው(Cummings et al., 2018)። ይህም የምዕራባውያን ያልሆኑ ንጽረተ ዓለማት፣ የሀገር በቀል ዕውቀቶች እና የትምሀርት ሥርዓቶች ለዘላቂ ልማት ያላቸውን እምቅ አበርክቶት ይገድባል።

የዘሬዎቹን የከፍተኛ ትምሀርት ተማሪዎች (የወደፊት የዘላቂ ልማት ፈና ወጊዎችን) በዘላቂ ልማት ብቃቶች   ማስታጠቅ ወደ ዘላቂ ልማት የሚደረገውን ጉዞ ለማፋጠን በእጅጉ ይጠቅማል። የዘላቂ ልማት ፈና ወጊዎችን በማዘጋጀቱ ሂደት የትምሀርት ሚና ለሌ የሚባል አይደለም። ይህንን በሚገባ በመረዳት እና ለአነንብጋቢ ዓለም አቀፍ የዘላቂ ልማት ተዳሮኞች ምላሽ ለመስጠት፣ በትምሀርት ሥርዓታችን ውስጥ የዘላቂ ልማት ይዘቶችን እያካተተ ያለ የተለያየ ሀገራት የከፍተኛ ትምሀርት ተቋማት ቁጥር ከጊዜ ወደ ጊዜ እየጨመረ ነው (Brundiers et al., 2020; Salovaara et al., 2020; Wiek et al., 2011)።

ለዘላቂ ልማት ወሳኝ ከሆኑ ብቃቶች አንዱ ሥርዓታዊ መስተጋብሮችን የመረዳት ብቃት ነው። ይህ ብቃት የዘላቂ ልማትን   ውስብስብ አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ዘርፎች ትሥሥርን መገንዘብን ያሳብታል። የከፍተኛ ትምሀርት ተማሪዎች ይህንን የመሰሉ የዘላቂ ልማት ብቃቶችን እንዲያዳብሩ የሚረዳ አዳዲስ የትምሀርት አቀራረቦች የቷቹ እንደሆነ ለመለየት የተለያየ ምርምሮጮ ተደርገዋል። ይህንና የዘላቂ ልማት ዘርፎችን ውስብስብ ሥርዓታዊ መስተጋብሮች የመረዳት ብቃትን ለማዳበር፣ ብርቶ የትምሀርት አቀራረብችንን አጣምሮ መጠቀም እና ትምሀርትን በእውኑ አውድ ውስጥ (ማለትም፣ ከመማሪያ ክፍል ውጪ በገሃዱ ዓለምሃላም) እ ያሳተፉ ማስተማር የሚኖሩን ፋይዳ የሚመረምሩ ጥናቶች ውስ ናቸው።

ይህም ጥናት የተሰራው ከላይ የተጠቀሱትን ክፍተቶች በመሙላት ረገድ አስተዋጽኦ ለማበርከት ነው። ለዚህ ዓለማ ሲባል በአብዛኛው በምዕራባውያን ልምድ ላይ ተመሥርተው የተጠኑ የምርምር ጽሁፎችን እንዳ መነሻ በመውሰድና ምዕራባዊ ካልሆኑ ሀገር በቀል ዕውቀቶች፣ በተለይም ከኢትዮጵያ ልምድ ጋር በማጣመር የተደረገ ጥናት ነው፡   የዚህ ጥናት ዋና ዋና ዓላማዎች በማደግ ላይ ያለ ሀገርር ዘላቂ ልማትን ለማሪገገጥ የሚያስፈልጋቸውን ብቃቶች ለይቶ ማውጣት እና የእነዚህን ብቃቶች ማጎልቢቻ ዘዴዎች መፈተሽ ናቸው። እነዚህን ዓላማዎች ለመሳካት የሚከተሉት የምርምር ጥያቄዎች ተዘጋጅተዋል:-

5. ኢትዮጵያን ለመሰሉ በማደግ ላይ ላሉ ሀገሮች ዘላቂ ልማትን ማሪገገጥ የሚያስችሏቸው ብቃቶች የቷቹ ናቸው?
   5.1 በበለፁ ሀገሮች አውድ ዘላቂ ልማትን ለማሪገገጥ ተገቢ ናቸው ተብለው ቀደም በተሰራ ምርምሮች የተለዩ ብቃቶች በማደግ ላይ ላሉ ሀገር ተጨባጭ ሁኔታዎች ያላቸው ተገቢነት ምን ያህል ነው?
   5.2 በማደግ ላይ ላሉ ሀገር ተጨባጭ ሁኔታ ዘላቂ ልማትን ለማሪገገጥ ለሚሩ ባለሙያዎች አስፈላጊ የሆኑ ብቃቶች የቷቹ ናቸው?
6. የዘሬዎቹን የከፍተኛ ትምሀርት ተማሪዎች (የወደፊትቷን የዘላቂ ልማት ፈና ወጊዎች) የዘላቂ ልማት ብቃቶች እንዴት ማዳበር ይቻላል?
   6.1 የከፍተኛ ትምሀርት ተማሪዎችን የዘላቂ ልማት ብቃቶች ለማጎልበት የቷቹን ሀገር በቀል ዕውቀቶች መጠቀም ይቻላል?
   6.2 የዘላቂ ልማት ብቃቶችን ለማጎልበት በዘመናዊ የከፍተኛ ትምሀርት ሥርዓት ውስጥ የሀገር በቀል ዕውቀትን እንዴት ማካተት ይቻላል?
   6.3 የትቷቹ የትምሀርት አቀራረቦች የከፍተኛ ትምሀርት ተማሪዎችን የዘላቂ ልማት ማሪገገጫ ብቃቶች ለማዳበር ያግዛሉ?
   6.4 በርካታ የማስተማሪያ አቀራረቦችን አጣምሮ መጠቀም (ማለትም በመተባበር መማማር፣ የመስክ ጉብኝቶች፣ በዘመናዊ ተንቀሳቃሽ ስልኮች መማማር እንዲሁም በጽሁፍ ማስታወሻ መያዝ) አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ የዘላቂ ልማት ዘርፎችን ውስብስብ መስተጋቦሮችን የመረዳት ብቃትን ለማዳበር   ምን ያህል ውጤታማ ነው?

ዋና ዋና ግኝቶች

ምዕራፍ 2 ዴልፊ የተባለውን የምርምር ዘዴ በመጠቀም የምርምር ጥያቄ 1'ን ይመልሳል። ይኸውም፣ በኢትዮጵያ ተጨባጭ ሁኔታ የትኞቹ የዘላቂ ልማት ማረጋገጫ ብቃቶች እንደሚያስፈልጉ ትኩረት በማድረግ መልስ ሰጥቷል። በዚህ ጥናት Heiskanen et al. (2016) 'ን, Osagie et al. (2014) 'ን, Roorda (2013) 'ን እና Wiek et al. (2011)'ን እንደ መነሻ በመጠቀም የዘላቂ ልማት ማረጋገጫ ብቃቶች ማዕቀፍ ተዘጋጅቷል። ይህ የዘላቂ ልማት ማረጋገጫ ብቃቶች ማዕቀፍ 7 የዘላቂ ልማት ብቃቶችን ያካተተ ነው። እነዚህም:-

1. ሥርዓታዊ መስተጋብሮችን የመረዳት ብቃት (የአካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ጉዳዮችን ውስብስብ ግንኙነቶች የመገንዘብ ብቃት)
2. በይነ ዲሲፕሊናዊ ብቃት (በእያንዳንዱ የሙያ ዘርፍ ውስጥ ለዘላቂ ልማት የሚያስፈልጉ ብቃቶች)
3. በይነሰባዊ ብቃት (ለዘላቂ ልማት የሚያስፈልጉ ተሳትፎዎችን ትብብርን የመሳለት ብቃት)
4. የመተግበር ብቃት (ለዘላቂ ልማት የሚያስፈልጉ ተግባራዊ እርምጃዎችን የመውሰድ ቁርጠኝነት ብቃት)
5. የቀድሞ- መተንበይ ብቃት (ወደፊት ሊገጥሙ የሚችሉ የዘላቂ ልማት ጉዳዮችን የመተንበይና መፍትሔዎችን የመሰናዳት ብቃት)
6. የአቅዶ-መተግበር ብቃት (ለዘላቂ ልማት የሚያስፈልጉ እርምጃዎችን የመቀድና አፈጻጸማቸውን የመረጋገጥ ብቃት)
7. የማስተናበር ብቃት (ለዘላቂ ልማት የሚያስፈልጉ አመለካከቶችን እና መርሆዎችን የመለየት ብቃት)

በኢትዮጵያ ተጨባጭ ሁኔታ ከላይ የተዘረዘሩት የዘላቂ ልማት ብቃቶች ለዘላቂ ልማት የለውጥ ፋና ወጊዎች ያላቸው አግባብነትና አስፈላጊነት በዘላቂ ልማት ከፍተኛ ባለሙያዎች ተመዝነዋል። ባለሙያዎቹ በኢትዮጵያ የትምህርት ተቋማት እንዲሁም በሌሎች መንግሥታዊና መንግሥታዊ ያልሆነ ድርጅቶች እንዲሁም በትላልቅ የንግድ ድርጅቶች ከዘላቂ ልማት ጋር ተያያዥነት ያላቸው ስራዎችን በመስራት ላይ የተሰማሩ ናቸው። የዚህ ጥናት ግኝት ሰባቱ የዘላቂ ልማት ማረጋገጫ ብቃቶች ለኢትዮጵያ ሁኔታ አስፈላጊ መሆናቸውን አመልክቷል። ባለሙያዎች ከሰባቱ ብቃቶች በተጨማሪም ለኢትዮጵያ አስፈላጊ ያሏቸውን ስምንት የዘላቂ ልማት ማረጋገጫ ብቃቶች ጠቁመዋል። እነዚህም:-

1. ዲጂታላዊን አቀፍ ብቃት (በተለያዩ የሙያዘርፍ ከሚሰፉ ባለሙያዎች ጋር ዘላቂ ልማትን ለማረጋገጥ ተባብሮ የመስራት ብቃት)
2. ዘመን ዋጅ ብቃት (የዘላቂ ልማት ጉዳዮች በፍጥነት የሚቀያየሩ መሆናቸውን መገንዘብና ቀጣይነት ባለው ሁኔታ ለውጡችን የሚመጥን የትምህርት ዝግጅቶችን የመድረግ ብቃት)
3. የተግባበት፣ መረጃ የማግኘትና የመጠቀም ብቃት (ስለሰበቱ የዘላቂ ልማት ዘርፎች ዕውቀት ማካበት እንዲሁም ስለማኅበራዊና አካባቢያዊ ጉዳዮች መረጃ የማሰባሰብና የመጠቀም ብቃት)
4. የፍትሃዊነትና የአካታችነት ብቃት (ማህበራዊ ፍትህ እና አካታችነትን ለማረጋገጥ የተለያዩ ቡድኖችን ፍላጎቶች እና እሴቶች (የወደፊት ትውልዶችን ጨምሮ) የመጠቀም፣ መቻቻልን እና ፍትሃዊ የሀብት ክፍፍልን የማሳደግ እንዲሁም አለመግባባትን በሰላም የመፍታት ብቃት)
5. የማቀናጀት ብቃት (ዘላቂ ልማትን ለማረጋገጥ ባለድርሻ አካላትን እንዲሁም ዓለም አቀፍ፣ ሀገር አቀፍና አካባቢያዊ ፖሊሲዎችን የማቀናጀት ብቃት)
6. የሀብት አጠቃቀም ብቃት (የቁስና የሰው ሀብቶችን ውጤታማ በሆነ አግባብ የመመደብ፣ የመጠቀም እና ለዚሁ የሚያግዙ ተቋሞችን የማዋቀር ብቃት)
7. የማመጣጠን ብቃት (የዘላቂ ልማት ምሰሶዎች የሆኑት አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ጉዳዮች ሊያገኙ የሚገባቸውን ትኩረት የማመጣጠን ብቃት)
8. ሀገር በቀል ዕውቀትንና ሃብትን ለዘላቂ ልማት የመጠቀም ብቃት ናቸው።

በአጠቃላይ 15 የዘላቂ ልማት ማረጋገጫ ብቃቶች ለኢትዮጵያ ተጨባጭ ሁኔታ አስፈላጊ ናቸው ተብለው ተለይተዋል።

በተጨማሪም፣ ምዕራፍ 2 በማደግ ላይ ካሉ ሃገሮች አንዱ በሆነችው በኢትዮጵያ የትኞቹ የዘላቂ ልማት ማረጋገጫ ብቃቶች ተገቢና አስፈላጊ እንደሆኑ አሳይቷል። በመሆኑም ዘላቂ ልማትን በሚመለከት ውስኑ ጥናቶች ብዥ ለተከናወኑበት በማደግ ላይ ለለ ሃገሮች አውድ ተጨማሪ የምርምር ውጤቶ አበርክቷል። እንዲሁም፣ የተለያዩ ሃገሮች ልዩ ልዩ ማኅበራዊና ምጣኔ ሀብታዊ ባሀሪያት ቢኖሯቸውም አንዳንዶቹ የዘላቂ ልማት ማረጋገጫ ብቃቶች በዓለም አቀፍ ደረጃ ተገቢና አስፈላጊ ሊሆኑ እንደሚችሉ የጥናቱ ግኝቶች ፍንጭ ሰጥተዋል።

ምዕራፍ 3 እና 4 "የዘሪዎቹን የከተተኛ ትምህርት ተማሪዎች (የወደፊቶቹን የዘላቂ ልማት ፈና ወጊዎች) የዘላቂ ልማት ብቃቶች እንዴት ማዳበር ይቻላል?" የሚለውን የምርምር ጥያቄ 2 እና ንዑስ ጥያቄዎቹን መልሰዋል።

በምዕራፍ 3 ኢትዮጵያ ውስጥ በዘላቂ ልማትና በትምህርት ዘርፍ የሰለጠኑ ባለሞያዎችን ያሰተፈ ጥልቅ ጥናት ተከናውኗል። ምዕራፉ የዘላቂ ልማት ማረጋገጫ ብቃቶችን ማጐልበት የሚቻልበት መንገድ ላይ በመተኮር የምርምር ጥያቄ 2ና ንዑስ ጥያቄዎችን ይመልሰዋል። በዚህ ምዕራፍ በኢትዮጵ ተጨባጭ ሁኔታ የተማሪዎችን የዘላቂ ልማት ብቃቶች ለማጐልበት የሀገር በቀል ዕውቀትን ከዘመናዊ ትምህርት ጋር በማጣመር የመጠቀም እምቅ አቅም ተንታ። በተጨማሪም፣ የዘላቂ ልማት ብቃቶችን ከማዳበር አኳያ ሀገር በቀል ዕውቀት በዘመናዊ የከተተኛ ትምህርት ሥርዓት መካተት የሚችልበትን መንገዶች ተመላክተዋል።

ከላይ ከተጠቀሰት በተጨማሪ፣ ምዕራፉ የምዕራባውያን/ የዘመናዊ ከፍተኛ ትምህርት ተማሪዎችን የዘላቂ ልማት ማረጋገጫ ብቃቶች ከማሳደግ አንጻር ያለውን አግባብነትና እና ውጤታማነት ለማጐልበት የሚያስፈልጉ የትምህርት አቀራረቦችና ተዘዛጅ ሁኔታዎችንም መርምሯል።

የጥናቱ ግኝቶች እንደሚያመለክቱት አንድ የትምህርት ሥርዓት የወደፊት የዘላቂ ልማት ፈና ወጊዎችን የዘላቂ ልማት ብቃቶች በማጐልበት ስኬታማ እንዲሆን እና ትምህርት ለተማሪዎች አግባብነት እንዲኖሩው ከስፈለገ፣ ለሀገር በቀል ዕውቀትና ተማሪዎች ለመጡባቸው ማህበረሰቦች ንጽረተ ዓለማት ዋጋ መስጠትና መጠቀም በጣም አስፈላጊ ነው። የዚህ ጥናት ተሳታፊዎች አጽንኦት የሰጡት ጉዳይ ተማሪዎች የመጡባቸውን ማህበረሰቦች ንጽረተ ዓለማት እና ማህበረሰቦች ዋጋ የሚሰጧቸውን ጉዳዮች ቸል ያለ የትምህርት ሥርዓት እምብዘም ጠቀሜታ እንደሌለው ነው።

በምዕራፍ 3 ጥናት የተገኙት ግኝቶች እንደሚያመለክቱት በኢትዮጵያ ውስጥ ያለው የዘመናዊ ትምህርት ሥርዓት ከአገሪቱ ተጨባጭ ሁኔታና ኢትዮጵያዊ ንጽረተ ዓለማት ጋር በተገቢው መንገድ እንዳልተዘመድ ሳይደረግና በኢትዮጵያ ውስጥ ያሉ የተለያዩ ማኅበረሰቦች ያላቸውን ሀገር በቀል ዕውቀቶች ሳያካትት ከውጪ ሃገሮች የገባ ነው። እነዚህ ሌሎች ምክንያቶች ተማሪዎች በትምህርት ቤቶች የሚማሩት ትምህርት ይዘት በአካባቢያቸው ካለው እውነታ ጋር ብዙዙም የሚዛመድ እንዳይሆን አድርገዋል። የዘመናዊውን የትምህርት ሥርዓት ተገቢነት ለማሳደግ በተለያዩ የኢትዮጵ ማህበረሰቦች ውስጥ ካለ ሀገር በቀል ዕውቀቶች እና ከሀገር በቀል የትምህርት ሥርዓቶች የመማር አስፈላጊነት ተመላክቷል። በተለይ የኢትዮጵ ኦርቶዶክስ ተዋሕዶ ቤተ ክርስቲያን የሀገር በቀል ትምህርት ሥርዓት ጠንካራ ልምዶች እንዲካተቱ ምክር ሀሳብ ተሰንዝሯል። እነዚህም በጋራ የመማር/የአቻ ድጋፍን፣ ኢትዮጵያዊ ቋንቋዎችን፣ የትምህርት ይዘትን እና ምሁራንን ማክበር እና መጠቀምን ያካትታል። በተጨማሪም የንጉሥ ሀዝብ ሁለንተናዊ እና ሀገር በቀል የፈጥሮ ሀብት አስተዳደር ብቃትን ከመሳሰሉ ከተለያዩ ማህበረሰቦች የትምህርት ይዘትን የመጠቀም አስፈላጊነት ትኩረት ተሰጥቷታል።

የምዕራፍ 3 ግኝቶች እንደሚያመለክቱት የኢትዮጵያን ዘመናዊ የትምህርት ሥርዓት ከሚገልጿቸ ባሀሪያት ውስጥ ትምህርት ከአካባቢው ማህበረሰቦች ጋር ውስጥ ግንኙነት ያለው መሆኑ፣ በመማሪያ ክፍሎች ውስጥ ብቻ የተገደና የመምህራን ገለጻና ትንታኔ የአንስሶ ውን ድርሻ የሚይዝበት አካሄድ መሆኑ ዋና ዋናዎቹ ናቸው። እነዚህ ሁኔታዎች የተማሪዎችን በመማር-ማስተማር ሂደት ትርጉም ባለው መልኩ የመሳተፍ ዕድሎች ይገድባሉ። ለእነዚህ በትምህርት ሥርዓት ለሚታዩ ውስንነቶች መፍትሄ ለመስጠት የተማሪዎች ትብብርን ማነቃቃት እና በዕውቀት ግንባታ ሂደት ውስጥ ትርጉም ባለው መልኩ እንዲሳተፉ ማስቻል፣ እንዲሁም ትምህርትን ከተለያዩ ማኅብረተሰቦች ጋር ተዘዛጅ እንዲሆን በሚያስችሉ የመማር ማስተማር አቀራረብ ተገባራዊ ማድረግ በጣም አስፈላጊ ነው።

በተጨማሪም፣ የኢትዮጵያን ሀገር በቀል ዕውቀቶች እና ሀገር በቀል የትምህርት ሥርዓቶችን መጠቀም የሚያስችሉ አምስት የትምህርት ንድፍ መርሆዎች በዚህ ጥናት ተጠቁመዋል። እነዚህም:- ሃገራዊ ንጽረተ ዓለማትን መመርመርና መተንተን፣ ሀገር በቀል ዕውቀቶችን በትምህርት ሥርዓቶች ማካተት፣ ለዘላቂ ልማት ተገቢነት ያላቸው የመማር ማስተማር አቀራረቦችን መጠቀም፣ ተማሪዎችን ማሳተፍ እና የተማሪዎችን

ተሞክሮዎች በግብአትነት መጠቀም ናቸው። የጥናቱ ግኝቶች እንዚህን የትምህርት ንድፍ መርሆዎች መጠቀም የሌላ ተማሪዎች (የነገ የዘላቂ ልማት ፋና ወጊዎችን) የዘላቂ ልማት ብቃቶች ለማዳበር አስተዋጽኦ እንዳላቸው አመላክተዋል።

በምዕራፍ 2 እና 3 ውጤቶች ላይ በመመሥረት ምዕራፍ 4 የምርምር ጥያቄ 2 ንዑስ ጥያቄ 2.4'ን መልሷል። በምዕራፉ የቀረበው ጥናት የተማሪዎችን የዘላቂ ልማት ዘርፎች ሆነ አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ጉዳዮች ያጌቸውን ውስብስብ ሥርዓታዊ መስተጋብሮች የመረዳት ብቃት ከማዳበር አንጻር ከማማሪያ ክፍል ውጪ በእነነታው ዓለም ትምህርትን ማስተማርን እና በርካታ የመማር አቀራረቦችን አጠምሮ የመጠቀምን አስተዋጽኦ መርምሯል።

ጥናቱ በአዲስ አበባ ዩኒቨርስቲ በጂኦግራፊ እና የአካባቢ ጥናት ትምህርት ክፍል የመጀመሪያ ዲግሪ ተማሪዎ ተማሪዎችን አሳትፏል። ትምህርታቱ የመስክ ስራዎች፣ የትብብር ትምህርት ዘዴ፣ በዘመናዊ ተንቀሳቃሽ ስልኮች የመማር ዘዴና ማስታወሻ የመያዝ የትምህርት ዘዴዎች በጥምረት ጥቅም ላይ ውለዋል። በአንድ ጊዜ ከላይ የተጠቀሱትን የትምህርት ዘዴዎች አጠምሮ መጠቀም ለተሳታፊዎች በትምህርት ሂደት ውስጥ ትርጉም ባለው መልኩ እንዲሳተፉ እድል ሰጥቷቸዋል። በእውነዊው ዓለም አውድ ውስጥ ጥቅም ላይ የዋሉት እንዚሂ ጥምር የመማሪያ ዘዴዎች የሆኑም ተሳታፊ ተማሪዎች የዘላቂ ልማት ዘርፎችን (ማለትም፣ አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ጉዳዮ) ውስብስብ ሥርዓታዊ መስተጋባሮችን የመረዳት ብቃት ለማዳበር ረድተዋል። በጨማማሪም፣ ግኝቶች ትምህርትን በእውነታው ዓለም መስጠቱ የተማሪዎችን ርስፖእርስ ትብብር እንደሚያምቻ አሳይተዋል።

የጥናቱ ንድፈ ሀሳባዊ አስተዋጽኦዎች

ስለዘላቂ ልማት ብቃቶች ማዕቀፍ

የዚህ ጥናታዊ ጽሑፍ ግኝቶች ለዘላቂ ልማት፣ ለዘላቂ ልማት ብቃቶች፣ ለዘላቂ ልማት ትምህርት እና ለሀገር በቀል ዕውቀት የጥናት ዘርፎች ንድፈ ሀሳባዊ አስተዋጽኦ ያበረክታሉ።

ስተርሊንግ እና ሌሎች (2017) በዘላቂ ልማት ብቃቶች ዙሪያ በሚደገ ላይ በሚገኙ ሃገሮች አውድ ውስጥ የተሠሩ የምርምር ስራዎች ቁጥር በጣም ጥቂት መሆናቸውን አመልክተዋል። እንዲሁ ያሉ ጥናቶች በዋናነት የምዕራባውያንን አውድ መነሻ በማድረግ የተሠሩ ናቸው (Rieckmann, 2012)።

በምዕራፍ 2 ላይ የተደረገው ጥናት በሚደገ ላይ ባሉ ሀገር ተጨባጭ ሁኔታ ዘላቂ ልማትን ለማረጋገጥ ለሚሰራ ባለሙያዎ አስፈላጊ የሆኑ ብቃቶችን ለይቶ ለማወቅ አስችሏል። በሚደገ ላይ ያሉ ሃገሮች ከምዕራባዊያን አውዶች የሚለያዩ ማኅበራዊ እና ምጣኔ ሀብታዊ ባህርያት አላቸው። በመሆኑም ይህ ጥናት የዘላቂ ልማት ብቃትን የምርምር አውድ ያሰፋል።

በተጨማሪም፣ የምዕራፍ 2 ግኝቶች አንዳንድ የዘላቂ ልማት ብቃቶች፣ የተለያየ ማኅበራዊ እና ምጣኔ ሀብታዊ ባህርያት ላሏቸው ሀገራት በተመሳሳይ መልኩ የሚያስፈልጓቸው መሆኑ አመላክተዋል። ይኸውም፣ አንዳንድ የዘላቂ ልማት ብቃቶች ዓለም አቀፋዊ ሊሆኑ የሚችሉበት ሁኔታ እንዳለ የጥናቱ ውጤቶች ጠቁመዋል። ከዚህ በተጨማሪ፣ የዚህ ጥናት ግኝት፣ ብቃት አውድ-ተኮር ተደርጎ የሚቆጠርበትን ሁኔታ ያጠይቃል። ብሎም፣ ብቃትን ለሚመለከቱ የምርምር ዘርፎች ንድፈ-ሀሳባዊ አስተዋጽኦ ያደርጋል።

ስለትምህርት ለዘላቂ ልማት እና የዘላቂ ልማት ማረጋገጫ ብቃቶችን ስለማሳደግ

በዚህ ጥናት ምዕራፍ 3 የተጠቀሱ ግኝቶች እንደሚያመለክቱት ከኢትዮጵያ ልዩ ልዩ ማህበረሰቦች የተገኙ እንደ የተፈጥሮ ህብት አጠባበቅና ሥነ ምህዳራዊ ሀገር በቀል ዕውቀቶችን በዘመናዊ ትምህርት ሥርዓት ውስጥ ማካተት ጠቀሜታው የጎላ ነው።

ግኝቶች በሀገር በቀል ዕውቀትና ዘላቂ ልማት ዙሪያ የተደረጉ ተዛማጅ ምርምሮች ከዚህ ቀደም የደረሱበትን ድምዳሜ የሚያጠናክሩ ናቸው (Berkes et al., 2000; Boiral et al., 2020; Guerrero-Gatica et al., 2020; Rist et al., 2010)። ከላዩ ማህበረሰቦች የሀገር በቀል

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ዕውቀት ይዘቶችን ከመውሰድ አስፈላንነት በተጨማሪም፣ የጥናቱ ውጤቶች ከኢትዮጵያ ኦርቶዶክስ ተዋሕዶ ቤተ ክርስቲያን ሀገር በቀል የትምህርት ሥርዓት ጠካላሪ ጎኖች ሊወሰዱ የሚችሉ ትምህርቶችን ጠቁሟል። ከነዚህ ውስጥ ለራስ ቁንቁቅዩ፣ ባህሎት እና ምሁራን ዋጋ መስጠትና መጠቀም፣ ለዘላቂ ልማት የትምህርት አግባባነትና ውጤታማነት እንደሚረዳ አመላከተዋል። እንዲዚሁም፣ ዘላቂ ልማትን ለማረጋገጥ የሚደረጉ ጥረቶች በልዩ ልዩና ቢርቢታ ንጽረተ ዓለማት ላይ የተመሰረተ ቢሆን የተሻለ ውጤታማ ሊሆን እንደሚችሉ ከጥናቱ ግኝቶች መረዳት ይቻላል። በተመሳሳይ መልኩ፣ የተማሪዎችን የዘላቂ ልማት ማረጋገጭ ብቃቶችን ለማሳደግ የሚሰጥ ትምህርት በምዕራባውያን ንጽረተ ዓለማት የማስተማሪያ ዘዴዎችና የትምህርት ይዘቶች ብቻ ከመወሰን ይልቅ ሀገር በቀል ዕውቀቶችን እና ንጽረተ ዓለማትን በመጠቀም ላይ ያተኮሩ ልዩ ልዩ አቀራረቦት የተሻለ አግባባነት እንዳለቸው የዚህ ጥናት ግኝቶች ያሳያሉ። በመሆኑም፣ የጥናቱ ድምዳሜዎች በተመሳሳይ የጥናት ዘርፍ የተደረጉ የቀደሙ ምርምሮችን ግኝቶች ይበልጥ አጠናክረዋል (Opstal& Huge, 2013; Reed et al., 2007)።

የምዕራባዊያን/ዘመናዊ ትምህርት ውስብስብ እውነታዎችን ከፍፍሎና አቃልሎ የማቅረብ ውስንነት አለበት በሚል ይገለጻል። በአንጻሩ፣ ሀገር በቀል ዕውቀቶች ሁለንታዊ እንደሆነ (ማለትም፣ አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ጉዳዮች ያላቸውን ውስብስብ ሥርዓታዊ መስተጋብሮት ለማገናዘብ እንደሚረዳ) ተዘዋጅ ምርምሮች ያመለክታሉ (Haigh, 2005; Johnson, 1992; Kaya &Seleti, 2014)። በመሆኑም የዚህ ጥናት ውጤቶች ሀገር በቀል ዕውቀቶች ከዘመናዊ ትምህርት ጋር በማጣመር መጠቀም ያበረታታሉ። በተጨማሪም፣ ጥናቱ የተማሪዎችን የዘላቂ ልማት ማረጋገጫ ብቃቶችን ለማሳደግ አንደር ከዘመናዊ ትምህርት ጋር በማጣመር የሀገር በቀል ዕውቀትን መጠቀም የሚያስፈሉ ዘዴዎችን በምዕራፍ 3 አቅርቢል።

በምዕራፍ 4 ከመማሪያ ክፍል ውጪ በእውናዊው ዓለም ትምህርትን በመስጠት የዘላቂ ልማት ዘርኦች የሆኑት አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ጉዳዮች ያላቸውን ውስብስብ ሥርዓታዊ መስተጋብሮትን የመረዳት ብቃት ተማሪዎች እንዲያዳብሩ የመስክ ስሮዎች፣ የትብብር ትምህርት ዘዴ፣ በዘመናዊ ተንቀሳቃሽ ስልኮች የመማር ዘዴ ማስታወሻ የመያዝ የትምህርት ዘዴዎችን በማፈናጀት የመጠቀምን አስተዋጽኦት ዳስሷል። ግኝቶቹም ከላይ የተጠቀሱት የመማማር አቀራረቦት እና በእውነታው ዓለም ትምህርትን መስጠት ተማሪዎች ትርጉም ያለው ተሳትፎ እንዲያደርጉ ከማመቻቸት በተጨማሪ፣ የተማሪዎችን ውስብስብ ሥርዓታዊ መስተጋብሮትን የመገንዘብ ብቃት የማሳደግ አስተዋጾ እንዳለቸው ጠቁሟል። እንዲ አይነቶ አቀራረቦት አንገጋባ የ ውስብስብ ለሆነ ዓለም አቀፍ የዘላቂ ልማት ተግዳሮቶች በትብብር መፍትሄ ለማበጀት አስቻይ ሁኔታዎች ይፈጥራሉ። የዚህ ጥናት ውጤቶች አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ጉዳዮች ያላቸውን ውስብስብ ሥርዓታዊ መስተጋብሮት የመረዳት ብቃት ማጕልበትን ለሚመለከቱ የጥናት ዘርኦች አስተዋጽኦ ይኖራቸዋል።

የፖሊሲና ትግበራ አንድምታዎች

ከላይ ከተመለከቱት ንድፈሃሳባዊ አበርክቶዎች በተጨማሪ የዚህ ጥናት ግኝቶች ለዘላቂ ልማት እና ትምህርት እንዲሁም ለተዛማጅ ፖሊሲና አተገባበር አስተዋጽኦ ያደርጋሉ። ጥናቱ የሚመለከታቸው ባለድርሻ አካላት ዓለም አቀፋዊ የዘላቂ ልማት ጉዳዮችን አንግብጋቢነት እንዲገነዘቡ እንደሚረዳም ተስፋ ተደርጎል። በተለይ ለዘላቂ ልማት ግቦች በዘላቂ ልማት ሒደት ለትምህርትና ስልጠና ፖሊሲ አውጪዎች እንዲሁም መምህራንና ተማሪዎችን ጨምሮ የተለያዩ ባለድርሻ አካላትን ሚና በማገዝ የጥናቱ ውጤቶች አስተዋጽኦ ያደርጋሉ።

በዚህ ጥናት የተለዩት የዘላቂ ልማት ማረጋገጫ ብቃቶች ለዘላቂ ልማት ለሚቀረጹ ትምህርቶችን ስልጠናዎች እንደመነሻ ሊያገለግሉ ይችላሉ። እነዚህ የዘላቂ ልማት ማረጋገጫ ብቃቶች ለዘላቂ ልማት ትምህርት፣ ለባለሙያዎች ስልጠናና ለሰው ሃብት ልማት መርሐግብሮች የትምህርትና ስልጠና ግብ በመሆንም ሊያገለግሉ ይችላሉ።

የተመድ የዘላቂ ልማት ግቦችን በተመለከተ፣ ዓለማችን እንዚህን ወሳኝ ዓለም አቀፍ ግቦች ለማሳካት በሚያሰችል ተገቢ ቁምና ላይ አለመሆኗን ሒደቱን የገመገሙ ዘገባዎች ያሳያሉ። ለዚህ አጥጊ ለልሆን አፈጻጸም ከሚጠቀሱ ልዩ ልዩ ምክንያቶች መካከል የትምህር ዘርፉ ዝቅተኛ አፈጻጸም አንዱ ሊሆን እንደሚችል ጥናቶች ያሳያሉ። ይህ ዘርፍ የወደፊቱ ዘላቂ ልማት ላይ አስተዋጽኦ እንዲያደርግ ከተፈለገ ሁሉንም የፍኮተኛ ትምህርት ተቋማት ተማሪዎች በዘላቂ ልማት ማረጋገጫ ብቃቶች በማስታጠቅ የለውጥ ፋና ወጊዎች ማዘጋጀት ላይ ማትኮር ወሳኝ ነው። ይህም በራሱ የፍኮተኛ ትምህርት ሥርዓቶች ብርቱ ለውጦች እንዲቀጹና እንዲተገብሩ ይጠይቃቸዋል። በመሆኑም፣ ፖሊሲ

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አውጫዎች እና ሌሎች ባለድርሻዎች የዘላቂ ልማት ጉዳዮችን አንገብጋቢነት፣ የትምህርት ዘርፉን እምቅ ሚና እንዲገነዘቡና ብሔራዊና ዓለም አቀፋዊ የዘላቂ ልማት ግቦች ላይ ለመድረስ አስቻይ ሁኔታዎች ለመፍጠር አመቺ የፖሊሲና የትግበራ ማዕቀፍ እንዲያዘጋጁ ያስፈልጋል።

ለዘላቂ ልማት ፖሊሲና ትግበራዎች አስተዋጽኦ የሚያደርጉት የጥናቱ ግኝቶች የትምህርት ሥርዓትን አግባብነት ለማረጋገጥ ለተለያዩ ንጽረተ ዓለማትንና ትምህርት የሚከፍወንበት ማህበረሰብ ቅድሚያ ለሚሰጣቸው ጉዳዮች ልዩ ትኩረት መስጠት እንዳለበት ያመላክታሉ። አግባብነት ያለው የትምህርት ሥርዓት ማህበረሰቦች ቅድሚያ የሚሰጡዋቸውን አካባቢያዊ፣ ማኅበራዊና ምጣኔ ሀብታዊ ዓላማዎች እንዲያሳኩ ለማገዝ አስተዋጽኦ ይኖረዋል። እንዲ አይነት የትምህርት ሥርዓት ማህበረሰቡ ቅድሚያ የሚሰጣቸውን ጉዳዮች በአግባቡ የተገነዘቡና የተገቢ ዕውቀት፣ ክህሎትና አመለካከት ጥምረትን (ማለትም ብቃትን) የታጠቁ የዘላቂ ልማት የለውጥ ፋና ወጊዎችን በማፍራት አስተዋጽኦ ያደርጋል።

የጥናቱ ምዕራፍ 3 ግኝቶች የተማሪዎች የዘላቂ ልማት ማረጋገጫ ብቃቶችን ለማሳደግ የሀገር በቀል ዕውቀትን መጠቀም አስፈላጊ መሆኑን አሳይተዋል። እንዲዚሁም፣ ለሀገር በቀል ዕውቀት እውቅና መስጠትና መጠቀም የተለያዩ ማህበረሰቦች ሀገር በቀል ዕውቀቶች እንዳይጠፉና ወደቀጣይ ትውልዶች እንዲሻገር ያስችላል። በተጨማሪም፣ የሀገር በቀል ዕውቀቶች ተቀባይነት ማግኘት ዕውቀቶቹ የተገኙባቸው ማህበረሰቦች ዕውቀታቸው፣ ቋንቋቸው፣ ባህላቸውና ምሁሮቻቸው እንደተከበሩና ጥቅም ላይ እንደዋሉ ስለሚገነዘቡ የማህበረሰቡን ስነልቦና በአዎንታዊ መንገድ በመገንባት ረገድ አስተዋጽኦ ያበረክታል።

ምንም እንኳን ሀገር በቀል ዕውቀቶች ከለይ የተብራሩትን ሌሎች ብርካታ አስተዋጽኦ ማበርከት የሚችሉበት እምቅ አቅም ቢኖራቸውም፣ ከዘመናዊ ትምህርት ጋር በጥሩ ሁኔታ ለማጣመር የሚደረግ ጥረት የተለያዩ ተግዳሮቶች ሊገጥሙት እንደሚችሉ ማስብና መፍትሄ ለማበጀት መዘጋጀት አስፈላጊ ነው። ሀገር በቀል ዕውቀትን በዓለም ከተንሰራፋው የምዕራቡውን/ዘመናዊው ትምህርት ጋር አድርጎ የማየቱ አዝማሚያ፣ በተለያዩ ማህበረሰቦች ውስጥ ያሉ ሀገር በቀል ዕውቀቶች በተቁዋዊ መመቅሮች ውስጥ ተካተው ጥቅም ላይ እንዳይውሉ ከሚያደናቅፉ ተግዳሮቶች መካከል አንዱ ነው። ስለዚህ፣ የዘላቂ ልማትና የትምህርት ሥርዓት ባለድርሻ አካላት እንዲህ አይነቱን አስተሳሰብ ለማጋፈጥና ሀገር በቀሉ ዕውቀት ጥቅም ላይ እንዲውል ለማድረግ የሚያስችል ቁርጠኝነት ሊኖራቸው ይገባል።

ይህ ጥናት የተማሪዎችን የዘላቂ ልማት ማረጋገጫ ብቃቶች በማጎልበት ረገድ የትምህርት አግባብነትና ውጤታማነትን ለማሳደግ እንዲሁም ሀገር በቀል ዕውቀትን ከዘመናዊ ትምህርት ጋር ለማቀናጀት የሚያስችሉ ዘዴዎችን አመላክቷል።

የጥናቱ ውስንነቶችና ወደፊት መጠናት ስለለባቸው ጉዳዮች

በዚህ የምርምር ሰነድ የተከተተ ጥናቶች ግኝቶች እንደ የአየር ንብረት ለውጥ፣ የእኩልነት መጓደል እና ድህነት ለማሳሰሎ ዋና ዋና ዓለም አቀፍ የዘላቂ ልማት ተግዳሮቶች መፍትሄ ለማፈለግ ለሚደረጉ ጥረቶች አስተዋጽኦ እንዳላቸው ይታመናል። ሆኖም፣ ጥናቱ ውስንነቶችም አሉበት። ውስንነቶችን በመጠቀም ወደፊት የሚደረጉ ጥናቶች በምን ዙሪያ ቢሰራ ይህንን ጥናት የበለጠ የተሟላ በማድረግ አስተዋጽኦ ሊያደርጉ እንደሚችሉ ለማሳየት ተሞክሯል።

ጥናቱ በምዕራፍ 2 ለኢትዮጵያ ነገሪዊ ሁኔታ የሚያስፈልጉ የዘላቂ ልማት ማረጋገጫ ብቃቶችን ለይቶ አውጥቷል። በዚህ ጥናት፣ ነገሪዊ ሁኔታውን የሚያያቁና በዘላቂ ልማት ጉዳዮች እውቀቅ ያላቸው ባለሙያዎች ተሳትፈዋል። በዚህ ምዕራፍ ውስጥ የተደረገው ጥናት በሀገር የጥናቱን ግኝቶች ከኢትዮጵያ ነገሪዊ ሁኔታ ባገር ለሁሉም ሃገራት እንደሚሰራ ለመደምደም የሚያበቃ አይደለም። ለተለያዩ ሃገራት ነገሪዊ ሁኔታዎች አግባብነት ያላቸው የዘላቂ ልማት ማረጋገጫ ብቃቶችን ለይቶ ለማውጣት በርካታ ሀገርትን ያሳተፉ ተጨማሪ ጥናቶች መሰራት ይኖርባቸዋል። ይህ እንዳለ ሆኖ፣ በአብዛኛው ከምስራቁውያን ነገሪዊ ሁኔታዎች የተወሰዱ የዘላቂ ልማት ማረጋገጫ ብቃቶች ለኢትዮጵያም ተገቢ መሆናቸው በጥናቱ ውጤ በመታየቱ፣ እንዳንዴ የዘላቂ ልማት ማረጋገጫ ብቃቶች የተለያዩ ማህበራዊና ምጣኔ ሀብታዊ በሀሪይ ባላቸው በርካታ ሃገራት ጠ�ሜታ ሊኖራቸው እንደሚችል አሳይቷል። ተመሳሳይ የዘላቂ ልማት ማረጋገጫ ብቃቶች በዓለም አቀፍ ደረጃ ስለሚኖራቸው አግባብነት እና አስፈላጊነት ድምዳሜ ላይ ለመድረስ ግን የተለያዩ ማህበራዊ ምጣኔ ሀብታዊ ገጽታዎች ባሏቸው በርካታ ሃገሮች ወደፊት ተጨማሪ ጥናቶች ማካሄድ አስፈላጊ ነው።

ምዕራፍ 3 ሀገር በቀል ዕውቀትን ከዘመናዊ ትምህርት ጋር በማጣመር ለዘላቂ ልማት አስተዋጽኦ ማበርከት የሚችልባቸውን ጉዳዮች መርምሯል። ይህንና፣ በተለያዩ ማህበረሰቦች ውስጥ ያሉ ሀገር በቀል ዕውቀቶችን እና ሀገር በቀል የትምህርት ሥርዓቶችን በቀጥታ አላጠናም። የዚህ ምዕራፍ ጥናት ከተሰታራፊዎች (ማለትም፣ በዘመናዊ ትምህርትና በዘላቂ ልማት መስክ ዕውቀት ካላቸው ባለሞያዎች) በተገኘ ግብአት ላይ ተመስርቷል። ይህንን ውጤንት ለማስቀረት በኢትዮጵያ ሀገር የትምህርት ሥርዓት፣ ሀገር በቀል ዕውቀቶች እና ዘላቂ ልማት ጉዳዮች ወደፊት የሚደረጉ ተዛማጅ ምርምሮች፣ ሀገር በቀል ዕውቀቶች ያፈቸውን ባለሞያያዎች እና ዕውቀቶች የሚገኙባቸውን ማህበረሰቦች በቀጥታ ያሳተፉ እንዲሆኑ ይመከራል።

በምዕራፍ 4 የተማሪዎች የዘላቂ ልማት ዘርፎችንትን ውስብስብ ሥርዓታዊ መስተጋብሮችን የመረዳት ብቃት ለማሳደግ በርካታ የመማማር አቀራረባችን በጥምረት የመጠቀም ውጤታማነት ተጠንቷል። በዚህ ጥናት ተሳታፊ የሆኑት በአዲስ አበባ ዩኒቨርስቲ በጂኦግራፊ እና የአካባቢ ጥናት ትምህርት ክፍል የመጀመሪያ ዲግሪ ተማሪዎች የነበሩ 36 ተማሪዎች ብቻ ናቸው። በዚህ ምክንያት ውጤቱ ለዩኒቨርስቲዉ የትምህርት መስኮች ሁሉ ተመሳሳይ ነዉ ብሎ መደምደም አይቻልም። የዩኒቨርስቲዉ የሁሉም የትምርት መስክ ተማሪዎች የወደፊት የዘላቂ ልማት የለዉጥ ፈና ወኪያዎች እንዲሆኑ መጠጋጀት ስለለባቸው፣ ወደፊት የሚካሄዱ ተዛማጅ ምርምሮች በበርካታ የትምህርት ዘርፎች ትምህርታቸውን የሚከታተሉ ተማሪዎችን ያካተቱ እንዲሆኑ ይመከራል።

ለማጠቃልል፣ የዘላቂ ልማት ተግዳሮቶች ውስብስብ ናቸው። በምዕራባዉያን ንጽረተ ዓለም እና የትምህርት ሥርዓት ብቻ ሊፈቱ ለማይችሉ ለእነዚህ ዓለም አቀፍ ተግዳሮቶች መፍትሄ ለማበጀት፣ የበርካታ ባለድርሻ አካላት ትብብርና የልዩ ልዩ ማህበረሰቦችን ንጽረተ ዓለማት በጥምረት መጠቀም አስፈላጊ ነዉ። ዘላቂ ልማትን ለማረጋገጥ የሚያስችሉ የተለያዩ ባለሙያያዎችን ውሳኔዎችና እርምጃዎች ለማሳለጥ የዘላቂ ልማት ማረጋጬ ብቃቶችን መለየትና ማጐልበት ጠቃሚ ነዉ። በዚህ የመመረቂያ ጽሑፍ የቀረበዉ ምርምር ግኝት ለኢትዮጵያ ነባራዊ ሁኔታ 15 የዘላቂ ልማት ማረጋጬ ብቃቶች ለይቶ አዉጥቷል። የከፍተኛ ትምህርት ተቋማት ተማሪዎች (ማለትም የወደፊት የዘላቂ ልማት የለዉጥ ፈና ወኪያዎች) ወደፊት ለዘላቂ ልማት የሚያበረክቱትን አስተዋጽኦ ለማጐልበትና የሚኖራቸውን ሚና በለቀ ሁነታ መጬወት እንዲትሉ ለማገዝ፣ የዘላቂ ልማት ማረጋጬ ብቃቶቻቸውን ማጐልበት ወሳኝ ነዉ። ከዚህ አንጻር የዘመናዊ ትምህርት ሥርዓቶችን ማሻሻልና የሀገር በቀል ዕውቀቶችን ማካተት ተገቢ እንደሆነ በዚህ ጥናት ተጠቁሟል። በተጨማሪም ለዘላቂ ልማት ዓለማ የሀገር በቀል ዕውቀትን ከዘመናዊዉ ትምህርት ጋር በጥምረት ጥቅም ላይ ማዋል የሚቻልባቸውን መርሆዎች አመላክቷል።

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About the author

Yared Nigussie Demssie (nyaredn@gmail.com) received his Bachelor's Degree in Business Education (with great distinction) from Addis Ababa University (AAU). After graduation, AAU hired him as a Graduate Assistant and offered him a scholarship to study a master's program. He received his Master's Degree in Public Administration (with excellent thesis grade) from AAU.

As an undergraduate student, Yared participated in essay writing competitions. He was co-winner of the FUFA essay writing contest (i.e., a critical thinking essay writing contest on the development challenges of Africa) for African university students.

He worked at AAU as a Fulltime Lecturer and coordinator of the undergraduate program in the Department of Public Administration & Development Management.

Yared has experience in research, training, consultancy, national curriculum preparation, and conference organizing by collaborating with (inter)national organizations.

Yared won the Netherlands Fellowship Programmes (NFP) €83,000 for his PhD studies at Wageningen University, in the Netherlands.

In his PhD studies, he used intervention, Delphi, and focus group studies. His research areas include sustainability competence, indigenous knowledge, education for sustainable development, and corporate social responsibility.

He co-taught the course Business and Society at Wageningen University during his PhD studies.

In 2017, Yared received the WASS Junior researcher grant from Wageningen University School of Social Sciences.

In 2018/19, Yared was an Affiliate Faculty member at Idaho State University in the United States of America.

Peer reviewed publications

Demssie, Y. N., Biemans, H.J.A., Wesselink, R., & Mulder, M. (2020). Combining indigenous
knowledge and modern education to foster sustainability competencies: Towards a set of learning design principles. Sustainability, 12(17), 6823.

Demssie, Y. N., Wesselink, R., Biemans, H.J.A., & Mulder, M. (2019). Think outside the European box:
Identifying sustainability competencies for a base of the pyramid context. Journal of Cleaner Production, 221, 828-838.

Submitted manuscript

Demssie, Y. N., Biemans, H.J.A., Wesselink, R., & Mulder, M. (submitted). Fostering students' systems thinking competence for sustainability by using multiple real-world learning approaches.

Presented conference paper

Yared Nigussie Demssie. (2012). Quality of Education in Selected Colleges of Addis Ababa University. Proceedings of the 21st Annual Conference of the Ethiopian Statistical Association

Social media

Yared creates social media content. In December 2019, he received the YouTube Creator Award - Silver Play Button in recognition that the YouTube channel he runs has surpassed 100,000 subscriber count. Currently, his channel has more than 31 million views and over 252,000 subscribers.

Yared Nigussie Demssie
Wageningen School of Social Sciences (WASS)
Completed Training and Supervision Plan

Name of the learning activity	Department/Institute	Year	ECTS*
A) Project related competences			
Writing Research proposal	WASS	2016	6
Research, Manuscript and PhD Meetings	ELS	2015/2016	2
Internship at Idaho State University, USA	ISU	2018/2019	4
Grasping Sustainability	SENSE	2016	2
Data management planning	WUR Library	2016	0.4
Competence Theory Research and Practice	ICO	2016	3
B) General research related competences			
WASS introduction course	WASS	2015	1
Systematic approaches to reviewing literature	WASS	2016	4
Research Methodology: From topic to proposal	WASS	2015	4
Project and Time Management	WGS	2015	1.5
Techniques for Writing and Presenting a Scientific Paper	WGS	2016	1.2
Information Literacy including EndNote Introduction	WUR Library	2015	0.6
Brain training	WGS	2015	0.3
C) Career related /Personal development competences			
Conducting training on a reference manager Mendeley at Addis Ababa University (AAU)	AAU	2017	1
Conducting training on a reference manager Mendeley at Bahir Dar University (BDU)	BDU	2017	1
Organizing an international conference and moderating a session at AAU	AAU	2018	1
Teaching at WUR – Business and Society course	ELS	2018	2
Session convener, the 5th Wageningen PhD Symposium. "Bridging Science and Society: Unifying Knowledge"	WPC	2018	1
Annual WGS PhD Workshop Carousel	WGS	2018	0.3
Reviewing a Scientific Paper	WGS	2018	0.1
Total			**36.4**

*One credit according to ECTS is on average equivalent to 28 hours of study load.