Norwegian University of Life Sciences
Faculty of Science and Technology

Philosophiae Doctor (PhD)
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Teacher education as key to adaptation to environmental degradation in Tanzania: Development of environmental education through participatory action research

Lærerutdanning som nøkkel til tilpasning til miljøforringelse i Tanzania: Utvikling av miljøopplæring gjennom deltakende aksjonsforskning

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Ås, January 2020, Vituce Jelasy Kalungwizi.

Summary of the Thesis

Environmental education (EE) is a key component of socio-economic transformation. Thus, teacher colleges and schools emphasize environmental topics in their curricula. Yet, environmental degradation continues in spite of the increasing number of people educated in line with EE curricula. Therefore, EE has not increased the community's capacity to adapt to the changing environmental conditions, including the environment and humans' individual and societal use of place-based resources. Policy makers emphasize participatory teaching as the way to transition out of unsustainability. Still, a lack of a wide range of resources is normally the major constraint, especially in rural primary schools, where communities remain as the major victims of the degradation and the changing socio-ecological systems.

Through participatory action research (PAR) implemented in collaboration with student-teachers, tutors at Ilonga Teachers' College, teachers in practice in primary schools, and surrounding local community members, we[1] attempted to create an example of an active teaching strategy for environmental topics using locally available resources. We formulated the following research question to guide our study:

> In which ways can participatory teaching of environmental topics in schools and teacher colleges facilitate local community members' adaptation to and management of harsh environmental conditions?

We addressed the main research question through three underlying research questions that addressed different dimensions of the main question:

1. How can we engage local actors in the participatory planning of environmental activities?
2. How do the student teachers learn environmental education and how does that influence their practice of environmental education in primary schools and in the local community?
3. To what extent do democratic teaching processes in the Teachers' College enhance the stakeholders' ability to manage environmental challenges?

We chose tree planting as the main, concrete approach for EE and linked the research process with experiential learning theories. Tree planting was a meaningful, comprehensible, and manageable environmental activity in the participating rural community, and a solution to the persistent environmental degradation. The PAR strategy involved two cycles of plan–act–reflect. After implementing the PAR cycles, we conducted a follow-up study to ascertain the sustainability of the intervention. The result of the PAR, as linked to the three underlying research questions, constitutes the three published articles that form part of this thesis.

[1] Throughout the summary section I have used "we" to reference the researchers.

Paper 1 summarizes and discusses the dynamics of engaging poor rural communities in EE and some critical empowerment issues. The paper relies on the mapping of the environmental conditions and resources, and on the engagement of the local communities in a critical reflection of their environmental realities. Therefore, the findings refers to the initial interaction between researchers and community leaders and EE committees. We followed the interaction up with interviews, focus-group discussions (FGDs) including local community members, and participant observations of environmental realities accompanied by learning workshops. The mapping gave important insights for elaborating and improving the theoretical perspectives and for contextualizing experiential learning theories in accordance with the realities of the local communities, aiming at improvements in future environmental practices. The critical reflection promoted a common understanding of the main environmental challenges and built local trust and confidence between the researchers and local leaders, which later became important social capital and an alternative to the lack of physical resources for the management of environmental stressors.

Paper 2 discusses the challenges involved in the transfer of experiential teaching strategies from the initially selected primary schools to a wider population of primary schools (i.e. the student teachers' practice schools all over Tanzania). In addition, we discuss the learning outcomes among the student teachers involved in the transfer of teaching strategies. In the paper, we analyze student teachers' teaching logs, interviews with practice teachers and student teachers, and FGDs involving student teachers who received experiential education and then participated in the second teaching practice to understand the realization of experiential teaching strategies in the primary schools. We found that educating the student teachers in experiential learning strategies enhanced their confidence and autonomy in planning and implementing EE programs in accordance with local realities in the teaching practice schools. The student teachers capitalized on democratic relationships to realize the teaching of environmental topics in order to secure social capital and physical resources in the schools they were teaching. The building of social capital increased their ability to handle contextual challenges when applying ideas in a new context.

Paper 3 focuses on the power dimension. We experienced the development of democratic power relations through student teachers' interactions with local stakeholders in the implementation of environmental management activities in the practice schools and the surrounding local communities. Still, we wanted to explore the sustenance of these relations and to understand the nature of power relations in the local community after the closure of the project. We interviewed primary school headmasters, the Dean of the Teachers' College, and tutors and teachers in the participating schools and at the Teachers' College. The result revealed an opposition between the participants' exercise of democratic power relations in schools and the top-down decisions in the educational system, for example, the distribution and allocation of teachers decided by the district authorities. The local community members countered the challenges made by hierarchical top-down decisions by recruiting new members, by expanding their network and support systems, and by attracting new

sources of funding. We realized that the implementation of EE to a large degree relied on political and economic aspects.

In spite of the challenges that were encountered, the three papers demonstrate that experiential learning strategies can contribute to the transformation of EE in Tanzania. The reason for this is that the teaching strategies both comprehended the transfer of knowledge and skills related to the self-sustaining management of environmentally-friendly activities and to the building of capacity to manage the lack of resources as well as the top-down-organized educational system. This means that the combination of experiential learning strategies and PAR is crucial. Although I will not underplay the significance of the challenges related to a lack of resources and power, the findings show examples of how to overcome these severe barriers. Thus, we recommend experiential learning strategies combined with the development of democratic relations as an approach for teaching EE in Tanzanian teacher colleges.

Another finding is that mobile phones seem to be important vehicles for enriching the partnership between schools, the local community, and teacher colleges, and for relating the community to their physical environment. The use of the phones seemed to enhance participants' environmental care due to the possibility of experiencing local environmental challenges, creating social, cultural, and symbolic capital, and building a community of learners, which could grow beyond the geographical boundaries of the projects.

Sammendrag

Utdanning knyttet til miljøspørsmål blir stadig viktigere i tanzaniansk grunnopplæring for å ruste elevene til å kunne møte og håndtere miljøutfordringer som følger av samfunns- og klimaendringer. Læreplanene inndrar i økende grad miljøspørsmål og håndtering av miljøutfordringer, og både skoler og lærere integrerer miljøtema i ulike skolefag. Likevel fortsetter forringelsen av det fysiske miljøet i Tanzania med svekkete levekår for planter, dyr og mennesker. Miljøopplæringen i grunnskolen har ikke styrket samfunnets kapasitet til å håndtere og tilpasse seg til endringene i det fysiske miljøet på bærekraftig måte. Bærekraftige tilpassinger krever at så vel individuell som samfunnsmessig bruk av lokale ressurser må endres. Politikere og offentlige utdanningspolitiske dokumenter vektlegger praktisk miljøundervisning med elevdeltakelse for å oppnå bærekraftig ressursbruk på lokalt nivå. Mangel på de fleste læremidler og ressurser som trengs i praktisk miljøopplæring begrenser omfanget av slik undervisning i Tanzania, spesielt i grunnskolene på landsbygda, hvor vi også finner dem som lider mest under miljøforringelsene.

Gjennom deltakende aksjonsforskning i samarbeid med lærerstudenter, veiledere ved Ilonga lærerskole, med lærere ved lærerstudentenes praksisskoler og med aktive medlemmer fra omkringliggende lokalsamfunn utviklet vi en praktisk rettet undervisningsstrategi for miljøutdanning ved å bruke lokalt tilgjengelige ressurser. Vi formulerte følgende forskningsspørsmål for studien:

> På hvilke måter kan deltakelsesorientert og praktisk rettet miljøundervisning i grunnskoler fremme lokalsamfunnets tilpasning til og håndtering av miljøutfordringer?

Vi utdypet forskningsspørsmålet gjennom tre underliggende delspørsmål som tok for seg forskjellige dimensjoner av hovedspørsmålet:

4. Hvordan kan lokale aktører engasjeres til å være med å planlegge miljøvennelige aktiviteter?
5. På hvilke måter lærer lærerstudentene om miljøutdanning og hvordan påvirker deres måter å lære på praksisen med miljøopplæring i barneskoler og omkringliggende lokalsamfunn?
6. I hvilken grad styrker demokratiske undervisningsprosesser på lærerskolen lærerstundentenes og andre prosjektdeltakernes evne til å håndtere miljøutfordringer?

Vi valgte treplanting som den viktigste praktiske læringsaktiviteten for miljøutdanning i prosjektet, og koblet aksjonsforskning som strategi med erfaringslæring som viktigste læringsteoretiske tilnærming. Treplanting viste seg å være et meningsfullt og håndterbart miljøtiltak i lokalsamfunnet, og ble også forstått som en mulig løsning på den vedvarende miljøforringelsen. Vi utførte to aksjonssirkler med situasjonskartlegging, planlegging av aksjoner, gjennomføring av de planlagte aksjonene og påfølgende evaluering. Etter å ha fullført to aksjonssirkler, gjennomførte jeg en oppfølgingsundersøkelse for å undersøke om iverksatte tiltak ble fulgt opp etter prosjektets avslutning. De tre publiserte artiklene tar for seg og drøfter resultater og funn fra hele prosjektet, der hver av artiklene går inn på hvert sitt delspørsmål under hovedspørsmålet, som drøftes eksplisitt i siste del av kapittel 6 i kappen.

Den første artikkelen drøfter prosesser omkring å engasjere og myndiggjøre lærerstudenter, lærere, elever og andre beboere i fattige bygdesamfunn i forhold til miljøutdanning og miljøtiltak. Artikkelen bygger på kartlegging av det fysiske miljøet, herunder miljøutfordringer og tilgjengelige ressurser, og diskuterer utviklingen av lokalt miljøengasjement som følge av økte kunnskaper om utfordringer i nærmiljøet. Funnene er basert på den innledende samhandlingen og samspillet mellom forskere, ledere i lokalsamfunnet og lokale miljøutdanningsgrupper. Vi fulgte samspillet opp med intervjuer av enkeltpersoner, fokusgruppeintervjuer med medlemmer av lokalsamfunnene samt i oppølging av deltakernes observasjoner av lokale miljøforhold i samtalegrupper. Kartleggingen bidro til å utdype, videreutvikle og praksisrette erfaringslæring i samspill med andre teoretiske tilnærminger i forhold til målet om å forbedre framtidig miljøpraksis. Samhandlingen om å reflektere omkring kartleggingen av miljøsituasjonen fremmet også felles forståelse av de viktigste miljøutfordringene og bygde lokal tillit til prosjektet og tillit mellom forskerne og lokale ledere. Tillitsforholdene etablerte en sosial kapital som til dels kunne erstatte manglende fysiske ressurser for seinere håndtering av miljøutfordringer.

Den andre artikkelen drøfter utfordringer med å overføre de innledende undervisningsstrategiene for erfaringslæring, som ble brukt i aksjonslæringssirkelen i barneskolene omkring lærerhøgskolen, til lærerstudentenes praksisskoler spredt over hele Tanzania. Videre drøfter vi hva lærerstudentene lærte av å overføre undervisningsstrategiene til en annen region kjennetegnet av andre kulturelle og fysiske forhold. I artikkelen analyserer vi lærerstudentenes undervisningslogger og intervjuer med praksislærere og lærerstudenter. Vi analyserer også fokusgruppeintervjuer av lærerstudentene som først fikk opplæring i bruk av erfaringslæring i konkrete miljøprosjekter og deretter anvendte denne undervisningsstrategien i praksisskolene rundt om i Tanzania. Opplæringen i erfaringslæring syntes å øke lærerstudentenes selvtillit og selvstendighet i planlegging og gjennomføring miljøutdanning i praksisskolene. Lærerstrudentene anvendte demokratiske prinsipper i miljøundervisningen for å bygge sosial kapital og for å sikre god utnyttelse av fysiske ressurser i praksisskolene. Oppbyggingen av sosial kapital økte lærerstudentenes evne til å håndtere utfordringer i forbindelse med å innføre og anvende ideer i en ny kontekst.

Den tredje artikkelen tar for seg maktforhold. Vi opplevde utvikling av demokratiske maktforhold i lærerstudentenes samhandling med lokalbefolkningen under gjennomføringen av miljøtiltak og miljøaktiviteter i praksisskolene og de omkringliggende lokalsamfunnene. Likevel ønsket vi å utforske i hvilken grad den demokratiske samhandlingen vedvarte etter prosjektets avslutning og også å få en utdypet forståelse av maktforholdene som ellers virket i samfunnet. Vi intervjuet rektorer og lærere på barneskolene samt dekan og veiledere på lærerhøgskolen. Vi fant en klar motsetning mellom demokratiske prinsipper i aksjonsforskningsprosjektet og på skolene og hierarkiske maktstrukturer basert på styring ovenfra og ned ellers i utdannelsessystemet, for eksempel i distriktmyndighetenes stadige omfordeling av lærere til barneskolene uten noen lokal innflytelse. Lokalbefolkningen møtte utfordringene med ovenfra og ned styring ved å rekruttere nye medlemmer i miljøgrupper hvis lærere ble reallokert, ved å utvide nettverkene og støttesystemene sine og ved å søke nye kilder for å

finansiere miljøtiltak. Vi erfarte at iverksettingen av miljøutdanning i stor grad var avhengig av politiske og økonomiske rammebetingelser.

Til tross for disse utfordringene, viser drøftingen i de tre artiklene, sammen med diskusjonskapitlet i kappen, at deltakende aksjonsforskning sammenholdt med undervisningsstrategier basert på erfaringslæring og praktiske miljøtiltak kan bidra til positiv endring av miljøutdanningen i Tanzania. Undervisningstrategiene omfatter overføring av kunnskaper og ferdigheter som kan istandsette lokalbefolkningen til å organisere og håndtere miljøvennlige aktiviteter. Demokratisk samhandling øker kapasiteten til håndtere konflikter mellom sosiale grupper, ressursmangel samt ovenfra og ned styring. Koblingen mellom deltakende aksjonsforskning og erfaringslæring synes å være avgjørende for å oppnå positive endringer. Selv om utfordringene knyttet til hierarkiske maktstrukturer og ressursmangel er store, viser funnene at det kan være mulig å overkomme disse hindringene. Vi anbefaler å koble undervisningsstrategier basert på erfaringslæring med utvikling av demokratiske prosesser og beslutningsmåter som grunnlag for miljøutdanning i tanzaniansk lærerutdanning.

Et annet funn er at mobiltelefonen synes å fungere som medierende hjelper for samarbeidet mellom skolene, lokalsamfunnet og lærerhøgskolen. I tillegg ble lokale kart i Google Maps øyeåpner for lokalbefolkningens erkjennelse av miljøutfordringer i nærmiljøet. Bruksmåtene for mobiltelefonen syntes å på den ene siden å øke deltakernes miljøbevissthet og ønske om å ivareta miljøkvaliteter og på den andre siden å skape sosial, kulturell og symbolsk kapital ved å bygge et lærende samfunn som kunne vokse utover prosjektets geografiske grenser.

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LIST OF ABBREVIATIONS

AIDS: Acquired Immune Deficiency Syndrome

BEST: Basic Educational Statistics

CARN: Collaborative Action Research Network

CCM: Chama Cha Mapinduzi – Revolutionary Party

EE: Environmental Education

EL: Experiential Learning

ESD: Education for Sustainable Development

ESR: Educational for Self-Reliance

FGD: Focus-Group Discussion

HIV: Human Immunodeficiency Virus

NAAEE: North American Association for Environmental Education

NMBU: Norges Miljø og Biovitenskapelige Universitet – Norwegian University of Life Sciences

NSD: Norsk Senter for Forskningsdata – Norwegian Centre for Research Data

PAR: Participatory Action Research

SLL: Seksjon for Læring og Lærerutdanning – Section for Teaching and Teacher Education

SUA: Sokoine University of Agriculture

UNEP: United Nations Environmental Programme

UNESCO: United Nations Educational Scientific and Cultural Organization

URT: United Republic of Tanzania

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PART 1:
EXTENDED ABSTRACT

1.0. Introduction

Environmental problems pose major challenges to the sustainability of communities worldwide (Kidegesho, 2015). Droughts, high temperatures, rising sea levels, the loss of biodiversity, and pollution pose high risks in terms of food insecurity, depleted water sources, and the eruption of diseases, especially in developing countries such as Tanzania. Educational institutions have a mandate to address environmental problems through integrating environmental education (EE) into the curriculum, and, foremost, by facilitating pupils' and students' skills and competences to face and manage the serious environmental challenges both now and during their adulthood. Therefore, as I have indicated in chapter 2 of this thesis, EE is an international and national agenda.To understand the significance and potential of EE, it is important to see how the current practice has evolved, and to be able to predict future trends and possibilities.

In this context, EE relates to the management of environmental challenges in local communities by fostering local participants to learn and mobilize resources and plan and implement actions to address environmental challenges. The concept involves contextualized education focusing on the local dimensions of environmental challenges to address learning in primary and secondary education in rural Tanzania and to manage the overarching and serious environmental challenges. Education is important in achieving community sustainability, which relies on sustainable management and the use of natural resources in the community and in the surroundings of the community. Therefore, several countries have taken various steps to strengthen the teaching of environmental topics in primary and secondary education. Yet, achieving environmental sustainability is still a major challenge in Tanzania despite the teaching of environmental topics at the various levels of education. For example, between 1990 and 2010, Tanzania lost 400,000 ha of forest cover (Kidegesho, 2015). The loss of basic natural resources with the subsequent disintegration of communities has resulted in ethnic conflicts, hunger, and communicable diseases. More than 50 years ago, the first president of Tanzania, in the Arusha Declaration, argued that such challenges reflect a gap between teaching practice and the application of knowledge in real-life situations (Nyerere, 1967).

Although the environmental problems are global, overwhelming, and frightening, I hope and believe it is possible to make changes toward a larger degree of environmental sustainability through education. In Tanzania, 44% of the population is youths up to 15 years of age (United Republic of Tanzania [URT], 2013). In rural areas, about 50% of youths attend secondary schools. Less than 50% pass Form IV (Ministry of Education, 2017). This means that primary schools are core arenas for addressing the management of environmental challenges. In order to improve EE in Tanzania, and elsewhere, I think it is crucial to raise awareness of EE and strengthen the EE competences in teacher education. Therefore, I decided to invite a Tanzanian teacher college's student teachers and their tutors to join a participatory action research (PAR) EE project.

This study addressed EE in teacher education in Tanzania through this PAR project. We—co-researchers from the Sokoine University of Agriculture (SUA) and myself—chose to locate the project at Ilonga Teachers' College in Kilosa, in the Morogoro Region (see map on page 23). The Sokoine research team implemented the PAR project in collaboration with teacher educators, student teachers, primary school teachers, and other local stakeholders where the student teachers were practicing. As the main facilitator, I opened up democratic processes to decide on the aims of the PAR project. In that way, "I" become a "we." Then together, we, the participants in the PAR project, attempted to strengthen ways of teaching that facilitated participants' experiential learning. We attempted to strengthen the active teaching of environmental topics at Ilonga Teachers' College, in primary schools, and in the local communities surrounding this Teachers' College, mainly by using tree planting as the arena for the active teaching of environmental topics. The aim of the project was to create examples of an EE project in the study area.

Throughout the study, I discuss the process and the results of community engagement in the above-mentioned EE program. Together with my supervisors, I have documented the PAR project in three articles based on different phases of the project. In the upcoming chapters, I will discuss the articles in depth. In the following, I will resume the discussion on the main phases of the study, and, thereafter, connect the phases with the core content of the three articles to give an introductory overview of the study process.

The study follows two subsequent action research cycles with the typical phases of planning, acting/implementing, and reflecting. The cycles, with three major phases in each cycle, constitute the core of the research strategy. The phases of mapping (situational analysis and identification of challenges), planning, acting through testing possible solutions to the challenges, and evaluating align with experiential learning processes in accordance with Dewey (Dewey, 1909, 1916, 1938a, 1938b; Miettinen, 2000). Furthermore, Dewey is one of the fore fathers of action research. In this way, PAR, as well as experiential learning theory, constitute my major research strategy.

The first two articles discuss the challenges of engaging local communities in EE. The first article deals with the planning phase, where we, in collaboration with the participants from the local communities, mapped and identified the critical environmental challenges and critical resources in the study areas. Through this time-consuming process, we developed mutual confidence and identified key stakeholders in addition to critical resources. In addition to student teachers and tutors from Ilonga Teachers' College and primary school teachers, the local stakeholders on the school environmental committee, village experts, and local gardeners joined the project. In the light of the mapping and identification of environmental challenges, we, together, decided about an action plan. The planning phase also included collaboration with the local stakeholders in pilot studies of experiential teaching and learning strategies reflecting on how primary school teachers and local stakeholders could realize the strategies in schools and local communities. The first article discusses

how the participatory and inclusive approach influences community engagement and the participants' emerging feelings toward EE activities in this initial phase of the project.

The second article deals with the implementation and reflection phase of the first circle of the PAR project. During the implementation phase, the student teachers realized the plans in primary schools in various parts of Tanzania under the supervision of tutors, researchers, and teachers in the primary schools. Together, they reflected on the student teachers' professional development when following the curriculum, but mainly related to their teaching of EE topics involving local stakeholders and focusing on experiential learning. In addition to considering how the participatory approach and new teaching practices influenced the implementation of EE practices in the study areas, the second article includes discussions from reflection workshops on the process throughout the realization, the results, and the way forward. A key issue was the sustainability of the observed changes in teaching practice.

The follow-up study founded the second circle of the study. Through FGDs with key stakeholders, the follow-up study became an arena for the discussion of the principles for sustaining the observed changes within the local communities. In addition, the discussions clarified that the hierarchical power structure, generally in Tanzanian society, and specifically in the education system, seems to define the conditions for the local management of environmental challenges. In the third paper, I therefore chose to focus on power dimensions and discuss how the existing hierarchical power structure of Tanzanian educational governance influences the sustainment of environmental educational changes. The tension, but also the potentially procreative relation between democratic and hierarchical power systems for sustaining EE projects, is an important theme in the paper.

1.1. Aims of the study

The main EE research and the relevant Tanzanian research show the significance of active teaching and teaching practices that facilitate learners' experiential learning through their participation in concrete environmental activities for the realization of positive learning outcomes in EE (Ahmad, 2016; Wals & Benavot, 2017; Zuber-Skerritt, 2012). Still, in Tanzania, there are only a few examples of active teaching including local community members as central actors (O'Sullivan, 2004; Vavrus, 2009). Therefore, the main purpose of this study was to create Tanzanian examples and cases of active teaching and learning in teacher education and to document the procedures and factors in the change process. We chose tree planting as an example of EE because deforestation causes environmental degradation in Tanzania, but also because trees might be income-generating through agroforestry. In addition, tree planting is well known as a means to improve the environment throughout rural Tanzania.

Based on our intention to create examples of how active teaching can promote local competence and skills in the management of environmental challenges, I formulated the following main research question:

In which ways can participatory teaching of environmental topics in schools and teacher colleges facilitate local community members' adaptation to and management of harsh environmental conditions?

However, below I have formulated a research question for each of the three papers, numbered chronologically and corresponding to articles one, two, and three. Together, the three questions cover different aspects of the main research question.

1. ***How can we engage local actors in the participatory planning of environmental activities?***
2. ***How do the student teachers learn environmental education and how does that influence their practice of environmental education in primary schools and in the local community?***
3. ***To what extent does the hierarchical power system influence the teaching and learning processes of environmental topics and the stakeholders' ability to manage environmental challenges?***

1.2. Reflecting on my educational journey

My childhood experiences and my educational journey highly influenced my entry into EE. In 1983, I started at Lyapona Primary School in my home village. When I was 14, I went to live with my uncle, who was a teacher in another village. He supported me by providing textbooks and extra tuition in the evenings, which my parents could not afford. In addition, I worked as a horticultural prefect for two years, coordinating gardening at Kawala-Chitete Primary School. At secondary school, I had already developed an interest in agriculture. Although I did not get a leadership position in any of the school projects, I studied agricultural science very hard and practiced in the school and at home.

When I was in Form III, my parents gave me one hectare of land to grow maize as my personal farm. The farmland had poor soil. Therefore, I decided to reclaim it by applying manure from our animal shed that I carried using our family ox. I managed to grow enough maize to pay for my school fees and learning materials, and I often even contributed food to my family during food shortage periods. The benefits I obtained from the farming activities boosted my interest in agricultural science. Therefore, I did very well in agricultural subjects in my final examination at the ordinary secondary school. Sadly, I was not selected to pursue agriculture since I did not pass mathematics. Instead, I was selected to study history, geography, and English. In Tanzania, the educators' and elders' decisions of which subjects a student will study usually rules out the student's own preferences. Therefore, you do not choose you are passively selected. At first, I declined because I wanted to continue with farming activities, which I had discovered had a lot of potential. However, my father and the other clan elders encouraged me to study the subjects I had been selected for.

After finishing advanced secondary school, I wanted to be a teacher, teaching geography in secondary schools. My advanced-level secondary school teacher, who was also the headmaster of the school, inspired me. Hence, I majored in geography and education at the university. Geography

at the university was oriented toward EE and emphasized topics such as natural resource management. After my bachelor education, I started teaching geography in secondary schools.

Later, I secured a position at the university to start the teacher education program oriented toward agriculture, and I was placed in the Psychology of Teaching and Learning Department. After taking up the post, I went to study psychology at the University of Dar es Salaam and did a small research project in the field of information sharing related to HIV and AIDS among secondary school students. This is the reason for my interest in the psychological effects on the participants, which characterizes important discussions in this study. In this period, I somehow lost touch with environmental conservation. However, my interest was revived when I started a small project at home generating biogas and using the project as a teaching facility for university students and primary schools near my home. This experience was important for the PhD project because it connected my current activities with my childhood experiences and revived my interest in agriculture and environmental issues.

When I met my future supervisors from the Norwegian University of Life Sciences (NMBU) at the SUA, I shared my biography with them. They encouraged me to conduct a PhD study on environmental challenges that we experience in Tanzania. I believe this study has finally allowed for the realization of my ambitions, which started in my childhood, sometimes lost direction, but finally came back into focus and continued.

I have divided the extended abstract of the thesis into four main parts: introduction; context; research strategy; summary of the articles and a discussion and major recommendations. The choice of PAR as a research strategy led to the choice of experiential learning theory as the main theoretical approach. Therefore, I relate the methodology and theory to each other in the chapter considering the research strategy.

2.0. Review of the related literature

The main purpose of this chapter is to provide the reader with an overview of the research tradition related to EE. Initially, I will give a historical view of the field from the 20th century to the present day. Thereafter, I discuss emerging critical perspectives related to the changing political and socio-economic context of the field. I summarize the subchapter by connecting the EE research tradition to teacher education, and especially to my Tanzanian research project.

2.1. Trends in the purpose and practice of environmental education

Throughout the 1960s, a range of scientists documented and highlighted environmental challenges and problems and, thus, the emergent need for public awareness of these problems (Gough, 2013). Environmental educators led by Rachel Carson, an American-born ecologist and the author of the renowned book *Silent Spring* (1962), initiated the modern environmental movement aiming at promoting technical training, stimulating general awareness of the environmental conditions, and lobbying for the inclusion of environmental topics in the school curriculum. The emerging connection between the environmental movement and education inspired Professor William B. Stapp and colleagues at the Department of Resource Planning and Conservation, the University of Michigan, to develop and publish the first scientifically-founded definition of EE:

> *Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution.* (Stapp et al., 1969, p. 34)

In 1972, Stapp, who based his concerns about EE on humankind's alienation from nature due to urbanization, as well as on the documented environmental challenges, co-chaired the United Nations Conference on the Human Environment in Stockholm. The Stockholm Declaration formally recognized the growing environmental problems and proclaimed:

> *We see around us growing evidence of man-made harm in many regions of the earth: dangerous levels of pollution in water, air, earth and living beings; major and undesirable disturbances to the ecological balance of the biosphere; destruction and depletion of irreplaceable resources; and gross deficiencies, harmful to the physical, mental and social health of man, in the man-made environment, particularly in the living and working environment*. (United Nations, 1972, p. 3)

In addition to the seven proclamations, the Stockholm Declaration stated 21 principles to inspire and guide the peoples of the world in the preservation and enhancement of the human environment. The Declaration stressed the significance of education:

> *Education in environmental matters, for the younger generation as well as adults, giving due consideration to the underprivileged, is essential in order to broaden the basis for an enlightened opinion and responsible conduct by individuals, enterprises and communities in*

> *protecting and improving the environment in its full human dimension.* (United Nations, 1972, p. 5).

The Stockholm Declaration institutionalized the international concern for common actions to manage the environmental challenges, including EE. The immediate result was the foundation of the United Nations Environment Programme (UNEP) in 1972. UNEP has coordinated the United Nation's environmental activities and assisted countries in the implementation of environmentally-friendly policies and practices. William Stapp became the first Director of United Nations Educational, Scientific and Cultural Organization's (UNESCO) Environmental Education Section in Paris.

Thus, Stapp had an important role in connecting the scientific understanding of EE with the institutionalization of EE through the Belgrade Charter in 1975 and the Tbilisi Declaration of 1977. The International Workshop on Environmental Education in Belgrade, former Yugoslavia, resulted in the Belgrade Charter, which states (UNESCO-UNEP 1976, p. 4) "the principal audience of environmental education (EE) is the general public." The Charter operationalizes the objectives of EE through six categories: awareness, knowledge, attitude, skills, evaluation ability, and participation. It is possible to interpret the charter as an elaboration of Stapp's 1969 definition.

The Tbilisi Declaration is the result of the comprehensive Intergovernmental Conference on Environmental Education lasting for two weeks in October 1977. Although the Tbilisi Declaration covers only one page, the conference resulted in 41 detailed recommendations related to the roles, objectives, and guiding principles of EE (UNESCO, 1977). The international society seemed to realize the complexity of EE. Thus, the Tbilisi Declaration proclaims:

> *Environmental education, properly understood, should constitute a comprehensive lifelong education, one responsive to changes in a rapidly changing world. It should prepare the individual for life through an understanding of the major problems of the contemporary world, and the provision of skills and attributes needed to play a productive role toward improving life and protecting the environment with due regard given to ethical values. By adopting a holistic approach, rooted in a broad interdisciplinary base, it recreates an overall perspective, which acknowledges the fact that natural environment and man-made environment are profoundly interdependent … Environmental education must look outward to the community. It should involve the individual in an active problem-solving process within the context of special realities, and it should encourage initiative, a sense of responsibility and commitment to build a better tomorrow.* (UNESCO, 1977, p. 24)

An action researcher could interpret the two last quoted sentences in the Tbilisi Declaration as an invitation to combine EE with PAR projects. Still, the merging of EE and action research was very unusual throughout the 20th century. According to Kyburz-Graber (2013), the main EE idea and approach throughout the 1980s and 1990s focused on instruction as a means to obtain environmentally-friendly behaviors. EE should foster awareness of what educators (normally

scientists) perceived to be environmental threats, and, thereafter, train or impart skills that the educators (scientists) believed addressed the identified challenges, and change those behaviors that the educators (normally scientists) perceived as being dangerous to the environment. Monroe, Andrews, and Biedenweg (2007) confirm the conception of EE as concerned with providing information about environmental challenges and about how to deal with these challenges.

Accordingly, EE was concerned with promoting technical training and stimulating a general awareness of the environmental conditions. According to Stapp and colleagues (1997, pp. 35–36), the focus of EE was to give:

- *A clear understanding that man is inseparable part of a system, consisting of man, culture, and the biophysical environment, and that man has the ability to alter the interrelationship of this system.*
- *A broad understanding of the biophysical environment, both natural and man-made and its role in contemporary society.*
- *A fundamental understanding of the biophysical environmental problems confronting man. How these problems can be solved, and the responsibility of citizens and government to work toward their solution.*
- *Attitude of concern for the quality of the biophysical environment, which will motivate citizens to participate in biophysical environmental problem solving*.

Gough (2013) claims that this initial EE tradition was prescriptive and mainly focused on changing and manipulating learners' behaviors, which were considered a threat to the state of the environment, and on fostering pro-environmental behaviors. The emphasis was on the production of citizens with environmentally-friendly behaviors rather than on how to facilitate the citizens' transformative learning processes related to the management of the changing environmental challenges. Eventually, many educationalists and researchers perceived the view of the purpose of education as behavioral change as too technical. Therefore, approaches to empower individuals to transform themselves emerged (Ferreira, 2013). This shift emerged some years after 2000.

There might be many reasons why EE researchers hesitated to include transformative learning and action research as perspectives and research and action strategies. The initial tradition was easy to understand, built upon a stepwise and logical structure, and, apparently, defined obtainable goals directly related to environmental challenges. In addition, the initial way of thinking in EE relied on the conveyance of scientific facts and the facilitation of citizens' attitudinal changes in accordance with the facts. This way of thinking and acting was commensurable with the prevailing worldview of science. Steel (2011) claims that the positivistic assumptions underlying mainstream science education contradict the transformative philosophy of EE. Thus, he maintains that, epistemologically and practically, the integration of EE into science education had become arduous. Up to quite

recently, science education had perceived reality as objective, value free, reliable, and neutral to social and political phenomena.

At the beginning of the 20th century, researchers started to recognize that poorer communities were more vulnerable to environmental degradation than richer communities were, as they seemed to have higher adaptive capacities to meet environmental challenges. The researchers were therefore becoming more interested in forms of capital that influenced individual, group, and community adaptation to environmental challenges. Within this context, the ability to learn from the changing environmental conditions and the power to acquire and use different forms of capital became very important research topics (Gigliotti, 1990). The researchers from Stockholm University in Sweden borrowed from the psychological concept of resilience to explain the differential capabilities to adapt to the changing environmental conditions, especially those related to climate change.

These perspectives and approaches were largely influenced by democratic education as propounded by Dewey (1938a), and later by Freire (1970), and by the action research movement (Elliott, 2006; Stevenson & Robottom, 2013), which emphasized adaptive and contextualized knowledge development. In accordance with this approach, researchers from the North American Association for Environmental Education (NAAEE) (Hart & Nolan, 1999), particularly Sauve and Bottom, researchers at the University of Quebec Montreal in Canada, started to engage local community members in the research process to promote contextualized problem solutions (Mordock & Krasny, 2001).

By the first decade of the 21st century, the international EE research society seemed to realize and agree on the need for a shift toward the holistic and action-oriented approach advocated in the 1977 Tbilisi Declaration. Thus, Taylor, Littledyke, Eames, and Coll (2009, p. 3) argued:

> *In the last few decades, there have been growing concerns that traditional environmental education (education **about** the environment) is limited in its scope and to effect the necessary attitudinal and behavioral changes needed if ecological degradation is to be reduced ... Rather, rich learning experiences must also include learning **in** the environment and learning **for** the environment, or the taking of actions to improve outcomes.*

However, for decades, the inclusion of learning in and for the environment has been a well-known and frequently used slogan and expression within education for sustainable development (Robottom & Sauve, 2003). Furthermore, the initial EE tradition involved learning about, in, and for the environment. Primarily, the recent changes concern an expansion of EE research strategies and theoretical perspectives, for example, to include PAR, transformative learning, and different perspectives from the social and humanistic sciences, which gives learning in and for the environment an expanded meaning because the understanding of the human being within human sciences differs from that of the natural sciences. Still, the research findings quoted above indicate that the movement from teaching about, to teaching in and for environmental sustainability has

remained as a theme within the academic discourse related to EE. To a large degree, the EE science teaching practice seems to follow the "business as usual" approach.

The academic discourse and understanding of EE has included political, social, and cultural dimensions that influence active participation in decision-making about environmental issues on the local, national, and global scale. The expanded understanding also considers a critical assessment and inquiry relating to the ecological principles and processes needed to make informed decisions about environmental issues. Furthermore, the expansion indicates that EE should facilitate critical discussions of the social and political structures that constitute environmental challenges and, in addition, should promote learning for adaptation and problem-solving abilities. The widening of the understanding of EE has led to debates over whether the discipline should remain as EE or merge with education for sustainable development (ESD) (Jickling, 1992; Wals & Benavot, 2017). Due to its emphasis on learning and the solving of concrete problems, I think EE should remain a distinct field of study.

While the development of EE was closely connected to the Stockholm Declaration, the Belgrade Charter, and the Tbilisi Declaration during the 1970s, the Brundtland Commission (1983–1987) highlighted ESD, which became a main concept in the Brundtland Report (UNESCO, 1987) and later in the Rio Declaration of 1992 (UNESCO, 2014). The integration of socio-cultural, economic, and ecological sustainability in ESD coincides with the expansion that characterizes EE in the 21st century, for example, emancipatory goals, enhancement of the democratic relationship between researchers and local communities, and between the research process and transformative practice (Fien, 2000). McKeown and Hopkins (2003) have compared EE and ESD and conclude that the ESD concept expresses a more developed and complex understanding of environmental challenges than was the case in the early 1970s.

2.2. Teacher education as the "priority of priorities"

Generally, the development of the understanding of EE in teacher education mirrors the description in the former subchapter. Since 1970, teacher education has been a priority of priorities for EE. To reiterate the importance of teacher education as a turning point toward education for the environment, Wilke (1985, p. 1) elaborated on the position of teacher education in EE, saying:

> *The key to successful environmental education is the classroom teacher. If teachers do not have the knowledge, skills and commitment to environmentalize their curriculum, it is unlikely that environmentally literate students will be produced.*

Thus, the idea of producing knowledgeable students aligns with the initial understanding of EE described above. During the Third International EE Conference in 1987 in Thessaloniki, UNESCO reiterated the role of teacher education in revitalizing the teaching of EE. In addition, UNESCO demands that EE should be based on an understanding of and an ability to implement objectives of EE through active teaching methods:

> *It is obvious that even the best curricula and the best teaching materials cannot have the desired effect if those with responsibility for them have not fully understood the objectives of environmental education and if they are not capable of directing the learning activities and experiments comprising such education or of effectively using the materials available to them.* (UNESCO, 1987, p. 47)

If realized through teacher education, the fulfillment of UNESCO's demands could enable teachers to facilitate a community of environmental learners with a critical worldview, which, according to the following authors, is required for dynamic EE (Fien & Tilbury, 1996; Moandikonza & Lotz-Sisitka, 2016; UNESCO, 2014). In line with UNESCO's suggestion, many researchers have also taken an interest in experiential learning as a way to empower teachers for dynamic EE (Gough, 2013; Ramsaroop & Rooyen, 2013; Wilke, Peyton, & Hungerford, 1987). Still, there is a gap between current perspectives in the research on EE and the traditional chalk and talk combined with textbook conveyance of knowledge in many parts of the world (Gough, 2013; Kyburz-Graber, 2013).

In Tanzania, the traditional scientific way of thinking still seems to have remained in place, at least among teachers. In accordance with Steel (2011), and from my own experience, Tanzanian teachers fear the integration of a value-based and action learning-oriented EE in science education due to the notion that such processes may devalue the science curriculum, alienate traditional science students, and jeopardize their own status as gatekeepers of scientific knowledge. Within this mindset and thinking, teaching science easily becomes a poor and dysfunctional vehicle for transformative learning through EE. Kimaryo (2011) found that teachers in Tanzania conceptualized the teaching of EE topics within the framework of positivistic scientific approaches focusing on the acquisition of environmental facts.

The comparison of the Tanzanian teaching tradition and the recent development in EE research in Europe, the USA, and Canada inspired me to want to explore dynamic teaching approaches in my own country, Tanzania. The expansion of relevant teacher knowledge including the ability to communicate with and motivate pupils and the local population regarding environmentally-friendly activities seemed to be very relevant in rural Tanzania. In addition, the inclusion of social science in EE research has brought the critical inquiry of societal issues and power issues into the research field. Still, the review showed limited research about how participation influences power relations. Furthermore, the EE literature under-represents African and Asian examples. Generally, there are limited studies focused on environmental learning and adaptation. I therefore feel that it is important to try to fill some of the gaps.

2.3. Filling the gaps

I conducted the study in Africa, which is an under-represented continent in the EE literature (Rickinson, 2001). I hope that the study can provide useful insights into improving EE practice in Africa and specifically in Tanzania, where a dependence on agriculture increases the local

vulnerability toward harsh environmental conditions. Through the dynamic teaching of EE with a PAR approach in local communities characterized by environmental degradation, resource constraints, and hierarchical power relations, I try to address the relevant, main challenges for EE in Tanzania with recent research approaches in mind. My hope is that teacher educators, teachers, and student teachers can apply the framework I have developed throughout the three articles as a tool for teaching and learning, and as a point of departure for reflecting on and improving teaching and learning approaches in communities where socio-cultural conditions make the adaptation of participatory teaching difficult to realize. I also hope the study offers some useful insights for countering hierarchical power relations in EE and for facilitating the local community motivation to address environmental challenges.

3.0. Socio-economic characteristics of Tanzania

Although Tanzania is endowed with rivers, mountains, wetlands, savannah, and coastal and marine ecosystems, many of these important ecosystems are turning into deserts and dry valleys, hence threatening the sustainability of rural communities (Devissche, 2010). In this chapter, I will provide a brief description of how the socio-economic characteristics of rural Tanzania and my study areas in particular connect with environmental challenges. Initially, I describe the socio-economic roots of environmental degradation. Then I will highlight the role of Tanzanian teacher education as a focal point of environmental knowledge.

The environmental challenges in Tanzania are related to the demographic conditions, livelihood characteristics, and the Tanzanian education system. Demographically, the fertility rate is high, also compared with other African countries. In 2012, the population of Tanzania was 44 million with a growth rate of 3.1% (URT, 2013). The high fertility rate puts pressure on farmland, forests, and rivers. The human use of natural resources exceed the ecological systems' ability and capacity to provide reliable sources of water, soil, firewood, and charcoal to the rural communities (Devissche, 2010).

In terms of livelihood characteristics, Tanzania is a poor country. The majority of the population depends on small-scale subsistence agriculture, which employs more than 70% of the population. Still, shifting cultivation, involving slash and burn, characterizes the farming systems in many parts of the country. Pastoralism, with lots of herds, leads to overgrazing. The extensive use of shifting cultivation causes deforestation and depletes soil fertility. Therefore, in Tanzania, the main farming systems are directly connected to high levels of environmental degradation (Kidegesho, 2015).

The government of Tanzania highly ranks education as a tool for addressing the existing socio-economic challenges related to poverty and disease. Therefore, the country has developed a 2+7+4+2+3 educational system, consisting of two years of pre-primary education, seven years of primary, four years of lower secondary, two years of upper secondary, and three years of university education. Although a large percentage of the population is enrolled, the number of pupils decreases sharply with increasing levels of education in secondary schools and colleges.

3.1. Characteristics of the study district

This subchapter describes the socio-economic characteristics of the study district. I conducted the study in Kilosa District, which is one of the six districts that form Morogoro Region in the East of Tanzania. The District has a total area of 14.245 km² (1424500 ha) out of which 5037.27km² (503727 ha) is covered by forests. The loss of forest is the major concern in the District. The available data show that 82% of the forest cover was lost before 1955 during the colonial period through the establishment of sisal farms. With the rate of forest loss per year at 0.7% thereafter, this means that 3528 ha of forest cover was lost every year between 2000 and 2006.

The population in the District is 438,175, the majority of whom depend on small-scale agriculture and pastoralism. Recent studies show that the agricultural and livestock systems and the unsustainable harvesting of forest resources for charcoal, firewood, and timber are largely contributing to the declining amount of unpredictable rainfall that has affected the livelihoods of the people in the area. The District has a total of 223 primary schools, 38 secondary schools, and a teachers' college, Ilonga Teachers' College. The College resides in the Northeastern part of the District, in Ilonga village at the foot of the Kaguru mountains, along the old central slave trade route (Beidelman, 1960) and along a new road between Dumila and Mkumi passing through Kilosa town. Originally, catholic missionaries built the College as a catechist education center. In 1995, the Tanzanian government developed and established the Ilonga Teachers' College (Figure 1).

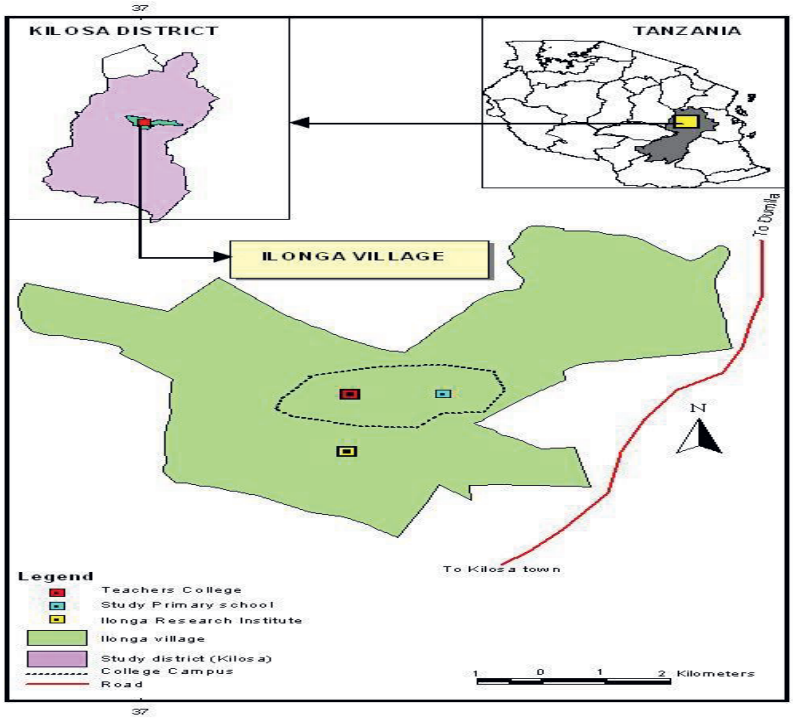

Figure 1: The location of Ilonga Teachers' College.

Figure 2: The distribution of the participating primary schools.

As indicated in Figure 2, I first conducted the study in Kilosa District involving Ilonga Teachers' College (number 5 in Figure 2) and in Ilonga Primary School (number 6 in Figure 2). During the second phase, I expanded the coverage to include more schools in Kilosa District such as Msimba Primary School (number 7 in Figure 2) and Msowero Primary School (number 8 in Figure 2). The other schools included in paper 2 are Ngudulugula Primary School (number 1 in Figure 2), Nyambulolo Primary School (number 2 in Figure 2), Lwemo Primary School (number 3 in Figure 2), Kazuramimba Primary School (number 4 in Figure 2), Mwambao Primary School (number 9 in Figure 2), and Bungi Primary School (number 10 in Figure 2). The distribution of the teachers in the schools all over Tanzania provided rich and varying experiences about the conditions for EE in Tanzania.

The changes and the associated community vulnerability to the changing ecological conditions was the major reason for the choice of Kilosa District as a study district. As reported in paper 1, the available documents indicated that the District was one of the most vulnerable districts to land degradation due to high numbers of livestock and a shortage of land for agriculture that forced the local communities to occupy marginal lands on mountain slopes. Government institutions and sisal settler farms own most of the arable land. Coupled with poor EE, the shortage of land threatened the sustainability of the community. In the next subchapter, I will discuss some contextual factors that

have shaped the teaching of environmental topics in Tanzania. First, I will start with a short history of Tanzania teacher education and then education policy development.

3.2. Organization of teacher education in respect of environmental education

The origin of Tanzanian teacher education in Tanzania coincided with the missionaries education of teachers to translate Christian bibles in the 19th century. In 1892, the German colonial administration established the first secular training center for teachers in Tanga Region (Anangisye, 2010). By 1931, there were 16 teachers' colleges in Tanzania. The number rose to 22 in 1962 and to 92 teachers' colleges in 2010. Currently, the government has expanded the enrolment in all the three levels of teacher education: 1) the certificate level of teacher education, which educates teachers to teach in primary schools; 2) the diploma level of teacher education, which educates teachers to teach in secondary schools; and 3) the degree level of teacher education, which educates teachers to teach in upper secondary schools (URT, 2016, 2017).

In order to meet the demand for the education of well-qualified teachers, the government has adopted competence-based teaching approaches in which the practice teaching sessions are important components of the curriculum (URT, 2017). Based on the 1925 native educational policy, and later on education for self-reliance (ESR), the competence-based teacher curriculum encourages inquiry-based teaching and learning processes that include solving real-life problems. The realization of ESR requires that teachers learn practical skills and strategies for the facilitation of school agriculture (Mulder, 2017), which forms a point of departure for EE.

In that respect, every teacher college connects with practice teaching schools where student teachers can practice their teaching. The practice teaching sessions constitutes 8 weeks of every academic year making a total of 16 weeks of practice teaching throughout teacher education. Although environmental learning is an important experience for student teachers, the themes that relate to EE follow the curriculum for the primary schools. Thus, the themes spread out and are divided between science, mathematics, and geography. The themes within and the organization of the curriculum give the framework through which student teachers can connect learning experiences with everyday practices, primary production, and with real-life environmental challenges.

In that respect, the framework provides both challenges and possibilities for improving the teaching of environmental topics in both teachers' colleges, primary schools, and in the management of environmental challenges. In the next chapter, I will discuss the research methodology.

4.0. Research methodology

In this chapter, I explain the research strategy and the theoretical framework that guided my decisions in the fieldwork and throughout my PhD studies. I chose PAR as my overarching research strategy and based my choice on my understanding of the nature of the environmental challenges facing Tanzania, opinions from colleagues, friends, and supervisors, and my prior experience with participatory community development processes to address similar challenges. Through PAR, I wanted to develop a community-based process that could lead to the generation of practical EE knowledge for the improvement of EE practices in a teacher training college. Carr (2006) supports that the goal of PAR is to create dialogues that foster a better understanding of and improvement in practical knowledge. Dialogues with colleagues, at conferences, and in other arenas also contributed to the development of my approaches. The idea of involving student teachers in the study arose after reflecting on the comments and opinions that emerged during the Collaborative Action Research Network (CARN) Conference in England in 2014. In line with the reasoning in subchapter 2.4, I consider teacher education to be a proper place to initiate changes in EE. Involving a group of student teachers and their tutors and practice teachers was manageable in my PhD project.

PAR became the research strategy due to the idea and belief that the researchers, together with stakeholders in the Teachers' College, local community members, and teachers from schools surrounding the College, could map the local conditions, plan for possible actions to address challenges, implement the actions, and evaluate the results. PAR had the potential to ensure local ownership and a continuous and long-lasting local capacity to manage environmental challenges. I chose relationship-based experiential learning elaborated by Krogh and Jolly (2012) as the main theoretical perspective because the model follows the same steps as PAR and is commensurable with how stakeholders might learn in the planned PAR process. The aim was to create an example of how teacher education together with a local community could develop EE through a PAR process. Such an example may inspire other teacher education institutions and lead to the development of and change within EE over time.

Hence, I chose my research strategy considering my personal experiences and the historical context of Tanzanian educational practice. Since 1961, Tanzania's government has been striving to achieve an emancipatory education system by decentralizing education services and encouraging contextualized learning to achieve problem-solving capacities in local communities using the education sector as a means to address ignorance, disease, and poverty (Swantz, 2001). The choice of relation-based experiential learning is in accordance with the history of the Tanzanian education system, which, under the leadership of Julius Nyerere, emphasized working together in cooperation as the means to achieve social changes. Thus, this learning approach also relates to the founding philosophy of Tanzanian education and ESR. In addition, relation-based experiential learning is in line with a current democratic movement in Tanzanian education policy and connects with the demand for

contextualizing and concretizing EE though teaching practices in collaboration between teacher education, practice schools, and local community members.

The potential of PAR as a strategy to improve practice and create practical knowledge (Eikeland, 2007; Fals-Borda, 2001; Herr & Anderson, 2005) contributed to my choice of research strategy. Dreier (1999), Kemmis and McTaggart (2007), and Lave and Wenger (1991) further indicated that the PAR strategy can lead to improved learning practice by promoting the application of ideas and skills in real-life situations. When the participants become co-researchers in the research process, the collaboration can promote new insights that both improve practices and empower researchers and practitioners, who then become the agents for change in their own practice, and, eventually, who can contribute toward advancing theories.

Elliott (1991), Hiim (2014), and Korthagen and Kessels (1999) emphasize that PAR is important in professional teacher development since it provides good sources of data for self-reflection and hence facilitates action and learning. According to Hiim (2014), PAR is a preferred alternative for the development of improved education systems that build on teachers' everyday practice with their pupils and is a bottom-up approach to changes in practice. These characteristics make PAR an important research strategy when the main purpose of the research process is to positively influence the teaching and learning practice and influence professional teacher development. This purpose is commensurate with the main aim of this study of improving learning and professional teacher development in teaching environmental topics. Therefore, scholars doing EE studies often prefer and emphasize the PAR strategy and methodology due to the aim of empowering schools and local communities to address environmental challenges (Stevenson & Robottom, 2013).

4.1. Background of PAR in Tanzania

PAR is a more established research tradition among universities in Western countries than among universities in Africa and Asia. In Africa, the PAR strategies are relatively more common in South Africa, where PAR often connects with the struggle against the antiquities and remnants of apartheid policies (Esau, 2013). In Tanzania, the struggle against post-colonial inequalities and the development of a socialist ideology at the beginning of 1960s, when community participation in Tanzania was the core principle of the development agenda, led to governmental encouragement of PAR (Nkulu, 2005; Nyerere, 1967; Swantz, 2001). As discussed in papers 1 and 2, the ruling party (Chama Cha Mapinduzi [CCM]) and the government emphasized and promoted the development of education for the service of the majority of the population.

Responding to party and government directives, schools created evening classes for adults and encouraged adults and pupils to participate in self-reliant activities. This kind of education aimed at teaching pupils the basic skills to manage their everyday lives in their communities and at developing the basic values of serving communities. The activities included farming, carpentry, animal husbandry, and the construction of public houses, especially for teachers' accommodation. In

accordance with the 1967 directives (Nyerere, 1967, 72–75), the University of Dar es Salaam, then the only university in Tanzania, allowed students to undertake PAR involving local communities (Swantz, 2001).

At the SUA where I work, PAR is a new research approach. Recently there has been some interest in using PAR, especially in research projects in the collaborative research programs between the SUA and the Norwegian University of Life Sciences (Ahmad, 2016; Jäckle, 2016). As a participant in those projects, my experience was that the projects initiated important dialogic processes between university researchers and involved small-scale farmers, which inspired many other researchers at the university. The sharing of knowledge and practical experiences with small-scale farming communities transformed our understanding of Tanzanian farmers (Msuya et al., 2014).

4.2. Research process: PAR methods and tools

In many parts of the world, EE policies emphasize that the goal of teaching environmental topics is to facilitate the management of environmental problems in local communities (Fien & Tilbury, 1996; URT, 1995, 2010). However, my experiences from being a secondary school teacher and an extension worker educator has made me aware of the gap between the theoretical and scientific approaches to EE and the lack of practical applications of the approach to be able to handle environmental challenges. After reviewing the EE literature and attending action research courses and several action research conferences, I developed a belief that PAR could help in transforming EE practice. PAR, which has become attractive to EE researchers (Stevenson & Robottom, 2013), seeks to explore problems while at the same time improving the situation of the people involved in the research process.

PAR appealed to me as a research strategy due to the emphasis on participatory processes and democratic decision-making. I had realized the importance of participants' involvement and their influence over decisions through partaking in HIV counseling. Through the counseling, I engaged in using communication tools such as active listening and working with client empowerment. These tools and values were transferable to PAR, which aim at participants' empowerment through involvement in democratic processes, and, through dialogues, of becoming conscious about and critical toward power structures (Rowell, 2019). In addition, my philosophy and worldview aligned with PAR's strategy to co-create knowledge that is useful in the local community.

However, as Bergold and Thomas (2012) warn, not all PAR processes will transform practice. The facilitators, co-researchers, and participants need to collaborate carefully in the planning, implementation, and evaluation phases to make PAR and action learning transformative. Therefore, I devoted the first phases of the PAR project to developing plans together with the participants, as discussed in detail in paper 1. I accomplished the planning process through participatory observation, interviewing teachers, tutors, and village leaders, and then organizing FGDs. We encouraged participants to document their teaching and learning processes as a foundation for learning from

their achievements and improving their weaknesses. The use of videotaped materials from teaching sessions encouraged and assisted student teachers to analyze and evaluate their teaching practice in new ways and to experience the school and classroom reality differently. The student teachers focused on small, familiar problems that they could manage through consultation methods, as suggested by Noffke (1997). During the planning phases, power issues were an important challenge, which we addressed through several strategies, as suggested by Somekh (1994), including informal talking, building local confidence and self-esteem, and fostering trust (see paper 1 for the details).

Thereafter, we introduced experiential learning methods to the student teachers, their tutors, and the practice teachers in the nearby schools. We (researchers, student teachers, teachers, and tutors) were learning by participation in tree planting and practical environmentally-friendly activities. Through the initial phase we also learnt by becoming critical of our own learning and by learning from our critical friends who had joined us in the initialization of the project (Ahmad, 2016; Jäckle, 2016). In accordance with Dewey (1938a, 1938b), we gradually learnt to live suitably with each other in the created community of practice. The experiential learning process involved the mapping and determination of the most critical environmental problems, conducting meetings to prioritize the challenges, and developing plans for teaching sessions that the student teachers implemented in the practice teaching schools. Later, the student teachers went through the same process in communities/schools in their home regions. After each practice period, the student teachers reflected on their experiences from the practice and the applied methodology in order to develop contextually appropriate knowledge about their EE practice. Inspired by Kemmis and McTaggart's (1988) PAR cycles, as shown in Figure 2 of paper 2, the participants collaboratively mapped the teaching situations of the environmental topics and the available resources at the Teachers' College and in the primary schools. Together with members of the local communities, they committed themselves toward improving the teaching and learning situation.

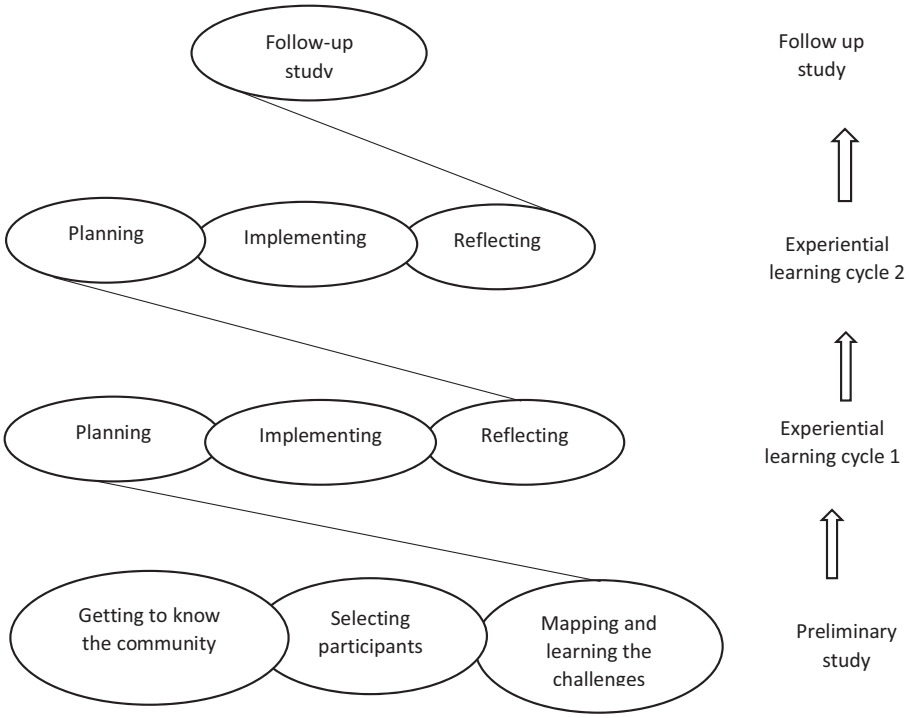

Figure 3: The research process.

In PAR, the grounding structure follows the cycles of planning, acting, and reflecting (Kemmis & McTaggart, 2005). Initially, it is not possible to make a detailed plan for the cycles, as the reflection after one phase of planning will determine the next phase. Nevertheless, I had to plan the initial phase of getting to know the community and mapping the environmental challenges. Reflections on this phase laid the groundwork for the next phase of planning and for conducting workshops on experiential learning. Thereafter, we planned the student teachers' first practice period and reflected on the experiences from their teaching. We carried out the mutual reflection after this period through FGDs. By considering our reflections from the first cycle, we planned the second practice period along the same lines.

Within the two main PAR cycles there were several smaller cycles, where the student teachers planned, carried out, and reflected on their teaching. These smaller cycles were action learning cycles where the student teachers learned together and from each other. The purpose of the action learning strategies was to promote the learning components of the study. We therefore visited participants in the field, conducted demonstrations, observed their teaching, gave feedback, and provided support via mobile phones in areas where the researchers could not go due to resource limitations. We also provided material support including handouts, diaries, and self-evaluation forms. In addition, we trained teachers to act as peer mentors in the practicing schools. Together with the

PAR principles of structuring and systematizing the research processes, we followed action learning principles to facilitate collaboration in the development of practical solutions to environmental and pedagogical challenges.

Therefore, we encouraged student teachers to value their own insights as important sources in the search for practical solutions. We also encouraged their sharing of practical solutions through their mobile phones and, in addition, their discussions of challenges related to the implementation of knowledge and skills in their practice. Thus, we encouraged the student teachers to learn by testing their emerging knowledge of EE practice and asking fresh questions (Bourner & Brook, 2019; Zuber-Skerritt, 2015).

The follow-up study was important in order to evaluate the sustainability of the first and second cycles and to learn from the whole process of the PAR. In this way, we could learn more about the challenges associated with PAR through uncovering participants' experiences of changes in their EE practice, and, with this background, establish further support that might be necessary to sustain positive changes. I carried out the follow-up study in the Teacher Education College and the nearby schools and communities where the students had their first practice period. The study involved the observation of teaching practice in participating schools, the observation of outdoor activities, and discussion sessions in meetings. The study also involved feedback on how to address the emerging challenges and local opportunities for supporting the challenges.

4.3. Selection of a teacher college, primary schools, and participants

I selected Ilonga Teachers' College because I had previously worked in the surrounding area and anticipated that my relations with the inhabitants would make the process of building trust easier. Then, I selected Ilonga Primary School, which is one of the practice teaching schools attached to the College. Later, we selected eight primary schools in different regions, because these schools were close to the participating student teachers' homes. The student teachers conducted their practice teaching in these primary schools. Ilonga Teachers' College is located in Ilonga village and cooperates with Ilonga Primary School.

Among the first-year students, the researcher and the College tutors, in collaboration, selected ten student teachers to participate in the study. The selected participants were student teachers qualifying for diplomas to teach in Tanzanian primary schools. As explained before, the majority of Tanzanians have access to primary school education. Therefore, teachers are crucial for the realization of EE in Tanzania. Prior to participating in the teacher education program, the student teachers had completed their secondary school level of education and, thus, they had the preliminary experience required to participate meaningfully in an EE program (URT, 2016, 2017).

Guetterman (2015) suggests that ten participants is sufficient for capturing the essence of the experiences. In accordance with Pine (2009), we also used prior teaching experience and readiness to spend time on the project as selection criteria. Furthermore, six tutors from the College and seven

primary school teachers from the practice teaching schools participated in the project. The seven primary school teachers would collaborate with student teachers in planning relevant EE activities in the practice schools. Furthermore, they would be responsible for sustaining EE activities after the student teachers had completed their education program at the Teachers' College. The tutors were to be co-trainers together with the project leader in experiential teaching and EE. In addition, a local gardener and a local extension officer were co-trainers. The co-trainers from the local community held valuable practical experience.

4.4. Clarification of the researcher's positions

In PAR, clarifications of the different positions of the researcher is of importance because these positions might influence the research outcome. In this project, I was the main researcher and the facilitator of the teaching and learning processes, for instance, through conducting workshops in experiential learning. In addition, I facilitated meetings, and worked together with and advised the participants in their choice of teaching methods in the respective EE topics. I also encouraged teachers and tutors to adapt and use strategies that fostered the empowerment of student teachers and community members in order to enable them to take responsibility for the environmental challenges.

My concern was not only to produce research, but also to support the project participants in solving the challenges that mattered to them. This included supporting them by providing some minor resources the participants could not afford to mobilize locally. During the first PAR cycle of plan–act–reflect, we encouraged homogenous and friendly group discussions to promote greater participation. Still, the anticipation of readymade answers from the researchers influenced the PAR process and the way local stakeholders initially participated. We needed time together to overcome such expectations and, thereafter, to develop a climate of collaboration.

4.5. The development of a theoretical framework

My theoretical framework emerged from a constant interplay between the research practice and reflection on existing theories. Initially, I drew my insights from John Dewey's (1916) theory of experiential learning. In this subchapter, I will elaborate on how the experience of EE practices called for the expansion and refinement of theoretical perspectives and how the choice of PAR served as the ideal strategy to create a theory of practice.

Experiential learning seemed to be an appropriate theoretical framework for structuring EE activities because the participants needed to deal practically with real-life challenges and reflect on and learn from their practice for the establishment of workable principles (Dewey, 1938a, 1938b; Kolb, 1984). I expanded my understanding of experiential learning by applying the relationship-based experiential learning framework developed by Krogh and Jolly (2012), which made me more aware of the motivational foundation for learning. Further, the nation-builder Julius Nyerere's (1967) ESR, the former policy framework for local community participation and cooperation in EE, inspired my

theoretical approach. According to Ahmad (2016), ESR still influences education practice in Tanzania. Cooperation through experiential learning with a practical approach to EE seemed crucial for the local inhabitants' motivation for participation in the project. The rural Tanzanian context with a high level of poverty, disease, and ignorance can explain the willingness to participate, as the need to handle the challenges is in high demand. The organization of workshops and seminars mainly followed the principles of experiential learning to train the participants in this way of learning.

On the other hand, drought management and the insecurity of planted trees facing uncontrolled animal grazing became arduous and demotivated some of the local inhabitants from participation. Therefore, questions related to human motivation, human resilience for the exposition to stressors, and the management of cultural conflicts occurred. Although Krogh and Jolly (2012) mentioned motivation as important for learning, I needed to explore theories of human motivation more extensively to be able to understand and analyze the findings in relation to motivational criteria. In that regard, I found the theory of self-determination developed by Ryan and Deci (2000), which relates to inner motivation, useful. Antonovsky's (1987) theory of salutogenesis complemented Ryan and Deci's psychological perspective on motivation with a sociological approach. After finishing the fieldwork, when I started to analyze the data, I further discovered a need for theories of human resilience (the capacity and expectation to manage environmentally-friendly activities in a harsh environment) in order to explain some of the main findings. Then I realized that Antonovsky's approach to salutogenesis is commensurable with perspectives on human resilience, especially the management of stressors.

During the first and second PAR cycles, I realized that the tension between the simultaneously existing traditional hierarchical and modern democratic power systems in Tanzania strongly influenced the conditions for continuous and long-lasting community engagement in EE activities. Applying a structural and neo-Marxist sociological approach, Bourdieu (1977) distinguishes between implicitly accepted power systems, doxa, for example the hierarchical power systems in Tanzania, and debated power systems, opinion, for example Tanzanian democracy. Bourdieu's approach permitted the disclosure of the existing and observed implicit power structures and critical analyses of the parallel power systems. On the other hand, the political and pedagogical theories of Nyerere (1967) and Freire (1970) revealed the potential and possible outcomes of the observed PAR processes. In this way, I developed the theoretical framework in dialogue with field observations and the findings from the PAR research. Still, the extended theoretical framework was coherent and in accordance with the founding principles of relationship-based experiential learning and self-determination theory.

Through dialogue between the findings and relationship-based experiential learning, self-determination theory, and the model of salutogenesis, I elaborated my own framework and models in article 1 and article 2. In article 3, I added Bourdieu's model of doxa and opinion into my theoretical framework, also as a theoretical answer to my findings. The theoretical framework I

developed mirrored the psychological, social, and political dimensions of EE practice (Kimaryo, 2011; Palmer, 2006).
According to these authors, the careful introduction of learners into the real-life world where they can participate in solving real-life problems fosters the mastery of problem solutions relevant to the real-life conditions. Antonovsky's (1987) concept of a sense of coherence, Ryan and Deci's (2000) concept of self-determination, Thomas and Vesthouse's (1990) approach to mentoring and team-building, and Bandura's (1986) concept of self-efficacy concretize the role of real-life experiences in promoting meaningful learning. Nyerere (1967) and Freire (1970) emphasize the roles of working together as the way to facilitate learning.

4.6. Data collection

PAR requires the use of multiple strategies in data collection. In this study, I used a combination of data-collection methods at every stage of the research process, including mapping, planning, implementation, and reflections.

I collected the first data set during the mapping phase between September 2016 and March 2017. The first data set was related to environmental challenges in the local community surrounding Ilonga Teachers' College. I also collected data concerning teaching and learning resources in the Teachers' College and the surrounding primary schools where student teachers did their practice. I primarily collected this data set through participant observation, semi-structured interviews, FGDs, and teaching logs for later analysis. Tutors, College administrators, student teachers, teachers in practice teaching schools, and local community members were important sources of data. I used the whole data set to write the first paper.

During the project implementation phase between May 2017 and September 2017, I collected the second data set relating to transfer challenges of environmental knowledge from Ilonga Teachers' College and the primary schools in order to address environmental challenges in the participating local communities in other regions in Tanzania. In the collection of this data set, I emphasized the student teachers' planning, their collaboration with teachers and local inhabitants, and the teaching methods they realized during the practice teaching period. I collected the data through semi-structured interviews and student teachers' diaries, teaching logs, and field reports. Tutors, teachers, and student teachers were important sources for this data set. I used the second data set to write paper 2.

Thereafter, I collected the third and last data set during the follow-up study in September 2018. This data set focused on the documentation of challenges associated with sustaining the environmental management activities in the two previous cycles. In addition, I wanted to get more data about power relations between actors in the education system. Teachers, tutors, local government authorities, and a gardener were important sources of data for this data set. The methods for data-

collection were semi-structured interviews and FGDs. I also observed teaching and outdoor activities. I used this data set to write paper 3.

Throughout the project I used four major data-collection methods; namely, FGDs, semi-structured interviews, observations, and document analysis. Thereafter, I recorded the data through writing and by photos, sound recordings, and a few videos. I provide details of the data-collection methods in the following.

4.6.1. Focus-group discussions

An FGD is an organized discussion around a particular theme or themes of interest. According to Kambeleris and Dimitriadis (2011), FGDs serve to produce rich data related to the dynamics of social relations. In addition, well-organized FGDs can democratize research processes and serve as an empowerment tool to engage and motivate participants. During the mapping phase, I used FGDs to detect, clarify, and nuance consensual opinions related to the main environmental challenges, which helped to summarize the interview data into key issues. The FGDs involved tutors, student teachers, teachers, and members of the local community. In this way, FGDs become both a tool for democratic decision-making and for verifying data.

4.6.2. Semi-structured interviews

A research interview is a guided conversation between two people on a specific issue(s). According to Patton (2002) and Punch (1998), the purpose of conducting interviews is to obtain a rich description of a theme, an event, or a phenomenon. Fontana and Frey (2005) emphasize that research interviews can be a way to promote interpersonal relationships and to create the space for interpersonal communication between a researcher and an informant or conversation partner. I used both semi-structured interviews and FGDs in many parts of the research process. I interviewed the College Dean, student teachers, pupils, and teachers in the practice teaching schools. Through the semi-structured interviews, I collected data about teaching methods, whether they were traditional, talk and chalk, or copying from the blackboard, or student active, experiential learning strategies. The semi-structured interviews also captured student teachers' opinions on how they experienced their teaching practice and therefore they were a gateway to elaborating on the outcomes of the experiential learning approaches. The interviews were conducted both face to face and through cell phones, especially in the second practice period. In addition, the interviews gave rich information on the realization of EE in the pupils' homes. Hence, I interviewed pupils in schools close to the Teachers' College. I wrote notes during the interviews and recorded interviews in audio files. I will elaborate later on how I analyzed the data.

4.6.3. Document analysis

According to Bowen (2009), document analysis is useful for revealing and clarifying the historical course of events and can therefore contribute to a nuanced and more precise understanding of the dynamic nature of the investigated phenomenon. Documents can suggest which issues to choose as most important for further exploration and inquiry. Bowen (2009) further points out that document

analysis is the best way to triangulate information we receive from other data-collection methods. In this project, document analysis became important to understand the founding conditions for teaching in primary schools and the teaching and learning methods in use. I reviewed the detailed instructions of the Tanzanian primary school syllabus, the teaching plans, teaching evaluations, teaching reports, and the minutes of school meetings. Student teachers' own teaching journals, diaries, teaching logs, and evaluation reports were also important data sources. The documents provided rich and detailed information that complemented the interviews and observation methods. Together, the data from different methods contribute to the validation of the findings. The analysis of the documents involved reading and interpreting the documents and then identifying words, phrases, and sentences supporting or contrasting the themes or categories that I identified by using thematic analyses. According to Bowen (2009), content analysis is the preferred method for data analysis involving secondary data, when the data collected aims to complement other data that has been collected. I will return to that later.

4.6.4. Participant observation

Combined with self-reflection in order to clarify the observers' biases, observation makes detailed descriptions and a holistic and thick descriptive view of events and phenomena in their own context possible. Because of the method's capacity to connect data closely to reality, Cohen, Mannion, and Marison (2008) accentuate observation as a well-qualified data-collection method for critical inquiry. Adler and Adler (1987) and Kawulich (2005) claim that participative observation is the best method to establish positive relationships with research participants, and to obtain a fair, broad, and adequate understanding of the natural setting of the research context. By carrying out PAR, the researcher is part of the planning, implementing, and evaluating processes (Schabort, Sinnes, & Kyle, 2018). Therefore, I was mainly a participant observer.

Throughout the PAR project, I mostly used observation in triangulation with the data collected with the above-mentioned methods, for example, related to teaching and learning practice in schools and at the Teachers' College. I also participated in outdoor activities related to tree planting and gardening to witness how practicing student teachers, together with pupils, teachers, and other local stakeholders, realized EE topics in schools. Furthermore, I observed outdoor activities when visiting some teachers in the field. In these sessions, my role was mainly passive as I was not actively participating in the teaching. However, I observed both student teacher interactions and relationships in the classroom and in outdoor teaching.

Following Kawulich (2005), one of the purposes of using participative observation was to build mutual trust and confidence between the local community members and other participants and myself as researcher. I anticipated the building of trust and confidence as a condition for the realization of democratic participation and decision-making, and, also, for motivating the participants to implement the teaching methods we were teaching. Therefore, I participated in teaching activities at the Teachers' College with the selected group of student teachers. I also participated in the

evaluation of teaching processes. Every member was aware of my role as a researcher, but I tried to establish myself as a colleague, and most of the time I worked under the supervision of the appointed leaders. Thus, I also participated in outdoor activities including planting trees, pruning, and doing the gardening. My intention was to gain insights about the motivation process and also to teach and motivate the participants to do the planting correctly.

I recorded the observations in field notes, which I complemented with photographs. Prior to the observations, I stayed with participants in Kilosa for one month to get access to and an in-depth understanding of their ordinary everyday lives, and to build mutual trust between the tutors, student teachers, community members, and myself.

Summarized, the data collection involved a range of strategies to obtain a rich description of EE practices in the study area and to discuss the outcome of the PAR processes. According to Yin (2014), the use of varied methods of data collection provides the researcher with the opportunity to establish an in-depth understanding of processes but also to triangulate data to secure authenticity, validity, and reliability.

4.7. Methodology for the literature review

The purpose of any literature review is to inform the research process with the current status of the field of study. Therefore, the review in this extended abstract informs the organization and implementation of this study. To ensure that quality publications were included in the review process, I consulted librarians at NMBU for current publications in EE and for common search engines that were relevant for EE reviews. Using the advice of the NMBU librarians, I identified four search engines; namely, Google Scholar, Web of Science, ERIC, and EBCOhost. I chose the following search terms: *environmental education, participatory methods in environmental education, action learning in environmental education and participatory action research in environmental education, education for sustainable development, science education for environmental sustainability and environmental sustainability*. I searched the terms in one search engine after the other, generating thousands of published books and articles. I narrowed down the search to include Africa and then Tanzania. Then I excluded articles and books that did not include participatory approaches. In addition, I consulted experts in PAR and in EE, and I included reading lists from course outlines that I attended as part of my PhD requirements.

Further, I updated the list during my fourth year of study after amendments to include some new publications. The process of adding new references followed the same process, including consultations and discussions. Knopf (2006) suggests the rule of thumb to use when choosing relevant articles and books from thousands of published books and articles. Accordingly, the authors should first read articles and books by lead authors, thereafter the author should turn to recent publications, and then consider articles and books that advance the interest of the reviewer. In that respect, articles from reputable EE journals such as the *Journal of Environmental Education,*

Environmental Education Research, International Handbook of Research on Environmental Education, and the Canadian Journal of Environmental Education were the primary sources. Within these journals, *Arjen E. J. Wals, Regula Kyburz-Graber*, *Robert B. Stevenson, Stephen Sterling, and William Stapp* become important authors and their work provided the building blocks for further development of the review process. To develop the theoretical framework, I first consulted motivational theories including that by Ryan and Deci (2000). Then I used the insights gained to expand the search to include Antonovsky's salutogenesis theory and later Bourdieu's theories of the connection between habituated practice and opinion, ideology and power (Antonovsky, 1987; Bourdieu, 1977, 1986). That means that the theoretical perspectives were evolving with the development and with input from the PAR process in close collaboration with my supervisors.

4.8. Data analysis

McNiff (2017) defines data analysis as the process of identifying information from the specific data set, which the researcher can count as evidence in relation to the themes she or he has focused on throughout the research process. In my study, data analysis followed immediately after data collection in order to inform the next phase of data collection. In accordance with McNiff (2017), the data-analysis process involves content analysis and coding. My first step was to convert all the voice data into a textual format. In line with Braun and Clarke (2006), the transcription is the starting point for understanding the meaning and identifying patterns in the qualitative data. The interpretation and systematization start with repeatedly listening to the voices and watching the videotaped actions.

Therefore, I listened to the FGDs and interviews several times. Sometimes I connected the devices to loud-speakers to be able to hear the voices properly. I did most of the transcription during the evening after the data collection to give time for the participants to validate the transcriptions before they had forgotten what they had said. Therefore, I transcribed in Kiswahili and gave the texts to the participants. Later, I translated the texts into English.

After the transcription, I read and re-read the transcribed texts to make sense of different sections and meanings implied in different sessions of the data sheet. Repeated reading gives an understanding of both the surface and the deep meaning of data. After reading a text, I marked, normally with computer highlighters, the sentences, words, and paragraphs that were related to my research questions. Thereafter, I analyzed the marked words, sentences, and paragraphs to identify patterns of meanings in the texts. Again, this process involved reading and re-reading in order to clarify and nuance meaning and patterns of meaning. This was a back-and-forth process from the original data to the research questions until I was certain that I had included every concept related to the research question.

Then I grouped sentences, words, or paragraphs according to similarities of meanings and named the groups accordingly. In the mapped data, I identified ten categories of aspects that related to

improved teaching of EE in the study area. I further grouped these categories into five themes, which I labeled as physical conditions, teaching conditions, material conditions, socio-cultural conditions, and teaching competence. These themes became the main organizing categories throughout the other analyses, since I later used the categories when the participants and the researcher discussed the practice improvements through the PAR process. Accordingly, in paper 2, the authors first categorized conditions for EE as learning conditions, teaching conditions, teaching competence, socio-cultural conditions, and physical conditions, and, thereafter, discussed the categorized conditions in relation to the PAR processes.

To explore the socio-cultural conditions affecting the teaching of environmental topics, I initially interviewed tutors, teachers in primary schools, and student teachers who had been teachers before joining the Teachers' College. Then I conducted FGDs to determine the extent to which the explored factors were important in influencing the relevant teaching. Thus, I used the responses from the interviews to formulate questions. The FGDs helped to filter out some issues that the group agreed upon as not very common. Through the FGDs, we identified ten main issues that affected the teaching, which we further collapsed into four main issues that we discussed in relation to the theories. I have reported the details for this procedure in paper 1, where I have attached the interview guide.

4.9. Consideration of trustworthiness

Trustworthiness in research is the extent to which the research process leading to the findings upholds the basic qualities of truth including confirmability and transferability (Lincoln, 1995). Bradbury and Reason (2001) suggested and outlined criteria for trustworthiness in action research studies. These include applicability, quality of interaction, actualization of democratic values, the advancement of human aspiration, a commitment to multiple ways of knowing, and methodological appropriateness. I have elaborated the first four qualities of this PAR in the three papers. In this section of the thesis, I will highlight and reflect on the methodological appropriateness, using reliability, validity, and generalizability as overarching components of trustworthiness (Lincoln, 1995; McTaggart, 1998).

4.9.1. Reliability

Reliability is highly debatable in qualitative studies because of its connotation in quantitative measurements. As a construct for evaluating the quality of studies, reliability is still popular in PAR as "criteria for defensibility, educative value, political efficacy and moral appropriateness" (McTaggart, 1998, p. 211). LeCompte and Goetz (1982) emphasize that reliability shows whether the study is dependable and thus credible. While the reliability could not be determined statistically, systematic data-collection methods with detailed documentation and careful transcription defend the study as reliable and thus credible (Creswell, 2009; Kvale, 1996; Yin, 2003).

4.9.2. Validity

Validity is the extent to which the findings represent reality (Brink, 1993). Like reliability, validity is a highly contested term in all qualitative studies. In PAR, validity might be threatened by the researcher's biasness, limitations of the data-collection methods, and the positions of the researcher against other research participants (Brink, 1993; LeCompte & Goetz, 1982). As explained before, by staying for one month in the study area to develop trust, these threats were minimized. And the fact that I used multiple data-collection methods defends the study's validity (McNiff, 2013). Furthermore, presenting the proposal at CARN conferences for peer recommendations defends the study's design as accurate for PAR. Also, the participants cross-checked the accuracy of the findings from time to time (Creswell, 2009; Kvale, 1996). The follow-up study showed that the process had been valid for the participants.

4.9.3. Generalizability

As explained in subchapter 3.1 and specifically in Figure 2, we expanded the study from the Teachers' College and nearby schools and local communities to several districts in Tanzania. In that respect, we showed that the student teachers were able to transfer their knowledge to new contexts. We have given an example of how EE can be taught and developed in teacher education in Tanzania through PAR. Kvale (1996) and Creswell (2009) emphasize that qualitative studies, and in this case PAR, appeal more to analytic or theoretical generalizations than to statistical generalizations of the sample to the wider population. Although it is impossible to replicate this study in a different context, the example provides insights others can draw from when they develop relevant EE in teacher education in their context. Together with other examples, through analytic generalization, the study adds to the theoretical foundation in the field of EE.

4.10. Ethical concerns

One of the pillars of PAR is democratic relations. When researchers and participants implement PAR in a context characterized by hierarchical power relations, there is always the danger that participants will feel a lack of respect, loss of authority, annoyance, or suffering. To address such ethical concerns, we discussed the democratic ideals during the early phases of the project. Together we agreed on pursuing basic democratic principles throughout the project. Yet, some teachers felt they were losing authority as pupils became more empowered. Since our workshops were always democratic, the participants slowly learnt and started to practice some democratic principles such as respecting pupils' opinions. We also employed democratic approaches to make sure that every participant experienced herself or himself as a respected member of the research process (Bradbury & Reason, 2001; Kemmis, 2001). We took all photos and audio recordings following consent from the participants. For pupils, we got consent from both teachers and parents. We also worked with people with previous commitments to EE processes who wanted to learn how to improve their practice. I chose not to anonymize the Teachers' College and the participating schools. After discussion with the participants from the Teachers' College and the schools, they agreed that the names could help for

future referencing. According to the ethical requirements for research projects in Norway, we submitted the research proposal to NSD, the Norwegian Centre for Research Data, and the NSD approved our proposal.

5.0. Summary of the articles

In this chapter, I present a summary of the articles in terms of the addressed rationale of the investigation, research questions, research methodology, and a summary of the findings. The summary is a short guide for researchers to understand the content of the articles.

5.1. Article 1

Kalungwizi, V. J., Gjøtterud, S. M., Krogh, E., Mattee, A., & Ahmad, A. K. (2018). Participative planning of environmental education activities: Experiences from tree planting project at a teacher training college in Tanzania. *Educational Action Research, 26*(3), 403–419.

In the first article, we addressed the following research question:

> *How can we engage local actors in participatory action research addressing resource constrains for environmental education; and what are the results of the participatory planning process?*

Community participation is a primary condition for a quality EE program. However, many local communities tend to have low motivation to participate in environmental management activities. In this article, we explored how we could establish relevant EE in the Tanzanian socio-economic and ecological context through experiential learning approaches. We had approached a teacher training college that wanted to broaden its insights into and practice of EE.

We describe and discuss how we collaborated with the chosen teacher training college, a group of student teachers and their tutors, along with other members of the local community in mapping the environmental challenges and resources. The article builds on data documenting the process of negotiating the varied needs and interests of the local community members in the initialization of EE. We collected data from the process of getting to know each other, from initial workshops, from mapping and discussing the environmental challenges, and from observations of exiting the teaching and learning approaches.

The analysis revealed that the use of outdoor activities such as tree planting, which was familiar knowledge and experience held by the participants, increased the participants' problem-solving abilities. In addition, the outdoor activities empowered the majority of the participants through increasing their confidence, knowledge, and trust toward each other and external actors. The ability of the local community to solve environmental challenges increased. We negotiated the environmental topics and included the increased capacity to improve physical conditions, teaching conditions, material conditions, socio-cultural conditions, and student teachers' teaching competence.

Still, there were challenges with the implementation of this approach in Tanzanian schools. The challenges included poor learning and teaching conditions, cultural challenges, power structures, and

shortages and poor management of resources. The grounding of the study in the local environmental conditions improved our understanding of how to plan for the next cycles of experiential learning in the later phases of the project and improved our understanding of local environmental challenges.

The initial process revealed that mutual empowerment through common language was important for engaging the local community in the research process and for enhancing the common understanding of EE. The paper contributes insights into ways in which to organize EE activities.

5.2. Article 2

Kalungwizi, V. J., Krogh, E., Gjøtterud, S. M., & Mattee, A. (2018). Experiential strategies and learning in environmental education: Lessons from a teacher training college in Tanzania. ***Journal of Adventure Education and Outdoor Learning.*** **Advance online publication. doi:10.1080/14729679.2018.1555047**

In the second article, we addressed the following research question:

> *How do the student teachers learn experiential teaching strategies and how does that influence their practice of environmental education in primary schools?*

The transfer of environmental knowledge to new contexts seems to be an important quality of EE. In this article, we explored and discussed how and to what degree the PAR approach supported the student teachers and enabled them to transfer their knowledge and skills of experiential learning strategies and environmental knowledge to the wider Tanzanian environmental conditions and primary schools. In order to understand, analyze, and discuss the students' learning and ability to transfer their knowledge, we developed a theoretical model building on Dewey's (1938b) relational approach to inquiry, Ryan and Deci's (2000) motivational theory, and Antonovsky's (1987) theory of salutogenesis.

Thereafter, we described and discussed the organization of the teaching practice in primary schools, applying experiential learning approaches that the student teachers had learned and practiced in previous workshops. The student teachers taught selected topics, first in primary schools close to the College, and later in seven districts spread out in Tanzania. In the second practice period, the student teachers were under the mentorship of teachers in the practice schools spread across the country, and the researcher supervised them via mobile phone. In this practice period, we expected the student teachers would establish collaboration with teachers, students, and other community members in line with what they had experienced in the initial phase. Furthermore, they were to plan outdoor activities, implement the activities, use them in teaching science concepts, and then evaluate the teaching and learning sessions.

The article builds on data we collected through interviews, an analysis of teaching logs, and through FGDs. We found that student teachers' autonomy in problem solving increased. They showed their ability to adjust and adapt to the changing environmental conditions. The students' ability to create

and use teaching and learning tools improved, and they developed social competences to mobilize local resources as the means to adapt to the changing conditions. We also found that the student teachers' ability to participate in environmental discussions and to mobilize peer education in schools increased as they established clubs in schools and engaged in conflict management.

Furthermore, we found that power decisions outside the local communities such as the allocation of important teaching and learning resources affected the student teachers' further professional development. In most cases, such decisions were unpredictable. This paper contributes to the knowledge on how to facilitate student teachers' autonomy in developing and using resources for improving environmental teaching and facilitating changes in their own communities. It gives a case description of curriculum contextualization in EE.

5.3. Article 3

Kalungwizi, V. J., Gjøtterud, S. M., & Krogh, E. (2019). Democratic processes to overcome destructive power relations and sustain environmental education in primary schools: Implications for teacher education in Tanzania. *Educational Research for Social Change (ERSC), 8*(2), 61–76.

In the third article, we addressed the following research question:

> *To what extent does the hierarchical power system influence the teaching and learning processes of environmental topics and the stakeholders' ability to manage environmental challenges?*

This article is based on data from the follow-up study that we conducted to find out to what extent the intentions of the project had been continued in the Teachers' College, surrounding schools, and the local communities after we pulled out. The article builds on a literature review to highlight the socio-political context of EE in Tanzania, which we then discuss with data we collected through FGDs involving primary school teachers and tutors, and interviews with local community members and leaders in schools, the local community, and at the College. We discovered that the participants carried on with some of the activities and intentions, while others had discontinued them. Power relations emerged to be the main factor for sustaining the activities. Therefore, in this paper we explored and discussed how power relations influenced the process to go on, and how PAR, with its democratic orientation, in part was able to counteract the top-down structure of the Tanzanian educational power structure.

We demonstrate that Tanzanian governance seems to be essentially hierarchical, which in some way affects the sustainment of EE activities, especially through the exercise of transferring teachers, and the unequal distribution of resources between rural and urban schools in which rural schools receive less resources. Through the perspectives of Bourdieu (1986), we discuss the cultural context of power relations in the Tanzanian educational system. We reflect on to what degree PAR can provide a strategy for transforming EE within the cultural conditions of top-down democratic governance.

The findings from the follow-up study indicate that PAR facilitates power sharing in local communities that partly counteracts the disengagement and powerlessness caused by the hierarchical power structure. Using findings from the study, we discuss different ways that the local actors can empower themselves.

The three papers show how contextualized experiential learning and PAR have the potential to engage the wider community in managing environmental challenges, developing dynamic teacher competences, and may challenge destructive power relations that threaten constructive collaborative EE processes. In the next chapter, I will provide a detailed discussion of some of these findings.

6.0. Discussion

According to Frankl (1959), the primary and sustainable driving force for human actions seems to build upon our search for meaning. In rural Tanzania, increasing the ability and capacity to solve severe and present everyday challenges gives fundamental meaning. Obviously, facing the environmental degradation in rural Tanzania, and considering how the degradation threatens the households' and communities' life conditions, knowledge and skills that enable individuals and groups to handle and manage these challenges gives meaning of urgent and compelling local relevance. The immediate relevance is a main driver for individual as well as local community participation in EE learning. I will begin the discussion in the extended abstract of the thesis with how the chosen PAR approach, which relates to everyday, severe environmental challenges in rural Tanzania, meets the conditions for the releasement of the stakeholders' individual and united inner motivation for the management of the environmental challenges.

In the first part of the discussion, and in relation to the first research question, I discuss the strategies for engaging local participants in the initiation of EE learning activities. In the second part, which I relate to the second research question, I will discuss the student teachers' learning strategies to manage the environmental challenges through practice teaching. In the third part of the discussion, which deals with the relevant power issues, I discuss the degree to which the existing hierarchical power systems in Tanzania can interact with the establishment and sustainment of democratic learning systems—the focus of the third research question. Through the discussion of the three research questions, I will elaborate on and suggest some answers to the main problem statement of the thesis: In which ways does the participatory teaching of environmental topics in schools and teacher colleges facilitate local community members' adaptation to and management of harsh environmental conditions?

To reiterate, the problem statement is broken into three research questions. (i) How can we engage local actors in the participatory planning of environmental activities? (ii) How do the student teachers learn environmental education and how does that influence their practice of environmental education in primary schools? (iii) To what extent does the hierarchical power system influence the teaching and learning processes of environmental topics and the stakeholders' ability to manage environmental challenges?

6.1. Engaging local community members/creating a participative climate

The initial aim of PAR processes is to build a coalition among researchers and local stakeholders to address problems that matter in the local society. In order for a research process to be empowering, the participation of local stakeholders in decision-making is necessary from the outset (Mordock & Krasny, 2001). Læssøe (2010) emphasizes that local participation is important for activating citizens so that they can take part in the transformation of their own lives. However, Mordock and Krasny (2001, pp. 18–19) warn that "even researchers who are committed to participatory approaches may

face challenges in engaging local participants, including socio-economic barriers like lack of trust, status, equity, and political issues and the applicability of the researcher in the social situation." Deketelaere and Kelchtermans (1996) further warn that despite the benefits related to the involvement of stakeholders, local participation and collaboration with local stakeholders will always encounter challenges, and often even difficulties. A fruitful collaborative process requires that those who are involved have developed secure and authentic relationships with each other and are committed to participatory and democratic values (Hawkins, 2015). In this project, creating a participative climate was a demanding exercise and a struggle. Subchapter 6.1 mainly discusses research question 1, which I also elaborate in paper 1: How can we engage local actors in the participatory planning of environmental activities? I will discuss the challenges I experienced during the project initialization and highlight some of the strategies that I used. Thereafter, I will discuss the results of community engagement.

6.1.1. Acknowledgment of local inhabitants and their everyday lives

Even though I come from a rural community in Tanzania, similar to the setting of my fieldwork in Kilosa, and even though I have been teaching geography in a Tanzanian secondary school, I started the project as an outsider in the local community and at the Teachers' College. Naryan (1993) discusses the nuances and challenges of being both an insider and an outsider when doing fieldwork as a part of ethnography or PAR "at home." Anyhow, conducting PAR often implies relational challenges (Wicks & Reason, 2009). According to Hawkins (2015), it is crucial that the researcher spends sufficient time with all the participants who are involved in order to build a mutual rapport.

Before starting the PAR process, I assumed that the development of my understanding of the local community culture and identities was a key to unlocking social and cultural barriers. During the first weeks of the fieldwork I was surprised by all the names the local participants called me such as "Black Mzungu" (black European), "Jamaa wa chuo" (university guy), or "Mwana mazingira" (environmentalist). All these labels characterized me as a foreigner. The community members seemed to be positive to many of my suggestions, but I realized that they wanted to please me as a foreigner. Gradually I understood that I required a different status to be able to conduct PAR. The transition of the local inhabitants' understanding of a researcher from being a mere outsider to becoming a partner in collaborative action research seems to require different efforts from the researcher such as attentively listening to local opinions, participation in local meetings, rituals, and activities, a willingness to self-disclose, and a continuous presence.

Therefore, I decided to stay in the local community for one month. I attended weddings, funerals, and parties. Slowly, after familiarizing myself with everyday local activities and interactions, the community members started to trust me enough to start sharing their experiences with me. Based on this local initiation, it became possible to negotiate values to guide a unified social and environmental practice in the PAR project such as care for nature, solidarity, respect, collaboration, trust, and an emphasis on the process (Hawkins, 2015). However, it was not until we had worked

together for a full year that local community stakeholders could call me “rafiki” (colleague/friend). In a letter that the Academic Dean of the Teachers’ College wrote to show his appreciation for the positive outcome of the project, he describes the researcher as a “friend” rather than as a “researcher.”

To summarize, my willingness to take part in everyday activities and celebrations/ceremonies in the field and my persistent participation in the project over a long period seemed to both increase participants’ confidence in me and in the PAR project. “Water bottle people” is a local term that characterizes foreigners, Tanzanians, or guests from other countries coming to local communities to arrange meetings and activities to assist local development. The opinion is that such visitors mainly bring and invest in their own safe bottled water and, thereafter, in the end, leave the community as it was before they arrived. The shift of my status from being a “water bottle” foreigner to becoming a guest who was regarded as a friend was crucial. My amended status seemed to build emotional trust that strengthened participants’ later engagement in the project.

6.1.2. Addressing cultural patterns of understanding to promote engagement

In spite of the gradual change in my foreigner status, there were several other challenges related to local stakeholders’ participation and engagement in the PAR project. Stakeholders’ choice of when, in which ways, and to which degree they would participate depended on a range of circumstances. Stoate, Jones, Crotty, Morris, and Seymour (2019) referred to the negotiation around involvement as forming the “wheel of participation” where each participant chooses where to play.

The majority of the local participants did not have any experience with research. Therefore, they seemed to assume that they were not able to conduct meaningful activities during the research project. In addition, many of the stakeholders expected that the researcher had more resources and time for research than the other participants had. According to Deketelaere and Kelchtermans (1996), individuals who join such participatory processes normally bring certain cultural beliefs and values with them. Therefore, it is important to uncover and discuss implicit cultural values during the participatory process to avoid cultural-based misunderstandings and frustrations. The occurrence of the Tanzanian “baadaye” culture, which means continuous delays and postponements of planned activities, like the Spanish “mañana,” was common, often expressed in the project participants’ argumentation for their choices. To withdraw was also a common strategy among participants, characterized by an attitude of “hamna shida” (no blame/let it go). Even after we started the processes, I needed to be flexible and keep my plans open.

In line with Hawkins (2015), I had to reflect on my values. I realized that the local participants were using patience as a way to cope with stressful conditions, since they, besides the PAR project, had to attend to subsistence activities and other obligations. Thus, the participants were reluctant to participate because they had limited knowledge about PAR and participatory teaching approaches and therefore thought that their possible contribution was of low value, both for the project and

themselves. In addition, the participants assumed that the researcher had more time and resources to put into the activities.

The explanation for choosing “baadaye” is manifold and relates both to the assumption of the researcher having more knowledge and resources and to a local strategy of shifting focus and aims to do activities that the local stakeholders perceive to be more vital and required at that moment. Poverty and the need to focus on the satisfaction from immediately experienced founding needs make this logic reasonable. This can create a local culture that apparently has characteristics such as low levels of, or is lacking in, perseverance and persistence. Especially when the participants do not have sufficient confidence or belief that activities will satisfy their immediate needs, and, if the realization of improvements is far away in time, the stakeholders’ individual and unified choices will easily be expressed as a “baadaye” culture.

In Tanzania, as in similar low-income countries, development projects often dissolve and vanish after a limited period of external support (Chambers, 1997). The experience of dissolving is an important reason for the withdrawal saying “hamna shida,” with the same meaning as the well-known Lion King expression “hakuna matata,” as a strategy to overcome and defeat hopelessness, as a strategy to survive the fatigue of poverty.

The poverty situation in the local community naturally leads to a preoccupation with immediate needs. Previous experiences of external projects leading nowhere leads to a cultural logic of “baadaye” and “hamna shida.” Such reasonable cultural logics were the main reasons for low project engagement. Knowing about the reasons for poverty, participants’ experiences with the low levels of sustainability of previous projects, and the cultural consequences of poverty is necessary for promoting engagement and preventing withdrawal in projects within similar contexts.

6.1.3. Awareness of local environmental challenges

In line with Freire’s (1970) concept of conscientization, raising the local awareness of environmental challenges through mapping, workshops, and discussions seemed to increase the stakeholders’ willingness and commitment to unify, engage, and act for environmental improvements. Thus, the raising of awareness seemed to be an approach that could counteract the “baadaye” culture. Mapping, combined with the presence of external actors who facilitated social arenas for local stakeholders’ reflection on challenges and what to do about them, seemed to generate shared insights about the challenges and, in addition, the possibility of addressing the challenges. Furthermore, the mutual discussions around findings and reflections on what to do strengthened old and identified new relationships. The process challenged the habituated pattern of each individual struggling alone. Many of the participants discovered the power of unifying and the power of mobilizing the resources and knowledge distributed among themselves.

The visual impacts from using cell phones and data technology motivated the student teachers’ project engagement and strengthened their understanding of the challenges in the first cycle. In

addition, Google Maps became an important tool for sharing the mapped environmental challenges between student teachers and local inhabitants. The democratic interaction, but also the substitution of English with the more familiar use of the Kiswahili language, smoothened the communication around challenges and reinforced the participants' self-esteem and self-confidence related to their ability to manage the environmental challenges. Thus, activity-oriented awareness presupposes more than the sharing of mapped challenges. Democratic interaction in a familiar language seems to strengthen local engagement for the management of environmental challenges.

6.1.4. Relevance of environmental education activities: Negotiating different environmental education perspectives

I anticipated that the mapping would clarify the most important environmental challenges, and, thereafter, contribute to unified local engagement for the management of the mapped challenges. However, the mapping and following discussion revealed that local stakeholders and groups of stakeholders focused on quite different activities to manage the challenges. Schools, due to their cultural understanding and values, suggested teaching environmental science, while local inhabitants and farmers suggested practical activities to obtain concrete outcomes. The latter group was divided into activities with long-term effects (tree planting) and short-term effects (gardening). There were different and competing perspectives among the participants about what the focus of EE should be.

According to Somekh (1994), competing needs in PAR may disrupt research processes as well as the implementation of planned activities. Therefore, listening and careful facilitation of discussions before decision-making is important in securing a sense of project relevance and the prevention of withdrawal. Teachers wanted EE to focus on theoretical scientific perspectives with relevance in school systems to teach pupils to pass standardized tests. The local community found relevance in practical, outdoor activities. Some local farmers highlighted the possibility and need for income-generation activities, for example, the production of seedlings or vegetables for sale in the local community. Even the reasoning behind tree planting differed. Some participants wanted to plant tree varieties they could later use for construction. Others wanted to produce fruits. Some wanted to focus on activities that had multiple purposes including income generation. To avoid the stakeholders' withdrawal, it seemed important to me to include all these possibilities. In addition, all of the suggested activities were meeting local challenges. Together, to ensure local engagement, we tried to build confidence around the project's ability to face the lack of physical and other resources.

As van Leeuwen (2007) suggests, the stakeholders' experience of relevance seems to increase with social attachment, in this case when there is support from valued outsiders or members of the community. When one of my supervisors visited the project area and talked to student teachers, one of the student teachers said that he was more motivated toward environmentally-friendly activities having seen that people from outside his country were supporting their initiatives. Integrating short PAR cycles with immediate results in addition to long-term results increased the participants' attachment to the project. Many teaching units and participants in the EE activities expressed a sense

of pride after they managed to produce vegetables through irrigation. When schools prepared and served the vegetables for lunch, even the parents were happy with the project. Thereafter, they encouraged pupils to learn and taught them at home. The lunch, as an immediate result of EE, motivated long-term engagement, even though the participants did not experience immediate results.

Considering the diversity of local preferences for environmental activities and the significance of social recognition and short-term results for project engagement, I observed and systemized which group preferred which activity to meet with the challenges. PAR seemed to be an important tool to do this systemizing, and later to negotiate how to choose between activities, and, probably, recognize the necessity of parallel implementations of different activities to meet with the environmental challenges.

6.1.5. Local capability: Creating teaching and learning opportunities

According to Freire (1970), the development of local inhabitants' capability to understand relevant challenges and, in addition, to search and work for ways to manage these challenges is crucial for local empowerment. In my study, the local stakeholders seemed to need stimulation regarding their capabilities in terms of dealing with environmental challenges. In this respect, their self-esteem and self-confidence was rather low. The local community had suffered from environmental challenges over a long period of time and the challenges seemed to be overwhelming.

Through facilitation of action learning processes, I assisted the local community members in identifying and sorting out the challenges so that they could decide to handle them one by one. In this way, the challenges became less overwhelming and, to a larger degree, perceived as manageable. The mapping of the challenges, followed by the facilitation of action learning processes, was an initial realization of the local capability to manage the harsh environmental challenges. Together, we searched for different manageable environmental activities and, thereafter, we discussed the possibility of substituting lacking resources with others. Even though we stressed the seriousness of environmental degradation and the difficulties with implementing measures to improve the situation, the stakeholders' self-esteem and engagement seemed to increase.

The above-mentioned procedures for contextualization and democratization founded the stakeholders' interaction and participation in the project. Due to the PAR project's building and nurturing of democratic relationships, both on the horizontal and vertical power levels (Læssøe, 2010), the participants could address and negotiate the shortage of teaching materials and unfriendly teaching conditions related to EE in Tanzania. Therefore, the participants gradually associated their community engagement with an enhanced local capacity to address land degradation, strengthened community participation in education for improved learning, and increased awareness of local environmental challenges. The democratic procedures for discussion and decision-making in the project built an emergent confidence in the leaders of the project as well as local engagement in the project activities. In a similar way, the status and role of student teachers

in the local community shifted from being teachers and supervisors to becoming friends and facilitators. Their new status and role seemed to build emotional trust that strengthened local stakeholders' later engagement in building knowledge about action learning and participatory teaching approaches. They also prioritized time and resources to put into the activities.

Following this argumentation, the student teachers and local community members together with the facilitators seemed to deliberate on the following key points to guide their future EE practice:

1. *Participation.* To involve all people related to or affected by the issues that the project addresses. We regarded student teachers, primary school teachers, parents of pupils, pupils, and other local community members as possible important actors.
2. *Building social capital.* To take part in everyday activities and celebrations/ceremonies in the local communities surrounding the practice teaching schools.
3. *Perseverance*. To be persistent in spite of frustrations and experiencing the participants' reluctance to engage.
4. *Creativity.* To use locally available physical, human, and immaterial resources to assess challenges.
5. *Flexibility.* To learn from the context and act accordingly.
6. *Organization.* To establish and facilitate functioning action learning groups.
7. *Confidence.* To trust your own capability and the capability of other actors.

6.2. Reconstructed knowledge and the pedagogy of environmental education

Changes in the way of knowing and patterns of understanding are among the most important outcomes of EE, which are particularly important for teachers (Combes, 2005). Still, to take care of the environment, humans need to transform knowledge into environmentally-friendly activities. Even though Tanzanian teacher education focuses on knowledge about environmental problems and on how to manage the challenges, it is difficult to observe the practical realization of teacher education's EE teaching in primary and secondary schools. This subchapter mainly relates to the findings of the second research question, as also elaborated in paper 2:

> *How do the student teachers learn environmental education and how does that influence their practice of environmental education in primary schools and the surrounding local communities?*

Through applying experiential learning processes, we wanted to facilitate the understanding of environmental challenges to include social and political aspects of environmental degradation. The findings show that the student teachers learned more than being able to talk about environmental challenges and the management of the challenges. Initially, in their teacher education programs, they had mostly learned about the challenges. In the PAR project, the student teachers learnt to address environmental challenges experienced by the inhabitants in the local communities around the Teachers' College. In addition, they received training in experiential learning and student active

teaching and learning approaches that were suitable for teaching in and for sustainable development. Furthermore, the student teachers had learnt how to involve the practice teachers and community members through the initial phases of the project.

In their second practice teaching period, the student teachers had to conduct the whole process themselves in communities with similar or different environmental challenges. The application of perspectives, approaches, and tools for teaching EE from the first practice period had obvious consequences for their professional development in terms of becoming teachers. The student teachers faced and learnt from conflicts between farmers and pastoralists and from top-down decisions on the transfer of teachers and other resources. In addition, unpredictable and longer drought seasons forced the student teachers to continuously reflect on and reevaluate their understanding of the environmental challenges and on which actions to choose to address the challenges. Therefore, the student teachers participating in the project did not just plant trees as they did at the College. They learnt to learn from social, ecological, and political processes in schools and in the surrounding communities. In this way, they appreciated and realized the potential of action learning in collaboration with relevant members from the local communities in order to develop adaptive strategies to manage the environmental challenges.

Gradually, environmental learning became a process of negations of values and needs. Instead of planting the same trees every learning cycle, the student teachers, together with members of the local communities, decided to plant different tree varieties. For example, in schools surrounded by pastoralist communities, some student teachers planted fodder trees. Other student teachers implemented decomposing, when they, after discussions with local participants, had concluded that soil fertility was the main challenge in their environment. Where a water shortage was the main challenge, students implemented water management processes. In Zanzibar, ocean cleaning was crucial due to the threatened aquatic life in those areas caused by pollution. In this way, EE became a process of adapting to and managing changing socio-ecological conditions. The student teachers' contextualization of EE involved both a transfer of general knowledge on environmental challenges to specific and concrete local challenges and a transfer of the contextualized knowledge about these challenges to the implementation of activities to manage the environmental challenges. In this way, the practical activities turned out to be a useful strategy for EE to reduce vulnerability to climate change.

The participatory mapping, dialogue, workshops, and discussions, grounded on the historical realities of Tanzanian society, countered a sense of powerlessness and vulnerability embedded in the hierarchical power relations of educational and other governance structures of Tanzania since the colonial period. The uncovering of physical, human, and immaterial resources strengthened the shoots of local empowerment. Throughout the experiential learning process, the PAR project participants acquired ways of learning and knowing that transformed scientific knowledge into social and political action. They experienced the possibility of transforming parts of the prevailing

hierarchical power structure in Tanzanian governance into more democratic power relations. Learning about, in, and for the environment expanded into learning to be resilient (Sterling, 2010). The student teachers contextualized their understanding of environmental challenges and this seemed to foster a sense of coherence among themselves and in the local communities (Antonovsky, 1987).

The contextualized teaching of environmental challenges, including critical discussions of local problems, seemed to promote a comprehensive understanding of the environmental topics and fostered dynamic professional teacher development with new understandings of learning as well as teaching practices (Carr & Kemmis, 1986; Freire, 1970; Hiim, 2014). The transfer of general knowledge about environmental challenges to contextualized knowledge and the practical testing of activities addressing the challenges initialized this professional development through multiple ways of learning (Carr & Kemmis, 1986; Combes, 2005). Thus, the student teachers developed critical inquiry, problem solving, and system thinking, which they could apply in the action learning processes toward the formation of contextualized knowledge. This transformative process opened them up for the development of their personal theories of teaching practice including their sensitivity to local needs (Kyburz-Graber, 2013). However, this transformation challenges the current fact-based teaching approaches dominating in Tanzanian teacher colleges, approaches that are inadequate to address the huge environmental problems facing local communities in the country. Such fact-based approaches are also counterproductive in terms of fostering the dynamic teacher professional identities needed in EE (Hiim, 2014).

During the study period, the student teachers' understanding of environmental topics and the teacher education curriculum widened out to encompass social and political dimensions of the experienced environmental problems. For example, the student teachers' understanding of the teacher education curriculum incorporated the understanding of local conflicts between farmers and pastoralists. The expanded understanding enabled the student teachers to facilitate mutual dialogues and the sharing of important resources. The student teachers became committed to assisting the management of challenges in the communities surrounding the Teachers' College and, in their second practice period, in their practice schools and their communities. Furthermore, they encouraged local environmental consciousness by giving assistance to the local community members in addressing environmental challenges including land degradation (Nche, Achunike, & Okoli, 2019). In this way, cultural sensitivity combined with social responsibility and communicative skills became additional tools in the toolkit for EE. On the other hand, the intersubjective collaboration on the undertaking of the variety of real-life challenges promoted an interdisciplinary approach to environmental challenges. The interdisciplinary learning combining knowledge and skills from mathematics, science, language, and agriculture challenged the trap of disciplinary division and the split between the "hard" natural sciences and social sciences.

The practical implementation of environmentally-friendly activities illuminated the significance of transfer simplification. The simple teaching and learning units for activities in the primary schools were easy to duplicate, elaborate on, and use in the local community by the inhabitants. The active support of and facilitation from student teachers, who visited the local community members to provide the required expertise, catalyzed the transfer. The student teachers established communities of learners based on shared problems and mutual support to address drought and other harsh environmental conditions. They even assisted the locals with planting materials, supplies of cheap technologies, and the use of mobile telephones as multiple communication tools. In this way, competent and service-minded helping hands facilitated transfer simplification.

In this subchapter, I have discussed how the student teachers learnt about EE in this PAR project, which closely relates to how they practiced as student teachers in primary schools. In their second practice period, the student teachers implemented what they had learnt about EE in their first practice period in primary schools surrounding Kilosa Teachers' College. To a large degree, the student teachers' learning relates to their application of teaching approaches, their facilitation of learning processes, and their use of methods for the engagement of local schools and communities. Thus, as anticipated, the student teachers' learning seems to reflect the results of their own participation and learning through their practice in the PAR project. On a general level, their learning seems to be multi-faceted, both comprehending soft skills and professional skills, and their ability to manage a range of different disciplines. When the student teachers practiced what they had learnt during their first practice period, their implementation of EE seemed to require interdependence between social responsibility, the capacity to organize action learning groups and local discussions, their ability to contextualize knowledge and transfer the knowledge into environmentally-friendly activities, and a comprehensive interdisciplinary approach. Application of this advanced toolkit seemed to presuppose the development of a committed community of learners.

6.3. Sustaining democratic processes within a hierarchical power system

Empowerment of the victims of environmental degradation is a key issue in EE. Throughout the PAR project, all the participants, in different ways, experienced the Janus face of the Tanzanian power system. Side by side, a hierarchical power system coexists with democracy. Even though democratic processes exist and are possible to establish and develop further at the local level, sustaining democratic processes within the hierarchical structures that characterize Tanzanian governance on a regional and national level can be a challenge. Therefore, we addressed the tension between these power systems in research question number 3, which we also discussed in paper 3:

> *To what extent does the hierarchical power system influence the teaching and learning processes of environmental topics and the stakeholders' ability to manage environmental challenges?*

In the former subchapters, I have elaborated on findings related to the application of the democratic PAR approach in the first phase of the project and later in the student teachers' application of methods and approaches during their second practice period. During the project period, the democratic approaches enhanced the local stakeholders' ability to manage environmental challenges in different ways. In the first phase, the inclusion of local stakeholders in mapping, discussions, and decision-making strengthened local engagement in and for the project and prevented comprehensive local withdrawal in spite of the appearance of challenges related to implementation. Democratic processes increased the confidence of the leaders and in the project itself. Thereafter, the facilitation of inclusive action learning processes offered the stakeholders a management tool for problem identification and for solving environmental challenges. In addition, the democratic communication in the implementation phase simplified the translation and transfer of environmental knowledge to adaptive strategies and activities for the local management of experienced environmental challenges.

Still, the question is to what degree is it possible to sustain the democratic processes after the student teachers had left and after the termination of the PAR project? The existing Tanzanian hierarchical power structure that limits local decision-making on resource allocation and impairs authority on the grassroots level challenges the sustainment and sustainability of the project-initialized democratic processes. Even though central or district authorities reallocated resources or removed active teachers, some local communities and primary schools continued the democratic processes and the local projects under the radar of the hierarchical power system. The hierarchical power system obviously threatens democratic processes and the stakeholders' capacity to sustain the qualities from such processes as elaborated in the paragraph above. Still, there will be an ongoing power struggle between the two power systems in Tanzania, as elaborated in paper 3, and successful management of the severe environmental challenges demands efficient strategies and solutions. My hope is that this PhD thesis can shed a little light on the possible ways in which to use EE as a strategy for the management of environmental degradation.

6.4. Emerging roles of schools and teacher colleges in community adaptation to and management of the changing socio-ecological systems

As Krasny, Lundholm, and Plummer (2010) emphasize, we cannot isolate EE from other socio-ecological processes. The discussion of the three research questions in the former subchapters elaborates on how different social and cultural activities can realize EE in a rural Tanzanian context. The obvious and ongoing environmental degradation emphasizes the ecological conditions for the management of environmental challenges, and, thus, the importance of EE. In rural Tanzania, more than 90% of the population is dependent on self-subsistence agriculture and incomes from sales from agriculture. This means that the socio-ecological systems in rural Tanzania must necessarily comprehend and connect social, cultural, ecological, and economic systems. The composition of rural Tanzanian socio-ecological systems corresponds with the domains of sustainability that constitute

the definition of sustainable development (Palmer, 2006). Therefore, in this study, EE is commensurate with ESD (see also the discussion in subchapter 2.2).

The main problem formulation highlights how a participatory approach to EE can promote the local management of environmental challenges:

> ***In which ways can participatory teaching of environmental topics in schools and teacher colleges facilitate local community members' adaptation to and management of harsh environmental conditions?***

In order to put a relevant perspective on the discussion of the problem formulation, I will introduce, define, and use the concept of resilience, which I thereafter expand to socio-ecological resilience. In my opinion, the concept of socio-ecological resilience can specify, express, and unify the ways in which local communities adapt to and manage environmental challenges.

During the 1970s, the vast majority of psychological and environmental scholars considered resilience as resistance to change. The environmental scholars measured resilience as the length of the period the ecosystem used or needed to reorganize to normal functioning. Gradually, the scholars expanded their view of resilience to the ability to resist changes to comprehend the ability to learn from feedback and even possibly transform the capacity to adapt to changes by developing new structures. This expanded understanding become the main view that dominated EE in 2000.

In the same way, socio-ecological resilience has expanded from the demarcated conception of resilience as the capacity to adapt to changes in socio-ecological conditions (Folke, Biggs, Norstrøm, Reyers, & Rockstrøm, 2016). Likewise, Krasny and colleagues (2010) defined socio-ecological resilience as the capacity to adapt, self-reorganize, and build diversity in the system. This capacity ensures the system's ability to regenerate in the face of changing conditions. Dubois and Krasny (2016, p. 251) further defined socio-ecological resilience as "the capacity of the socioecological system to continually change, adapt, or transform so as to maintain ongoing processes in response to gradual and small-scale change or transform in the face of devastating change." These definitions of socio-ecological resilience emphasize adaptation, change, learning, and transformation. In the same way, I view socio-ecological resilience as the individual and united ability to learn in order to cope with and adapt to changes, and, if necessary, transform oneself and ourselves. Changes are inevitable. Therefore, our learning ability in the changing system is what matters. This ability to learn adaptively and transform individuals and institutions, especially schools, has become an important part of EE.

Therefore, socio-ecological resilience consists of and connects with ecological, psychological/social, cultural, and economic resilience. The use and the potential of the concept presupposes a unified societal approach for adaptation to and the management of experienced environmental challenges. In this project, we have applied PAR and action learning to obtain a unified approach. In the

following, I will discuss each domain of socio-ecological resilience separately, before I connect the domains in a concluding discussion.

6.4.1 Ecological resilience

According to Gunderson (2000, p. 425), ecological resilience is the "amount of disturbances that an ecological system can undergo without changing self-organized processes and structures." The development of ecological resilience relates to the transformation of the biophysical characteristics that can withstand and recover from exposure to huge risks, shocks, and the pressure from human activities and natural hazards (Irwin, 1990; O'Donoghue, 1989; Palmer, 2006). Sterling (2010) emphasizes that biophysical components constitute a fundament for socio-ecological systems.

The importance of the biophysical components in socio-ecological systems defends ecological resilience as a separate domain. Tanzanian farmers' ability to adapt to biophysical changes in their environment is crucial. The majority of the rural inhabitants are farmers. Accordingly, education about the environment, the traditional EE approach in Tanzania, focuses on biophysical characteristics. However, the complexity of adaptation requires an expansion of the traditional EE approach to include strategies that build the ability to plan and implement conservation activities (Fien & Tilbury, 1996; Palmer, 2006).

Widening the view of ecological systems

A wider understanding of biophysical characteristics seems to stimulate adaptation to changes in ecological conditions (Gunderson, 2000). We found that the use of cellphones and Google Maps facilitated the local inhabitants' overview of their environment and gave them an expanded understanding of environmental changes threatening the ecological systems that they rest upon. This expanded understanding fostered emotional commitment to address environmental challenges, for example, through joining tree planting schemes. Still, the ongoing changes in the physical conditions demand continuous learning (Krasny & Tidball, 2009).

The understanding of multiple dimensions of ecological systems

While the use of cellphones and Google Maps increased the local inhabitants' ability to perceive their environment from a broader perspective, discussions and dialogue supplied a richer understanding of ecological variations and diversity (Barnett, MaKinster, Trautmann, Vaughn, & Mark, 2013; Ferry, 2009). The understanding of the multiple dimensions of ecological systems led to discussions about which activities to choose to take care of the ecological diversity. Thus, discussion and dialogue as key experiential learning strategies seem to have a double function in EE. The strategies can improve the participants' understanding of ecological variation and, in addition, increase their adoption of multiple ecological management strategies, in our project, tree planting, gardening, and soil fertilization.

Umoja ni nguvu: Unity is power

The common discussions and dialogues built a shared understanding of the ecological systems and environmental challenges. The shared understanding became the fundament for united collective actions. The building of a common understanding concretizes the local capacity to address and manage ecological challenges (Barnett et al., 2013). In the same way as with any other ecosystems, ecosystems involving human beings depend on biophysical components. Still, human beings separate out from other species due to their capacity and potential to observe and analyze complex situations and to unify their efforts to manage mapped and realized challenges and complexity through chosen actions. Even though this capacity and potential seems to be hard to realize, it is very difficult to neglect the existence of the mentioned human characteristics. Ecosystems with human beings in them rest upon ecological resilience, but humans have to manage the systems through socio-ecological resilience.

The careful, committed, and skilled management of socio-ecological systems presupposes knowledge about and emotional attachment to the systems. Knowledge about local environmental challenges promotes the commitment to take care of the environment. Broad, multi-faceted, and unified knowledge seems to strengthen the ability to manage environmental challenges. In addition, the local inhabitants' close relation to their environment stimulates a precise and relevant identification of ecological challenges, which can result in a unified local "scheme" of understanding and an improved local ability to manage the ecological system.

6.4.2 Psychological and social resilience

Socio-ecological resilience is dependent on ecological resilience but requires human management. If local inhabitants develop an expanded understanding of environmental challenges and if they observe and experience positive results from environmentally-friendly activities, their motivation for participation in the management of socio-ecological resilience might increase. Self-determination theory (Ryan & Deci, 2000) claims that satisfaction of the human need for relatedness, competence, and autonomy releases inner motivation. In this subchapter, I argue that the satisfaction of the need for autonomy, competence, and relatedness through EE can motivate individually as well as societally. The development of an expanded understanding of environmental challenges both influences perspectives on farming at the household level and broader perspectives on how to deal with environmental challenges in the local community. Individual and societal motivation seems to be positively interdependent in the management of socio-ecological resilience.

Relatedness

As mentioned, the majority of rural Tanzanians are farmers. The student teachers' contextualization of concrete EE activities in their practice period, when scattered around in nine primary schools throughout Tanzania, motivated the local participants individually as well as socially (Kalungwizi, Krogh, Gjøtterud, & Mattee, 2018). Trying out useful experiments and activities oriented toward the management of experienced local environmental challenges affected and involved core physical

relations in the participants' everyday struggle for survival. For example, the management of environmental challenges through gardening supplied vegetable production for school meals, which altogether stimulated local engagement in EE. The facilitation of EE activities with immediate outcomes seems to be crucial for building engagement when the local ability to meet basic needs is low. Still, a gradual transition to activities with long-term ecological, social, cultural, and economic benefits seems to be necessary to build a sustainable local socio-ecological resilience.

The action learning provided a space for the common understanding of environmental challenges and for the coordination of local efforts. The common efforts strengthened local unity and expanded the problem-solving capacity beyond the limits of the individuals. In addition, external support, for example from physical, economic, and human support from projects and persons outside the local community, or internal support, from local leaders and local experts with an enlarged understanding of local challenges, constitute relations that might increase local socio-ecological resilience.

However, the ongoing environmental degradation in Tanzania seems to aggravate some local conflicts, for example, between farmers and pastoralists. The combination of PAR and EE brought farmers and pastoralists together in seeking solutions to manage with the environmental challenges. Instead of continuing the battle for land as a scarce resource, the unifying processes revealed that pastoralists could offer manure for farming and farmers could offer fodder for the livestock. The realization of positive interdependence (Johnson & Johnson, 2002) between farming and pastoralism toned down the conflict.

Supplying farmers and pastoralists with multiple communication tools through cell phones widened and unified their perspectives on environmental challenges and, in addition, facilitated communication of the perspectives between the two groups. Thus, the technology promoted the development of a common understanding of challenges, strengthened social ties across previous separations, and motivated the unified management of complex environmental challenges (Barnett et al., 2013). The use of cheap and locally affordable cell phones challenged the habituated pattern of each person and group struggling alone and against each other. The cell phones, as cultural artifacts, functioned as tools for mediation and contributed to the establishment of a new learning community of practice (Vygotsky, 1978, Lave & Wenger, 1991). The new learning community strengthened the local socio-ecological resilience.

Competence

As discussed in subchapter 6.4 and in other subchapters, an expanded understanding of the environmental challenges and unified efforts to manage the challenges might release competence in the management of environmental challenges. According to Ryan and Deci (2000), the experience of coping with or mastering the management of experienced environmental challenges is another prerequisite for the release of inner motivation and engagement for the management of environmental challenges and, thus, for socio-ecological resilience. In subchapter 6.1.5, I discussed

how the action learning processes in the PAR project seemed to both strengthen the individual participants' and the groups' self-esteem and engagement in the management of environmental challenges.

The successful use of action learning as a tool for increasing the local capacity for the management of environmental challenges rests on several conditions. We have described certain steps in the action learning process: mapping and identifying challenges, making an action plan focused on the management of the identified challenges, implementing planned actions, and evaluating results. Another part of the process is the identification of stakeholders and facilitating collaboration between stakeholders throughout the learning process. In addition to the coordination and facilitation of the action learning process, the sustainability of such a process requires the transfer of project coordination competence to the local community. Even though the requirements are diverse and comprehensive, this PAR project has shown the potential of action learning processes as a tool for the development of local socio-ecological resilience.

According to Freire (1970), local action learning processes can make the participants aware of and conscious about oppressive power structures. Therefore, the pedagogy of the oppressed should promote conscientization and provoke self-determination among the oppressed citizens and social groups. Ryan and Deci (2000) emphasize autonomy or self-determination as the third and last condition for the release of inner motivation.

Autonomy

The action learning process in this PAR project made the participants conscious about prevailing hierarchical power structures that challenged local decision-making as well as local control over central resources for the management of environmental challenges (Kalungwizi, Gjøtterud, & Krogh 2019).

Freire (1970) maintains that awareness of power relations causing vulnerability is a necessary condition for unifying the understanding and the choices of possible actions. Adger (2000) emphasizes that social resilience requires capacity building among the community members and in their institutions in order to transform social structures. Irwin (1990, p. 3) stresses that creating "political structures that enable active participation in decision making about environmental issues on local, national and global scale is a crucial part of environmental education."

To increase self-determination or autonomy, we have addressed conscientization as well as collaboration with district authorities, the nearest representative of the hierarchical power structure. Without any possibility of removing or changing the existing hierarchical power structures, we chose to discuss the allocation of resources with the authorities and to try to influence their decisions. Tanzanian district authorities control the preparation and distributing of teachers, who are important resources in EE in many poor local communities. In addition, we established alternative or parallel power systems through the PAR project and action learning processes. The identification and

education of facilitators such as local gardeners among themselves was also intended to strengthen the development of autonomy and local socio-ecological resilience.

However, the central power might have an important power function through regulating unwanted local overexploitation or destruction of resources causing environmental challenges. Unrestricted local autonomy might threaten socio-ecological resilience. Therefore, a central legitimized power on a national and international level possesses a required regulating function for the local management of socio-ecological resilience. Unfortunately, in Tanzania, the central governance structure seems to be contra-productive when neglecting to allocate any of the most necessary resources for the functioning of local autonomy, which then limits innovation, creativity, and flexibility.

Given these limitations, and according to Ryan and Deci (2000) as well as Freire (1970), local democracy and autonomy in local decision-making seem to be a necessary condition for the satisfaction of the psychological and social needs for self-determination, and thus for motivation for the management of local environmental challenges and socio-ecological resilience. In Tanzania, we have experienced that democratic processes may be long lasting and still delay tangible outcomes, characterized by the Swahili concept of "baadaye," which means later. In the next subchapter, I will discuss how to deal with cultural patterns of understanding and behavior that might be barriers for cultural resilience.

6.4.3 Cultural resilience

Within cultural anthropology, "shared patterns of understanding and behavior" is a general and wide definition of culture. Thus, Handwerker (2002, p. 107) refers to Tylor (1871) when arguing for the continuous validity of Tylor's definition of culture as "the knowledge people use to live their lives and the way in which they do so." Still, in accordance with the development of EE and ESD during the last decades, which I discussed in chapter 2, the anthropological understanding of the phenomenon of culture has become more multi-faceted, changing, and even contested (Ingold, 2011; Laplantine, 2015). To a varying degree, cultural patterns of understanding and behavior seem to be complex and changing, and, in addition, possible to influence and change. Anyhow, conscious changes of existing cultural patterns presuppose human realization and consciousness about these patterns.

When socio-ecological systems change, for example, due to particular forms of environmental degradation, there might be a need for adjustments and even changes in existing cultural values and patterns to be able to manage with the system changes in a resilient way. Thus, we cannot equate cultural resilience in a socio-ecological system with the conservation of cultural patterns. On the contrary, cultural resilience might presuppose the ability to adjust and transform shared patterns of understanding and behavior. New cultural solutions might exist within the local community, come from external sources, like research or other communities, or be an outcome of problem-solving processes, for example through PAR.

The local gardener's expertise on the positive environmental effects of the use of different local tree species shows that new cultural solutions can exist within the local community. The local knowledge concerned trees that treated different diseases and which repelled dangerous insects. Still, this knowledge needed exposure for recognition in the local community. In general, research on EE acknowledges local knowledge and practice as important for environmental management. Even though further studies would be necessary to confirm the supposed effects of the local tree species, the sharing of the idea about the usefulness of these trees both motivated local interest for inquiring about the suggested effects of the use of the trees and for the conservation of the tree species. In this way, the revelation of local knowledge can give an expanded understanding of the potential use of local resources in the management of environmental challenges, and, thus, increase socio-ecological resilience.

In subchapter 6.1.2, I discussed the reasons as to how and why cultural patterns of "baadaye" and "hamna shida" could be barriers against the local management of environmental challenges. The two cultural patterns seem to be ways to protect oneself and fellow citizens from the negative consequences of a lack of confidence in projects and other organized activities related to environmental management. Gradually, the removal of negative consequences seems to downplay the significance of the patterns, for example, by reducing participants' tendency to withdraw from the project when difficulties occurred. This might lead to local cultural resilience, and, in the same way, socio-ecological resilience.

Negotiations on the perspectives underlying different cultural worldviews might transform the understanding of environmental degradation within each cultural worldview and initiate transformative actions. In subchapter 6.4.2, when discussing relatedness, I addressed the recognition of positive interdependence between farmers and pastoralists. The communicative space, which we created in this study, seemed to be an important avenue for initiating dialogue between these two cultural worldviews. The dialogues, related to concrete practices, paved the way for intercultural awareness and a limbering up of rigid institutional structures that complicated conflict management (Adger, 2000). Recognition of the interlinkages between culture and income generation by the inclusion of fodder cultivation as an example of EE involved and engaged the pastoral communities in environmental care (Chambers, 1997). Still, the development of fodder production requires time for learning. Thus, showing patience to allow the realizations and learning processes that underly changes in a worldview is important to strengthen cultural resilience. In addition, cultural tolerance combined with dialogues are socio-cultural resources that can promote socio-ecological resilience.

As the coordinator and facilitator of the PAR project, I realized the decisive significance of intercultural awareness caused by long-lasting interaction with the local inhabitants. Outsiders easily misunderstand cultural expressions. According to Deketelaere and Kelchtermans (1996), revealing the underlying cultural beliefs and values might minimize misunderstanding and frustrations and, in addition, can be a foundation for the development of new values. In this study, the revelation of

everyday practices and cultural belief systems awakened and increased my intercultural awareness. Even though I am a Tanzanian citizen coming from a rural background, I am, as a scholar and a researcher from SUA, in some ways an outsider in other Tanzanian rural settings. Realizing my cultural outsider status made possible the transition to become more of an insider, facilitator, and co-learner. Participation in local meetings, rituals, my willingness to self-disclose, and my continuous presence in the community seem to be the prerequisites for self-understanding as well as for entry into new cultures. In addition, such participation can strengthen the citizens' confidence in a facilitator of action learning and EE. Throughout the PAR processes, we identified and promoted local cooperation based on mutual respect and solidarity as common cultural resources that strengthened socio-ecological resilience.

Psychological, social, and cultural resilience presumes that human beings, individually and societally, can consciously change and improve their actions and practices in environmentally-friendly ways. In this subchapter, I have discussed culture as changeable patterns of understanding and action that can be assets as they are, hindrances to remove, themes for negotiation, or gateways for self-understanding and gaining confidence from others. The common feature is the use of culture to strengthen human resilience toward environmental challenges.

6.4.4 Economic resilience

There are a variety of definitions of economic resilience that often relate to macro-economic systems. Briguglio, Cordina, Farrugia, and Vella (2009, p. 233) define economic resilience as "the policy-induced ability of an economy to recover from or adjust to the negative impacts of adverse exogenous shocks and to benefit from positive shocks." Indeed, on the macro level of societies, policies are crucial for the development of economic resilience. However, Tanzanian farmers as well as Tanzanian rural communities have minimal or extremely low influence over macro-level policy decisions. The majority of rural inhabitants are poor farmers living in households. Their livelihood depends on the extraction of resources from nature, and they need to cope with the effects of environmental degradation and adapt to longer term changes in their environment in a sustainable way. If not, they risk losing their livelihood and basis for existence.

Therefore, I have chosen to delimit the definition and discussion of economic resilience to certain micro-economic systems; farming households as the core micro-economic unit throughout rural Tanzania. Resilience Now, an international non-governmental organization working in Rwanda and Burundi, has defined economic resilience as "the ability of a livelihood to resist, absorb, cope with and recover from the effects of hazards as well as to adapt to longer term changes in a timely and efficient manner" (Handicap International, 2019, p. 2). This definition does not deprive farmers or communities of opportunities to manage environmental challenges through their economic activities, even though they realize that their room for maneuvering is limited.

Environmental researchers have stated that extensive Tanzanian agricultural practices such as shifting agriculture and pastoralism with large herds cause environmental degradation through deforestation and erosion (Palmer, 2006). Knowledge about the major causes behind environmental degradation are well known among researchers and scholars. This widespread knowledge might have influenced the mapping of environmental challenges as well as the choice and testing of EE activities in the first cycle of the PAR project.

When the student teachers, in the second cycle of the PAR project, were practicing in local communities away from the Teachers' College in Kilosa, the choice of EE activities diversified (Kalungwizi et al., 2018). Most of the EE units consisted of EE activities combining environmental care and a potential improvement in farmers' livelihood. The local participants adjusted the choice of EE activities according to local knowledge and the local environmental challenges. Still, six of nine local EE units carried out tree planting, the main EE activity of the first cycle, in addition to locally specified activities. The follow-up study showed that only one of the six EE units continued with tree planting after the second cycle, although all cared for the trees that they had formerly planted (Kalungwizi et al., 2019). Gardening within or nearby the tree plots with vegetable production for school meals predominated on all sites.

Ahmad (2016) and Jäckle (2016) have discussed and shown the link between school meals and pupils' performance in rural Tanzania, where the pupils are usually hungry at school. In poor societies, the inhabitants tend to prioritize the satisfaction of fundamental needs. Food is more important than trees. Poverty might lead to a choice of activities characterized by short-term sustainability and to toning down sustainable adaptation to long-range environmental changes. Even though the participants' awareness of the environmental challenges with agricultural activities in their communities led to the substitution of these activities with less polluting and degrading activities in the EE units, increased socio-ecological resilience presupposes the continuous inclusion of EE activities with long-range sustainability in mind.

Still, short-term income-generating activities are crucial for the rural livelihoods of Tanzanian farming households. Unfortunately, the integration of short-term goals in EE seem to be rather absent in most EE programs. Therefore, socio-ecological resilience presupposes the consideration of the rural conditions for life in Tanzania and need to combine and bridge EE activities with short-term and long-term sustainability.

6.4.5 Socio-ecological resilience: Connecting the four domains of resilience

In the first sentence of subchapter 6.4.2, I stated that socio-ecological resilience depends on ecological resilience but requires human management. The following subchapter elaborates on how psychological, social, cultural, and economic resilience can constitute the human management of socio-ecological resilience. The four domains of resilience intertwine, but each of them, in my opinion, has immanent characteristics that defend a conceptual separation to secure clarification of the different conditions for socio-ecological resilience.

For EE to succeed under harsh conditions, such as in rural Tanzania, it is crucial that the education strives to develop psychological, social, and cultural resilience. The psychological conditions relate to the participants' motivation, will, and ability to carry out actions that strengthen such resilience. These human qualities and driving forces seem to require social resilience, through coordination, leadership, and organization, and ecological and economic resilience, through approaches for the management of challenging and shifting environmental conditions in the local community. PAR seemed to meet this diverse set of conditions for resilience in our study, while action learning can be a sufficient tool when research is not the objective but solely the management of the challenges is. The enactment of collaborative projects builds on lasting motivation, will, and vigor among the participants, which requires that the project's content, structure, and mode of operation does not contradict local ways of understanding, methods, and values. Working in accordance with the local culture requires cultural insight but might also require that one has to counter the negative effects of cultural beliefs toward such projects such as through overcoming "hamna shida"—it does not matter.

Macintyre (2019) envisions the future environmental educator as a gardener. When cultivating, the gardener depends on natural processes in the plant and the physical environment. The same is the case with environmental educators who work within the framework of ecological resilience. When we expand to socio-ecological resilience, the cultivating gardener of EE needs to bring human complexity in the individual, social, cultural, and economic fields into consideration. In this discussion, I have entered this complex landscape with some preliminary suggestions based on findings from the PAR project in this thesis. I hope my entry into this landscape might inspire others to further develop the concept of socio-ecological resilience.

6.5. Implications of the study

In this concluding part of the thesis, I will emphasize some educational contexts where the findings of this study are likely to be useful. I start by presenting possible implications of the study for teacher education and primary school education. Next, I look at suggestions from the study for the EE research community in Tanzania and beyond, then highlight how the study can inform practice at my university, and lastly, I will discuss recommendations from the study for participatory action researchers.

6.5.1. Implications for teacher education and primary school practices

Given the need to integrate environmental topics in the primary school curriculum in Tanzania, the teaching strategies that foster the transfer of teaching strategies from teacher education to primary schools are important. I found that experiential learning connected with the production of vegetables for immediate use as EE was manageable and fruitful for teacher colleges, primary schools, and the local community, while the natural environment and local challenges must determine whether tree planting or other activities are suitable. Based on this experience, I recommend that teacher colleges should capitalize on experiential learning connected with various gardening activities as the means to promote relevant learning.

6.5.2. Implications for the Tanzanian environmental education research community

As elaborated in the methodological chapter, university teachers dominate the research in EE, which tends to be positivistic. The results from such research are normally not immediately applicable for solving community problems. Through this PAR project, we were able to address community problems at once. In accordance with Eikeland (2012), we argue that researchers, and especially EE researchers in higher education, should be interested in PAR because it is transformative and has the potential for changing teaching practice as well as the practice of the local community in ways that can create awareness of local environmental challenges and promote problem-solving skills. The use of PAR and experiential learning transferred skills and attitudes to teachers and tutors so that they started researching their own practice. The research itself dealt with solving life problems, and, thus, the PAR approach reduced the gap between research and practice for environmental management. Therefore, I recommend that teacher education teach and involve student teachers in action learning and action research processes as they develop their EE ability. In this way, teachers might become resources in the Tanzanian EE research community.

6.5.3. Implications for my university

Research is a key function of my university (SUA). Still, most of the research activities have not generated the expected impact in the local communities. This low-cost project yielded tangible results in terms of human development and ecological sustainability in the project area. I think emphasizing PAR, which encourages local community participation in knowledge generation, can make the university more impactful. Building more researchers' capacity in using PAR is probably the starting point. Therefore, the university needs to commit sufficient resources to building researchers' capacity to construct impactful research results through PAR. The university should also collaborate with teacher colleges and primary schools in order to make university research accessible, applicable, and transferable to Tanzanian communities.

6.5.4. Implications for participatory action researchers

A central idea in PAR is that local actors should be the initiators of the change processes. In line with emerging studies, including Ahmad's (2016) study, this study shows that a committed external agent can mobilize local initiatives to start the needed changes. Therefore, external participatory action researchers should facilitate the development of local autonomy to address the environmental challenges.

6.6. Final remarks

Reflections on the project processes show that experiential teaching strategies and PAR can have social and ecological benefits. The following factors strengthened the study:

1. The mapping of environmental challenges and resources expanded the local understanding of environmental challenges and developed and strengthened the participants' attachment to the environmental conditions and to each other.

2. The availability of adequate time for negotiating different meanings about environmental challenges and for building local trust in researchers and local leaders strengthened the local legitimacy, and thus, the sustainability of the EE activities. The project's EE activities continued despite the numerous challenges related to power structures, changing environmental conditions, and challenges related to pastoralists and wild animals.
3. The researcher's background as a Tanzanian secondary school teacher was beneficial to the study. In addition, my background in social psychology, especially my listening skills, helped me to understand nuances in the participants' opinions and perspectives and to perceive the challenges associated with the organization and implementation of the study.

I can now claim that:

1. It is possible to transform teacher education and primary schools into centers for community learning where teacher educators, student teachers, students, and other community members may share strategies for addressing environmental challenges and thus become able to move out of unsustainability.
2. Trust in the local community leaders and in the leaders of the EE projects is a precondition for engagement in the management of the environmental stressors.
3. In the rural context of Tanzania, mobile phones seem to be important tools for the facilitation of the formation and development of a community of learners and for the management of learning and teaching processes as well as environmental stressors.
4. Tree planting combined with gardening seems to be a suitable point of departure for the transformation of EE teaching in primary schools and teacher colleges, since the majority of the Tanzanian rural population has a positive emotional attachment to these activities.

Finally, I see this study as a living case for transforming education to serve the rural poor communities in Tanzania and elsewhere to enable the development of EE that works to address the local realities.

6.7. Limitations of the study and suggestions for further studies

First, I implemented the study in *one* teachers' college. Therefore, it is difficult to generalize the findings. Still, the study is a case with potential for analytic generalizations (Yin, 2009), as is noted throughout chapter 6, especially in subchapter 6.4. In addition, I believe that the findings can also be useful in many rural areas in developing countries that are striving to deal with climate change. Another critique might be that most of the data originate from self-reports, which are likely to hold biases. Still, I have verified the data with multiple methods.

We recommend similar studies in other parts of the country to establish other cases that can express, illustrate, and convey the diverse reality of the Tanzanian context. The developed ideas about the motivation of local communities for active EE strategies and for local socio-ecological resilience are relevant for further investigation.

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APPENDIX 1: Interview Guide on The Understanding of Environmental Education Practice (student teachers, teachers, tutors, gardener)

1. Please tell me about your background in environmental education.
2. Can you tell me about the realization of environmental education in this institution?
3. What are your roles in the realization of environmental education in this institution?
4. Tell me about the common challenges you face in realizing environmental education in this institution.
5. Tell me about the strategies you use to address the challenges (in 4).
6. The curriculum and education policy writes about participatory teaching methods. Can you tell me how you realize participatory teaching methods in the teaching of environmental topics?
7. What do you see as the main challenges for realizing participatory teaching methods in environmental education?
8. What is your own perspective about environmental education?
9. Education policy writes about community engagement in education. How do you engage the local community in environmental education?
10. Education policy writes about connecting teaching to the practical life of learners. Can you tell me how you realize this statement in environmental education?
11. What are the challenges of engaging the local community in environmental education?
12. What are the possibilities for further engagement of the local community in environmental education?
13. What is your plan to improve the environmental education in this institution?

APPENDIX II. Interview Guide on Environmental Education Learning Outcomes (student teachers, teachers, tutors, gardener)

1. Can you tell me about your overall experience of this project?
2. What did you find important from the planning and implementation of this project?
3. What are your perspectives about environmental education?
4. In which ways might the project influence your future practice in environmental education?
5. What is your future plans about the facilitation of the development of environmental education in schools and local communities?

APPENDIX III: Focus-Group Discussion Guide for Further Understanding the Environmental Education Practice and Outcomes of the Practice (discussed in FGDs involving student teachers, teachers, tutors, and local community members)

1. What do you perceive to be the main challenges for the realization of environmental education in schools and local communities?
2. What do you see as the main opportunities for improvements in environmental education practices?
3. What do you see as the main challenges for community engagement?
4. How can we improve local participation in teaching and learning?
5. What do you consider as the main strengths and weaknesses of this project?
6. How can we improve the strengths and minimize the weaknesses?

PART 2:
PAPERS

Participative planning of environmental education activities: experiences from tree planting project at a teacher training college in Tanzania.

Vituce Jelasy Kalungwizi, Sigrid M. Gjøtterud, Erling Krogh, Amon Mattee and Ahmad Kyaruzi.

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Participative planning of environmental education activities: experiences from tree planting project at a teacher training college in Tanzania

V. J. Kalungwizi[a], S. M. Gjøtterud[b], E. Krogh[b], A. Mattee[a] and A. K. Ahmad[a]

[a]Department of Agricultural Education and Extension, Sokoine University of Agriculture, Morogoro, Tanzania; [b]IMT, Norwegian University of Life Sciences, Ås, Norway.

ABSTRACT

Engaging local actors in Environmental Education activities seems to be an important condition for environmental sustainability. Lack of common purpose among local and external researchers constrains the engagement. Following these insights, we implemented a participatory action research project related to tree planting as part of creating an Environmental Education programme at Ilonga Teacher Training College, surrounding primary schools and villages. The purpose of the initial phase of the project was to contextualize an action plan as a strategy to engage local actors in the change process from the beginning of the project. The research questions were: How can we engage local actors in participatory action research addressing resource constraints for EE; and what are the results of the participatory planning process? To answer these questions, we mapped environmental resources and challenges in the chosen area. Thereafter, we organized an empowerment process through Focus Group Discussions and a workshop discussing the challenges and opportunities available for successful implementation of the project. These discussions formed the foundation for creating a plan for implementing the EE project. In this paper, we present the results of the planning strategies, and discuss factors contributing to the success of the initial phase of the project. We found that stakeholders' trust and sense of project coherence were key motivating factors for the development of a collaborative planning process and learning through initial actions.

Key words: Participatory action research (PAR); contextualized plan; environmental education EE); teacher education; Tanzania

Background for environmental education and participatory intervention

One of the main challenges in Environmental Education is low level of engagement of local actors (Graber-Kybutz 2013; Johnson-Pynn and Johnson 2010; Palmer 2006; Rickinson 1999). United Nations agenda 2030 recommends that people learn how to work together to end land degradation which is the main cause of extreme poverty and hunger in many nations (UN 2015). Though Tanzania has been implementing EE curriculum since 1995, the country is still experiencing a high level of environmental degradation in terms of deforestation, land degradation, pollution and water shortage, which threaten community sustainability. According to FAO (2011), between 1990 and 2010, Tanzania had been losing 400,000 ha of forests per year; and according to Kidegesho's (2015, 24) prediction, 'in 50 to 80 years to come all forests will disappear in Tanzania'. Deforestation has been exacerbating other environmental degradations that have made huge impacts on human life in terms of food security, water availability, health, peace and community sustainability in general. Due to environmental damage, Tanzanian communities experience shortage of clean drinking water,

outbreak of diseases, including cholera and malaria, falling agricultural productivity and increased rural–urban migration. Shortage of productive land for crop and animal farming has become the main source of inter-ethnic conflicts in agro-pastoral systems (Maurel and Kubik 2015; Noel 2011). In Tanzania, many people live in rural areas, where agriculture is their main source of income and trees are the main source of energy (URT 2013). Large numbers of youths, who are the majority in the country's population (URT 2013), have limited opportunities for post-primary education. As a result, they become an important source of agricultural labour in rural areas soon after completing grade seven. Environmental degradation, which is accompanied with loss of important natural resources, is a major challenge in the sustainability of rural communities and for the well-being of youths in rural areas. Educational policies and curriculum at all levels of education recognize the mastery of environmental issues as one of the important learning outcomes (Kimaryo 2011; URT 2010). Although active learning methods are suggested as important in the learning processes from pre-primary to higher learning institutions, (UNESCO 2006; URT 2010) in reality, traditional methods of lecturing and memorizing environmental issues still dominate the learning process at all levels of education in Tanzania (Ahmad, Krogh, and Gjøtterud 2014; Barrett 2007; Roberts, Brown, and Edward 2015; URT 2010; Vavrus 2009). The application of knowledge is limited to standardized tests (O-saki and Agu 2002) and not to solving practical problems that are facing the Tanzanian community. The situation has led to a number of negative consequences including the negative attitude towards agriculture especially among the youth, youth migration to urban areas and low motivation in learning. Part of the solution to these challenges lies in working with relevant local actors to address environmental challenges and improve teaching and learning conditions using locally available resources and local experts. Since teachers are the most important and omnipresent experts in rural areas in Tanzania, we view them as key change leaders, hence the study targeted teacher education.

On this background, we formulated the following research questions: *How can we engage local actors in participatory action research addressing resource constrains for EE; and what are the results of the participatory planning process?*

Educational institutions have the potential to initiate and lead social transformations. The use of educational institutions as agents for social change was a common practice in Tanzania between 1960s and early 1980s under the auspices of Education for Self-Reliance (Ahmad, Krogh, and Gjøtterud 2014; Nyerere 1967; URT 2010).

Theoretical perspectives that guided the PAR project

During the planning process, theories related to experiential learning, resilience and social empowerment, specifically those propounded by Antonovsky (1987), Beach (1999), Dewey (1938), and Freire (1970), inspired our activities and decisions. These theories view participation as a learning process that might encompass the transformation of realities. The purpose of approaches aiming at social empowerment is not to develop ability to reproduce or copy what is taught, but to develop ability to question and take meaningful actions to change reality. PAR rests on these ideas, and sharing and application of useful knowledge is a key component of the empowering processes (Esau 2015; Mezirow and Taylor 2009).

Therefore, we chose PAR as our strategy to engage relevant institutions in designing and implementing an intervention to improve EE and hence the environment. Sterling (2009) indicates that engaging with people and their expressed needs is the best way to facilitate them in reconstructing their realities and in implementing meaningful change. When engaged, participants might experience self-determination, meaningfulness, competence and a sense of empowerment (Fals-Borda 2001; Ryan and Deci 2000; Thomas and Velthouse 1990, 674). In addition, Antonovsky (1987), found that participation in situations characterized by perceived comprehensibility, manageability and meaningfulness both foster motivation and capability to manage stressors. These

assumptions suggest that collaborative mapping and problem analysis, discussions and decision-making are useful in transformative processes of environmental education (Chambers 1997; Chiu 2003; Maclaren, Mills, and Tommbe 2014). In the initial phase of the project, we wanted to create conditions where student-teachers and primary school teachers could engage in securing resources for active teaching and learning processes in respect of EE. We expected that the process would lead to increased self-efficacy and self-esteem as observed by Bandura (2013), which are important for participation and for teacher's professional development in a long run.

According to Palmer (2006), there are three main orientations to Environmental Education and these are education about, education in, and education for the environment. Education about the environment focuses at information dissemination and it is associated with low level of participation. Education in the environment involves using the environment as an arena for teaching and learning. This orientation is associated with moderate engagement. Education for environment on the other hand entails that the whole purpose of teaching and learning is to meet ecological sustainability and sustainable development as a holistic goal, and to influence the long-term values and moral dimensions of learners toward sustainability. This approach demands the highest level of learner participation in teaching and learning processes.

Initiating a holistic environmental education was the aim of this project. In emphasizing the importance of participatory approaches, Arnesen (2000) identifies six main levels of participation where passive participation is the lowest and interactive participation is the highest level. Local motivation and ownership seem to increase with higher levels of participation, hence we intended to facilitate interactive participation of the local communities in EE. Piggot-Irvine (2012) identified six main conditions that predetermine effective participation as follows: trust, shared goal, shared language, a desire to participate, openness and listening and passion for the process. According to Wicks and Reason (2009), participation is a process that proceeds in three main stages, namely, inclusion, control and trust, trust being both the determinant and the outcome of the participative process. To achieve these conditions, we conducted a participatory mapping of EE, organized Focus Group Discussion (FGD) and a workshop, engaged local community leaders and encouraged the use of shared language (Kiswahili) in the planning process.

In the following sections, we describe the context of the study, the methodology for the planning process, and finally we discuss the process and the outcome of the PAR planning process.

Context of the study

We conducted this study in Kilosa District in Morogoro region, Tanzania, at Ilonga Teacher Training College and Ilonga primary school. The college prepares teachers for primary and pre-primary school. Ilonga primary school serves two villages – Ilonga Msalabani and Mkono wa Mara. The villagers are largely small-scale farmers mostly living on the slopes of the Ukaguru Mountains. Beans and maize cultivation, charcoal making, hunting and beekeeping are the main sources of income. The area is semi-arid with bimodal rains. However, climate change has altered rainfall patterns making the rains largely unreliable. In the study area, 82% of the forests have been cleared out and the pressure on the remaining forests is high (Kajembe, Silayo, and Vatn 2015). According to Thaxton (2007), land, water and forests are the most important natural resources for rural people in Tanzania. Therefore, we focused on the sustainable use of these basic natural resources for EE.

Due to a long history of having suitable land for agriculture and as a destination for retrenched migrant workers from sisal plantations, the area has attracted many immigrants. With an increase in population, the local inhabitants are increasingly becoming landless, and hence are forced to occupy marginal lands on the mountain slopes where productivity is low and the potential for land

degradation is high. As a result, the local inhabitants are particularly vulnerable to climate change, land degradation and other natural hazards. These reasons were the motivation for carrying out the current project. Methodology for initiating the process

This project employed action research methodology. According to McNiff (2011), action research is the best option when the purpose of the research project is to create meaningful change in collaboration with local actors. This action research project aimed at improving teaching and learning practice in respect to EE in the chosen institutions through a series of planning, acting and reflecting cycles, to ensure curriculum relevance (Elliott 2001; Kemmis and McTaggart 2007; Zuber-Skerrit 2012). The ultimate goal of the process is to improve practice and empower local institutions and individual participants (Elliott 2001; McNiff 2011). It is essential to have local stakeholders cope with the environmental issues affecting them so heavily. PAR has the potential for enhancing the local capacity to deal with social, economic and environmental challenges (Freire 1970; Nyerere 1967; Swantz 2008).

We chose to establish a tree garden at Ilonga Teacher Training College as part of EE. The choice of the site was ideal since the college is close to Ilonga river, which is the only reliable source of water in the area. Tree planting has multiple environmental benefits. Trees can restore degraded land, modify microclimates and reduce pressure over natural forests (Kajembe, Silayo, and Vatn 2015; Kidegesho 2015). Planting trees improves understanding of scientific processes and provides an arena for active teaching and learning. Development of students' attitudes and skills has the potential of restoring environmental degradation in the end.

Through initial collaborative activities in the context of tree gardening, shared vision, a strategy and a sense of unity could be created. These are important qualities for working together throughout the project (Wicks and Reason 2009). We aimed at achieving this foundation through contextualizing the planning process by rooting the PAR project in the local community from the beginning. The process was envisioned to provide a learning opportunity for local actors to internalize local environmental issues, and identify the existing opportunities and challenges for addressing them.

Plan for the initiating phase

The first step in the planning process was the introduction of the project to college administrators and collaborative recruitment of participants, which was meant to encourage institutional ownership.

Secondly, we planned to map EE practices and resources to identify environmental issues and opportunities for addressing them. We expected that the mapping would increase local ownership to EE practices and local inhabitants' confidence towards students, researchers and the project idea. In addition, we wanted to reveal relevant local knowledge, including the available local trees for planting in the garden and the understanding of the existing linkages among local institutions. In order to develop the relationship with the local actors, the first author stayed in the area for one month during the mapping.

Thirdly, we conducted FGDs, one for student-teachers (10 participants), one for tutors (five participants) and one for primary school teachers (six participants). Chiu (2003) recommends a maximum of 10 participants per group for optimal interactions as they might open for revealing and sharing deeper understanding of lived experiences. We conducted the FDGs in Kiswahili, the language the participants preferred. Using a common, wellknown language, can make discussions flow freely with equal opportunities for participation. Each of the three FGs discussed the conditions for improving EE in schools and in the local community based on the outcomes from the mapping.

The themes that emerged engaged the participants in critical reflection of EE practices and the roles they played in environmental sustainability in their institutions (Calder 1977; Maclaren, Mills, and Tommbe 2014). Critical awareness could in turn enable participants to contribute in the planning sessions. This was meant to strengthen their professional identity, which is important in facing professional challenges. It was important to empower the teachers, who normally feel underprivileged.

Finally, we carried out a stakeholders' workshop to discuss issues of common interest and develop an action plan. We organized the workshop during a weekend in order to take advantage of empty classrooms at the college. A local caterer served breakfast and lunch for all the participants. We ate together to foster friendship and togetherness, which is important for working together (Woolley and Fishbach 2016). In the workshop, we mixed student-teachers, primary school teachers, tutors and experienced participants to capitalize on Vygotsky's (1978) ideas of Zone of Proximal Development (ZPD). Local actors at Ilonga Teacher Training College were responsible for coordination, including inviting the participants to the workshop. We invited participants from neighbouring primary schools and from two schools in other parts of Morogoro, which had implemented similar projects (Ahmad, Krogh, and Gjøtterud 2014). Only 1 of the 30 invited participants could not attend due to religious reasons.

The external researchers' roles in this process were mainly to facilitate the learning process and group interaction by asking prompting questions. We chose the workshop as a tool for mutual prioritizing and planning EE activities for student-teachers to carry out in their following teaching practice period.

Ethical issues

It is important to note that the local community had remnants of chiefdom administration, which was based on hierarchical power relations. Democratic and horizontal power relations, which constitute PAR processes, could evoke distress among participants in such a community (Jolley 2011; Sesanti 2010). Therefore, we chose to provide basic information on PAR processes in order to facilitate informed decisions to participate in the project. Prior information on the democratic nature of PAR was important since participants would be interacting with people from different socio-economic background like tutors vs. student-teachers, researchers vs. practitioners and primary school teacher vs. pupils and parents. We obtained consent from participants to take photographs and to audio record conversations and interviews. To avoid interrupting local programmes like teaching schedules, we scheduled project activities in respect to institutional timetables. We engaged pupils, after obtaining consent from their parents.

Data collection and analysis

The mapping consisted of observation, interview and conversation and was documented by photographs, audio records and field notes, while FGDs and workshops were documented through audio records and the participants' notes. Researchers and participants' diaries were also vital data. According to Yin (2014), such approaches provide researchers with the opportunity to establish an in-depth understanding of processes.

We analysed the data by listening to the tapes, organizing themes using thematic and content analysis and then interpreted the data in relation to the central aims of the project. We analysed the plans the participants submitted for the plenary sessions and together with participants, we discussed how we best could accommodate the EE concerns in the final project plan, taking available

resources and time into consideration. All data, sounds and written, were in Kiswahili and the first author translated into English as part of the analysing process. Results from the initial process

In this part of the paper, we provide an outline of the process of selecting participants. We will further outline the context of EE as revealed in the mapping, FGD and workshop processes. We will emphasize the physical conditions, teaching conditions and material conditions of EE in the study area.

Selecting institutions and participants

We selected Ilonga Teacher Training College, because of the natural conditions surrounding the college, as discussed above that gives rise to an urgent need for EE. Secondly, because the college has a central position among teacher training colleges in eastern Tanzania. Hence, we assumed that the results of the transformed practice could easily roll out to other institutions through snowballing effects. The nearby Ilonga primary school was given since the student-teachers would be doing their teaching practice there.

In each institution, we worked with members of environmental committees. In Tanzania, school environmental committees are responsible for coordinating environmental education and other activities in schools (URT 2010). To ensure and strengthen local ownership, we found it necessary to work with established committees and institutions. From Ilonga Teacher College and Ilonga Primary School there were 10 members in this category. Further, we selected 10 student-teachers from year one at the college. During subsequent meetings, we added two more participants based on their roles and experiences in working with the local community, namely the local extension officer and the local home-based gardener. The total number of participants was 22.

Mapping – awareness of and the context of EE

During the mapping, the first author visited Ilonga, Msimba and Ustawi Primary schools, in addition to Ilonga Teacher Training College, together with local leaders and interested participants. We also visited farmlands, rivers flowing in the area and forests, which are the source of firewood and charcoal. Furthermore, we consulted community experts, including home-based gardeners and extension officers, and interviewed farmers close to the institutions. The interview guide focused on various dimensions of knowledge, attitudes and practices of EE and on motivation dimensions of EE in schools, as well as farmers' opinions for improving the practices. We also interviewed the local project coordinators, student- teachers and tutors on key conditions that predetermine participation; namely participants' relationships, perceptions of the project relevance and commitment to the project (Piggot-Irvine 2012). Moreover, we observed school gardens, land use patterns in the surrounding communities and the practices of outdoor activities and teaching plans in the respective education institutions.

The collaborative mapping of the context of EE, gave researchers and local actors the opportunity to share experiences on environmental education and particularly key environmental issues relevant to the study area. The following are some of the key environmental issues that emerged during the mapping exercises.

Shortage of water and land degradation

Community members reported that it was increasingly becoming difficult to get water due to drying of rivers and shortage of rains. The whole area relied largely on Ilonga river as the main sources of water for drinking, domestic use and for small-scale irrigation schemes, which are carried out along river sides and basins. Other streams were reported to be seasonal. The schools we visited had no

pipe water. Shortage of water as observed during mapping meant that it was difficult to practice tree-planting activities in the area. Yet, trees are needed not only to prevent erosion but also to provide shade and to protect the school buildings against strong winds. In one of the primary schools we visited, one classroom had no roof.

Participants told stories on how soil erosion was a threat to land productivity and to sustainability of road infrastructures. They revealed low knowledge of proper agronomic practices and poor animal husbandry among local community members. One of the participating teachers said that it was normal for animals to roam about in the school campus, destroying school gardens and infrastructures. Furthermore, they told stories about how scarcity of land resources had intensified conflicts and created challenges in planning for better use of available resources, which indicated that there was a competition for land resources. One of the participants reported that though farming activities close to water sources was restricted by law, shortage of land forced many to continue farming in the restricted areas.

Shortage of expertise

Teachers lacked expertise to sustain tree planting. Trees previously planted had died of diseases and drought. They said they lacked knowledge and skills to manage land degradation and the ability to teach EE practically. Newly employed teachers shied away from outdoor activities. Outdoor activities in many teacher-training collages were reported to be poorly emphasized. Moreover, education for Self- Reliance was less emphasized in both schools and teacher training colleges. As a result, participants further noted that lecturing dominated teaching and the teachers were not able to deploy local resources such as local experts, for managing land degradation and for improving the teaching and learning situation. Low institutional collaboration

Participants indicated that the relationship with local government authorities was not facilitative. Others emphasized that they do not get sufficient visits from foresters, extension officers and environmental experts to provide advice on how to teach and manage local environment.

FGDs – discussing the critical environmental issues and EE

The FGDs affirmed what had been revealed in the mapping. In all the three FGs, it was evident that land degradation was a critical environmental problem in the area. The FGs revealed that teaching about land degradation in the schools was theoretical, passive and deficient. Lack of time for practical teaching, low motivation, shortage of water, shortage of planting materials and insufficient security for planted seedlings were reasons discussed. According to the teachers, most of the trees in the schools had been planted at least five years ago. The tree planting tradition was fading away, despite the government emphasis that every pupil should have at least one tree. One of the teachers explaining the difficulties to sustain tree planting activities in schools said:

> Most of the tree planting activities are done after working hours (…) many teachers and students live very far from the schools, some up to 15 kms away: It is very difficult to stay at school after working hours to continue working on planting and taking care of trees. Pupils do not eat lunch at school so you cannot keep children all day without giving them something to eat. We allow them to go home after classes. As a result, among the trees we plant, especially during special government campaigns, some die of drought, livestock destroys some and others are stolen. We have no time and resources to take care of the trees in these very harsh conditions (Teacher 18.11.2015)

The participants indicated that watering plants was difficult because the water resources were five km away from the schools. Another challenge was that many students lived with parents in the government houses where tree planting was prohibited. Therefore, they lacked home-based tree planting experience. Moreover, inadequate number of teachers affected the practical aspects of EE.

Lack of teachers' houses, unreliable transport, lack of lunch, incidents of theft and similar matters made teachers unmotivated for practical work of EE after regular school hours. The already overloaded curriculum left little space for practical activities.

However, the participants differed in the points they emphasized. The tutors mostly related the challenges to physical conditions while student-teachers perceived teaching conditions as more challenging.

Workshop – light in the tunnel

Amidst all these challenges, a result from the collaboration between researchers and local actors were that they were able to identify some opportunities for transforming EE in the area. The local gardener ignited our hope. This rather old participant was not a trained specialist, but a local inhabitant who had started a small garden at his homestead. The garden contained a range of tree varieties, raised for different purposes, including shade, fruits and medicine; some were fast growing (for instance African mahogany and teak trees). The gardener was eager to share his knowledge with visitors, yet very few people visited him. In the workshop, we realized that the garden as an important resource for EE. The schools could focus on fast growing trees to achieve quick results, a motivating factor for pupils as well as for teachers and student-teachers.

The mapping had revealed that manure was available and livestock keepers were ready to contribute manure to improve learning in their schools. The analysis of the primary school curriculum in the mapping had informed us that all subjects including geography, science and mathematics integrate environmental activities. Although the FGDs revealed shortage of important resources for project implementation such as water and available time, the motivated gardener, the promised support of manure and the focus on environmental-friendly activities in the curriculum, seemed to be motivating factors driving the further planning process in the workshop. Deciding on strategies for meeting the challenges

During the workshop, the participants identified and chose strategies for addressing the environmental issues in their communities, including consulting parents and other community members. The participants prepared the action plan. The details of the plan are outside the scope of this paper, it is deemed sufficient to present critical challenges that the actors thought to be important for inclusion in the project. Table 1 summarizes the selected challenges and strategies.

The 10 challenges in Table 1 highlights the critical conditions influencing EE as already discussed. The first three challenges relate to physical characteristics of the area and therefore they are under the category of *physical conditions of EE*. The next five challenges relate to teaching and learning, these are under the category *teaching conditions*. The last two challenges relate to *material conditions* for EE.

Table 1. strategies for addressing the challenges.

S/N	Challenges	Possible strategies for countering the anticipated challenges
1	shortage of water	identify simple technologies for conserving water and soil moisture during dry season
2	shortage of land	consult local community members
3	soil not fertile	consult local community members for manure and other indigenous methods of soil fertilization
4	no time for practical activities	use available time effectively – make use of tools
5	low motivation	Relate EE to income generation activities. Work with teachers who are interested in EE
6	teachers' lack of relevant expertise	Engage local experts in planning such as gardeners and extension officers
7	low parent involvement in teaching	Engage parents in planning
8	shortage of teachers	use tools like computers and mobile phones to make effective use of available teachers
9	shortage of planting materials	consult local gardeners
10	trees and planting materials stolen	Build positive relationships with community members

The mapping, FDGs and the workshop emphasized the physical conditions of the area that related to shortage of water, shortage of land and low soil fertility. Deficient physical conditions increase the demand for labour and other resources on the part of actors involved in EE. These conditions seem to constrain sustainability of the project but at the same time they are the reasons for the necessity of the project.

To handle the physical conditions, the participants proposed strengthening of positive relationships among local actors and training on local technologies related to soil and water management for EE activities. Positive relations would be important for the acquisition of manure and for protecting planted trees from theft and destruction by wild animals and livestock.

Low salaries and insufficient houses for teachers affect their engagement in EE. Teachers need to supplement their incomes through other activities, and many spend weekends and after school hours at their farms. To handle the teaching conditions, the participants proposed to consult local actors to agree on convenient times for EE activities. Another strategy was the recruitment of local actors who were interested and willing to spend extra hours during weekends for EE activities in the schools.

Material conditions of EE such as shortage of planting materials could impede the implementation of the project. The participants suggested engagement of community members with the experience in similar projects and acquisition of external support to overcome resource constraints. Since research in Tanzania is the mandate of higher learning institutions, schools and teacher training colleges do not have sufficient budget and necessary materials for research activities. Therefore, we had to rely on locally available materials in order to make the costs manageable within local community. The participants decided to start by consulting local gardeners for planting materials, through organizing parent meetings and looking for sources of manure. Participatory planning was important in order to get an acceptable plan for all local actors including gardeners and agricultural extension workers, who were normally busy with other responsibilities. It was also crucial for motivating student-teachers and their tutors who struggle against high demands of teacher education curriculum.

Discussion

As we have shown, we chose a variety of strategies to engage the participants in the initial phase of the project. Engagement of participants with experience in EE, the use of local knowledge to frame the FGDs, the choice of experienced participants to take a lead in the FGDs, the use of common language as a medium of FGDs and recruitment of local and critical organization leaders as important

co-researchers were the main strategies. In the following sections, we discuss the results of these strategies in related to the research questions. After the presentation of the main outcomes of the initial phase, the discussion will focus on the process qualities that seemed to be important for the engagement: emergent trust and project coherence as the effects of the use of common and well-known language, shared background and facilitation of problem-solving skills.

Outcome of the process

Local actors became more knowledgeable of their environmental situations. They identified environmental challenges and strategies for addressing the challenges throughout the initial interactive process. Moreover, the participants acquired and improved their understanding of strategies for managing environmental calamities and for teaching environmental issues in their institutions. For example, a majority of the participants acknowledged the use of environmental activities to generate some incomes for the pupils and schools by selling tree seedlings, and by growing and selling fruits. The chosen research approach seemed to provide opportunities for the development of local resilience and mastery of situations characterized by environmental calamities.

The local actors proposed simple strategies in accordance with their memory of Ujamaa African socialism (see Nyerere 1967). Ujamaa was a political ideology that guided social economic transformation of Tanzania soon after her independence (Nkulu 2005; Nyerere 1967). The ideology was based on working together for common goods. These principles of mutual assistance and holistic development still existed in this community and provided the best ground for this transformative project. The initial phase of the project succeeded in setting important conditions for people to work in mutual relations and communal spirit in securing resources to address environmental challenges in their local communities. The following are some of the factors that may have propelled the success of the phase.

Trust, hope and motivation

Despite the numerous hindrances and their history of prior unsuccessful projects, the teachers still wanted to keep on with the EE project. The participants attended meetings according to the plan, and they expressed willingness to volunteer. In the initial mapping, the use of Google Maps through ICT and mobile phones facilitated the student-teacher's overview over the environmental challenges. In addition, the use of ICT itself motivated participation. One of the participants said: 'We really like what we are doing!' The commitment to the project was probably a result of mutual trust; moreover, the challenges associated with the handling of EE in poor schools and communities which were under the pressure of land degradation may have motivated local cooperation for improvement of teaching, learning and living conditions.

The first cycle of the action research project created conditions where participants trusted each other. The recognition of local knowledge, the researchers' staying in the area for 30 days and the use of local leaders as coordinators indicated that the external researchers were genuinely concerned with the challenges in EE that local actors experienced. Still, at this stage, the participants preferred to communicate with the local coordinators rather than with the researchers, especially on matters they considered sensitive, like remuneration. Gradually, local actors developed confidence towards the project and the researchers. Since the local actors had no resources for conducting research activities, we had to sort out what kind of financial support that was possible to the local actors and to the participants. In the end, the research project supported lunch, transport and planting materials. In addition to building confidence, the materials support may have raised their hope to accomplish activities and hence their motivation.

Winning trust from local actors is important in successful implementation of action research projects. According to Wicks and Reason (2009), in action research, the 'first steps are fateful' and participants' democratic experience during the first interaction is important in building trust which is one of the crucial qualities when working together (Kemmis 2001). According to Wicks and Reason (2009), also as elaborated by Fambrough and Comerford (2006), trust develops through three main stages; namely inclusion, control and intimacy. In addition, willingness to share through concrete acknowledgement of local demands seems to be an important condition for emotional trust. We also found that spending time and forming trustful relationships with local leaders were crucial in order to build trust with other community members. Thereafter, sharing seemed to foster emotional confidence and hope for change and improvement, for both among participants and the researchers.

Presentation of researchers' background

In Tanzania, the tribal system, with a hierarchy of status and power with chiefs as rulers, still influences the societal power structure; this had also an implication in the educational system. In the context of this mind-set, universities are powerful, and are also physically and mentally distant from primary schools and the rural communities. The sharing of researchers' career background seemed to bridge the differences in the social and economic status between local actors and the researchers. This bridging of the gap created the communicative space. The first author shared his professional background as a secondary school teacher. Like the majority of local teachers, the first author had organized environmental education programmes in secondary schools. Furthermore, the first author is also a farmer. By listening to his experiences, the majority of the participants seemed to perceive him as more of a colleague than an external researcher. In one of the meetings, one of the local actors said 'you are more than a researcher, you are a friend'.

Common background seems to be a stepping stone for the development of a community of practice (Wenger 1998). In accordance with Wenger's concept, the researchers and participants seems to share a concern or a passion for improvement of environmental practices through interaction and collaborative learning. In conjunction with the already discussed aspect on development of trust, the community of practice seems to have the potential to become a community of friendship or even a community of empathy.

Common language

Sharing a common language, Kiswahili, unified the first author with the context. The local actors preferred using this language, which is the official medium of instruction in primary schools and the national language in Tanzania. The use of common language reduced communicative hindrances, widened the communicative space and gave us an important tool for democratic expressions (see Fairclough 1996; Kemmis and McTaggart 2007; Neke 2003). Facilitation of problem-solving skills

To promote common confidence and self-esteem among local actors, we gave participants simple tasks in groups, and these were finished successfully. Thereafter, we gave them more demanding and individual tasks. The strategy was in accordance with Vygotsky's Zone of Proximal Development (ZPD) and learning in steps from simple to more complex. The accomplishment of simple solutions creates a sense of coherence, which facilitates trying out and mastery of more complex solutions. A sense of coherence, which has three main elements, namely comprehensibility, manageability and meaningfulness of life conditions (Antonovsky 1996) is important when learners face stressful conditions.

The project matched the local needs and therefore it was meaningful to the participants. The participants were eager to take part in improving the situation with regards to water scarcity and

crop failure through EE in order to obtain manageability of the experienced challenges. The mapping and situation analysis fostered comprehensibility of the challenges, the third and last of Antonovsky's situational conditions for a sense of coherence. We tried to learn from previous unsuccessful projects, by using local resources and creating collaborative working conditions emphasizing learning and environmental awareness rather than just planting trees. The participants reported that though they had negative experiences with tree planting, they needed to learn new strategies since environmental problems were accelerating interethnic conflicts and youth's migration and hence lowering agricultural productivity.

When local actors experienced a sense of coherence through a PAR-oriented planning process there was motivation which rested on experiential learning. They (local actors) seemed to develop capacity of managing stressors, as Antonovsky (1987) discusses this aspect using Freire (1970) concept, this process seemed to empower the actors for the upcoming actions through the development of shared critical consciousness.

This discussion can lead to different conclusions. Lack of water and harsh working conditions are severe constraints for the implementation of a sustainable EE project. This could mean termination of the project after the initial phase. The participants were clearly conscious of the immense challenges facing them and the environment. Still, they wanted to keep on. The discussion shows both development of self-esteem and self-efficacy (Bandura 2013) among participants and development of a community of practice with emotional attachment to the project. Land degradation threatens sustainability of natural resources especially forests and water sources which are essential for people's livelihood, and the choice seems to either accept and live with degradation or try to find solutions even though the challenges are hard to overcome. Development of trust and problem-solving skills seem to strengthen the hope and empower participants for taking environmental action through an increased emphasis on EE in the teacher education. Obviously, the challenges are the effects of global environmental degradation, yet there is hope that local initiatives can make a difference.

Conclusion

Unfortunately, the situation in Tanzania in respect to land degradation and lack of available resources to address this challenge is commonplace in Africa. To a large degree, the overarching principles we have developed through the discussion are transferable to other regions and countries with similar challenges. Development of self-esteem, self-efficacy, problem-solving skills and communities of environmental friendly practices might be a key to environmental education in African primary and secondary education and in local rural communities. Through detailed documentation of the initial phase of this action research project, we gradually realized the basic significance of building mutual confidence to develop such human and societal qualities and capacities. Through emotional acknowledgement of the other, actors in the communities of practice can transform themselves to communities of friendship and empathy. Under harsh conditions, such communities might be catalysts of courage and hope that are necessary to overcome physical constraints. Environmental change in rural Tanzania seems to presuppose actors who are willing and able to act together.

In line with Dippenaar (2015), we acknowledged that teacher education institutions are important hubs in building close relationships with other education institutions for the purpose of working together to transform their surrounding communities. Still, we were in the initial phase of this action research project. The preliminary findings suggest the potential for transferability of the above-mentioned qualities and capacities for social and environmental change, these will be elaborated in a later article. There were positive signs that the tutors, teachers and student-teachers had started to

become transformative agents. The tutors expressed commitment to share results of transformed teaching with other teacher training colleges using available avenues in inter college meetings, seminars and conferences. The teachers were willing to use evidence of transformative learning to influence teacher education curriculum to improve the teacher preparation programs; while the student-teachers started to share ideas with practice teachers. In line with Ajzen (2013), we consider commitment to the transformative values, which also presupposes the increased self-esteem and knowledge, as a key to actual change and transformation.

Though we tried to make the costs manageable by drawing on local resources, we chose to use small funds to buy planting materials and to finance transport. The local actors had no budget for research activities. Hence, to realize the snowball effect, some external support from local authorities, other institutions or donors seems to be required. While the government encourage EE, realization of the policy directive presupposes a minimum of funding and support.

Geolocation

Latitude 6°S and longitude 37°E.

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Experiential strategies and learning in environmental education: lessons from a teacher training college in Tanzania

V. J. Kalungwizi[a], E. Krogh[b], S. M. Gjøtterud[b] and A. Mattee[a]

[a]DAECD, Sokoine University of Agriculture, Morogoro, Tanzania; [b]Department of Learning and Teacher Education, IMT, Norwagian University of Life Sciences, Ås, Norway

ABSTRACT

The teaching of environmental topics is still the main challenge. In this paper we discuss how student teachers learning of experiential teaching strategies influenced their teaching of EE in primary schools in Tanzania. Student teachers learning to use tree-planting as example of outdoor learning for the teaching of environmental topics were the main sources of data. The first author collected data by interview and participant observation and then transcribed and organized the data as part of the analysis process. The results revealed that the student teachers teaching of environmental topics were active and particptory. We discuss the results in line with the quality of facilitation process. The study demonstrates the potential of experiential learning strategies in promoting actions related to environmental sustainability among student teachers and hopefully, their future students and the wider community.

KEYWORDS

Environmental education; teacher education; facilitation; outdoor learning and experiential learning

Introduction

Due to the increasing vulnerability to climatic variations (Kidegesho, 2015; United Republic of Tanzania, 2013), environmental education (EE) has become an important topic in primary schools and teacher education curricula in Tanzania. As a form of practice that aims at promoting ecological awareness and competences, EE focuses on enabling the application of knowledge and skills across contexts (Palmer, 2006; Rickinson, 1999; Sterling, 2010; Thomas, 2005; United Republic of Tanzania, 2010; Wals & Benavot, 2017). Palmer (2006) identifies three orientations to EE: education about the environment, education in the environment and education for the environment. According to Thomas (2005), experiential learning is a fitting approach for the realisation of education for the environment that also meets the requirements for knowledge application across contexts.

The main purpose of EE in Tanzania is to enable the application of EE knowledge in the conservation of natural resources (United Republic of Tanzania, 1995, 2010, 2014) which can be achieved through participatory teaching methods. Thus, one of the objectives of teacher education in Tanzania is to enable student teachers' development of participatory teaching competences that include experiential teaching approaches for environmental issues facing the country (United Republic of Tanzania, 2010). Experiential teaching approaches in the teacher training college can transform EE activities into other levels of education through trained teachers and hence help the country to realise the best EE outcomes in the practice of agriculture, livestock and fisheries, which are still the mainstay of Tanzanians' livelihoods (United Republic of Tanzania, 2013). However, due to a deep-rooted tradition of learning by memorising, neither policy-makers nor the educational system has translated the policy commitment into EE practice (Bhalalusesa, Westbrook, & Lussier, 2011; National Council for Technical Education, 2014). Tanzanian primary schools attached to teacher training colleges provide practice opportunities for experiential teaching approaches. Still, the orientation towards lecturing and learning by memorising has resulted in low utilisation of practice teaching

schools. Therefore, teachers are not sufficiently prepared to teach environmental topics in practice schools and in their future teaching jobs. Based on the scenario dominated by lecturing and memorisation as teaching and learning methods in Tanzania, and in many other parts of the world, scholars are now questioning whether education can help to meet environmental sustainability challenges in such countries (Rickson, 1999; Sterling, 2010; Wals & Benavot, 2017).

Yet, there is much literature in support of experiential learning approaches. Sterling (2010), the United Republic of Tanzania (2010) and Zuber-Skerrit (2012) argue that teaching methods based on experiential approaches facilitate the development of problem solutions and relevant skills that enable pupils to manage local challenges. However, Barret (2007), O'Sullivan (2004) and Vavrus (2009) argue that the use of experiential teaching approaches is less applicable in an African context with larger class sizes and poor infrastructure. In their opinion, organisation and supervision of outdoor activities is time-consuming, which delays the completion of the set school curricula. Hence, most teachers refrain from using the approach. Still, the mentioned curricula, the organisation of teacher education and the education policy argue for contextualised learning activities to improve the management of environmental challenges. A large body of literature, and specifically the education policy of the Tanzanian government, emphasises the encouragement of dynamic teaching approaches (Fien & Tilbury, 1996; Rickinson, 1999; Sterling, 2010; United Republic of Tanzania, 1995, 2014; Zuber-Skerrit, 2012).

The need for sustainable environmental activities and policy support for new teaching methods in EE in Tanzania inspired us to carry out an action research project to develop examples of EE projects together with local actors. In this project, implemented in the Ilonga Teacher Training College in Kilosa District, we cooperated with tutors, primary school teachers, student teachers and local communities to improve the teaching and learning in EE using tree-planting as an example of EE practice involving outdoor activities.

In this article, we will show how we facilitated skill training for experiential teaching strategies, we will discuss how student teachers can learn to teach relevant EE in collaboration with local actors and then we will discuss how student teachers can influence EE practice in primary schools through practice teaching. Our research question is: How do the student teachers learn experiential teaching strategies and how does that influence their practice of EE in primary schools?

Development of a contextualised theoretical perspective on EE teaching

Our theoretical approach relies on our experiences with Tanzanian society. We also draw insights from the theory of salutogenesis, experiential pedagogy and self-determination theory (Antonovsky, 1987; Miettinen, 2000; Ryan & Deci, 2000), which elaborate on the processes of inner motivation to address life challenges. Our opinion is that the applicability of any model with theoretical contextualisation requires sensitivity to relevant cultural and structural characteristics that influence practice. Our theoretical perspective informs the choice of action research as a research strategy, the choice of outdoor activities and the choice of facilitation strategies of active learning approaches needed in EE. We sequenced the teaching and learning activities according to experiential learning model of plan-act-reflect and we used the theories to set analytical categories a priori (Guettermen 2015). Evaluation of the transferability of the model follows in the discussion prior to the conclusion.

Environmental education practice in Tanzania is influenced by conflicts between pastoralists and agriculturalists, the low level of local understanding of sustainable practices and the low availability of resources for implementation of alternative practices. Conflicts for resources, the lack of knowledge, skills and resources might appear overwhelming and as unmanageable challenges for any facilitation and adaption of sustainable practice. In rural Tanzania, where such challenges are prevalent, promotion of a cooperative spirit, trust and emotional support built on self-reliance initiatives might be the pathways through which to motivate and enable local participation in promoting sustainable practice (Ahmad, 2016; Nyerere, 1967; Swantz, 2001).

At any rate, the successful transfer of knowledge, from understanding the reasons behind major environmental challenges, to understanding possible solutions to handle the challenges, and after that, the choice and acquisition of sustainable techniques and practices to improve the challenges is a complex endeavour. The existing theories related to transfer of knowledge mainly focus on how acquisition of knowledge in a given context can qualify for competent action in another context (Lobato, 2006; Wals & Benavot, 2017). In the Tanzanian context, conflicts related to the use of resources, the limited availability of resources needed to implement sustainable practices and the necessity of trust to foster participation in sustainable projects demand an expansion of the transfer approach. Some transfer theorists recognise the significance of the availability of physical resources (Lobato, 2006), but in our opinion, emotional, social and cultural resources are equally important. Therefore, we argue that the facilitators of transfer processes need to be sensitive to personal and interpersonal resources.

Below, we have visualised our theoretical approach in a circular, processual model (Figure 1). Student teachers' and, thereafter, local inhabitants' and communities' continuous engagement and participation in the chosen environmental learning activities, is, according to the model, dependent on participants' inner motivation. Ryan and Deci (2000) state that satisfaction of the basic human needs of autonomy, competence and psychological relatedness are the three main conditions for the release of inner motivation. Without satisfactory and continuous inner motivation, marked as the core and centre of the model, we expect withdrawal from project participation due to the mentioned conflicts and a lack of physical resources. Considering the need for participants' engaged perseverance despite a harsh environment, we connect the selfdetermination theory regarding inner motivation with Antonovsky's (1987) theory of salutogenesis, which emphasises emotional meaningfulness, manageability and comprehensibility as the main conditions for the successful management of stressors. Managing stressors strengthens self-efficacy (Bandura, 1986).

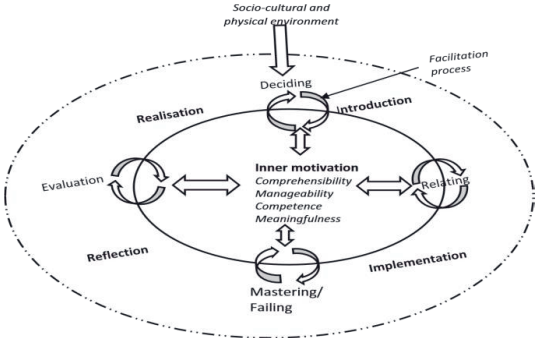

Figure 1. Facilitation of relation-based experiential learning, modified from Krogh and Jolly (2012).

The processual organisation of the model relates to pragmatism and Dewey's educational philosophy, which elaborates on experiential learning in social, cultural and physical contexts (Dewey, 1897, 1916, 1938). Kolb (1984) visualised Dewey's philosophy in a circular model with four phases. While Kolb combined Dewey's philosophy and ideas with Piaget's constructivism (Piaget, 1964) in his model and phases of experiential learning, we have focused on Dewey's relational approach to inquiry and realisation in our model. The phases in our model, with planning, introduction, implementation, reflection and realisation, mirror the construction and phases of both the action research strategy and action learning. Thus, our model is in accordance with the chosen research strategy and the cooperative action learning project approach.

The role of the facilitator is to strengthen and elaborate the connection between participants' inner motivation and involvement in and obligation towards the environmental learning activities throughout the learning cycle. Successful facilitation both presupposes contextual knowledge, that is emotional, social, cultural and physical resources, and insight into the conditions for inner motivation.

The facilitation follows the phases of the experiential learning model, with choice and the decision to take action, and environmental learning activity as the point of departure. Throughout the subsequent phases of the learning cycle (introduction, implementation, reflection and evaluation), the model emphasises the significance of the nourishment of student teachers' continuous inner motivation. During implementation, we regard failing as differing from failure. The facilitation can focus on an investigation of the causes behind failing as a pathway to subsequent improvement and mastery (Thomas & Vesthouse, 1990). Experiential learning requires the development of technical, intentional, person-centred and critical facilitation skills (Thomas, 2005). Mastery and failing might provide entry into facilitating student teacher reflection.

Through reflection on comprehensibility, a sense of coherence and self-efficacy (Bandura, 1986; Antonovsky, 1987), the student teachers can realise the implications of the environmental learning activity as preparation for the evaluation phase. Thus, the implementation and reflection phases can broaden student teachers' initial motivation for the chosen environmental activity, in this case, tree-planting, towards motivation for teaching environmental issues based on conscious and contextualised choices of learning activities. The realisation phase relates to empowerment of student teachers and to their ability to transfer what they have learnt. Through the evaluation, the student teachers can analyse which further environmental actions and learning activities they will choose to focus on.

In this way, the project process might empower the student teachers to become the next facilitators of environmental actions and learning activities at primary schools and in the local communities. After that, their pupils and the inhabitants of the local communities where student teachers conduct practice teaching might be next facilitators of EE in their homes and local communities.

Methodology

Research approach

We chose an action research approach in this project. The action research approaches are commensurate with the phases and the structure of the contextualised theoretical model. According to Eikeland (2007), action research gives the opportunity not only to describe the world, but also to change it. Dreier (1999), Kemmis and McTaggart (2007) and Lave and Wenger (2003) further indicate that participation in social practice continually leads to an improved understanding of the practice, local situation and an increased ability to transform oneself and turn the situation around.

Elliott (1991), Hiim (2014), and Korthagen and Kessels (1999) claim that action research is important in professional teacher development since it provides good sources of data for self-reflection and hence facilitates action and learning. Hiim (2014) further denotes that action research is a preferred alternative for the development of improved education systems that build on teachers' everyday practice with their pupils and a bottom-up approach to a change in practice. These characteristics make action research an important research approach for transforming practice in environmental education.

Our action research process followed a normal action research pattern of plan-act-reflect (Hiim, 2014; Kemmis, 2009; McNiff, 2013). Eikeland (2007) and Hiim (2014) describe action research as a systematic process of planning, acting, reflecting and new planning, where the researchers continuously collect data to document how the process is running. When the participants become co-researchers in the research process, the collaboration can promote new insights and practices and lead to empowerment of the participants. This correlates with the EE approach we chose and have discussed in the previous part of the paper.

As indicated in Figure 2, our two-year action research process proceeded in two main cycles; namely, the introduction and implementation with realisation as a future cycle, as student teachers take up their teaching jobs. The elaboration of the cycles comes under the facilitation section.

Choice of study area and participants

The study was conducted in Kilosa District, Tanzania. We selected Kilosa District based on reviews of relevant Tanzanian literature. The literature indicated that Kilosa was a heavily degraded district (Kajembe, Malimbwi, Zahabu, & Luoga, 2002; Kajembe, Silayo, Mwakalobo, & Mutabazi, 2013). The key drivers of degradation seem to be uncontrolled charcoal making, overgrazing and poor agronomic practices. The situation analysis also revealed a shortage of land for agriculture that forced the local communities to occupy marginal lands on mountain slopes that are susceptible to erosion. Most of the arable land is owned by government institutions and sisal settler farms. Coupled with poor EE, the shortage of land has threatened the sustainability of the community. This situation prompted researchers and local participants to conduct the study in this area.

The study was implemented at Ilonga Teacher Training College. The college trains certificatelevel and diploma-level teachers for Tanzanian primary schools. The teacher education programme includes science, mathematics and social science. The college collaborates with one primary school, Ilonga Primary School, as a practical training facility where the student teachers conduct microteaching during practical training periods. Ilonga Primary School participated in the project along with the college.

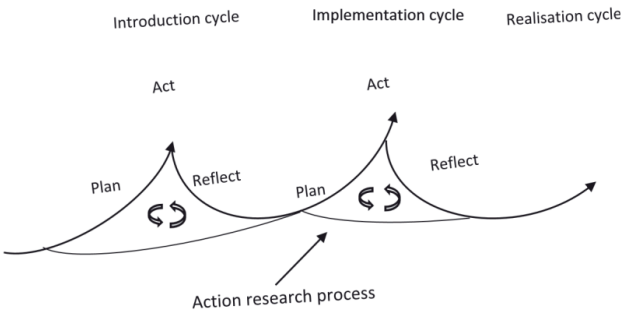

Figure 2. The action research.

Furthermore, eight primary schools in different regions participated in the project because these schools were close to the student homes where the student teachers conducted later practice teaching.

We selected ten student teachers to participate in the study among first-year students. According to Guetterman (2015) and Mason (2010), ten participants could be sufficient for generating useful information about the social phenomenon. In addition, prior teaching experience (Pine, 2009) and readiness to spend time on EE activities was a selection criterion. Furthermore, six tutors from the College and seven primary school teachers from practice teaching schools were involved in the project. The seven primary school teachers would collaborate with student teachers in planning relevant EE activities in the practice schools. Furthermore, they would be responsible for sustaining EE activities after the student teachers had completed their training programme at the teacher college. The tutors were to be co-trainers together with the project leader in experiential teaching and EE. Other co-trainers were a local gardener and a local extension officer. The cotrainers from the local community held valuable practical experience.

Choice of EE activities

We chose tree-planting as an example of EE learning activity due to our long-lasting experience with the socio-cultural conditions of Tanzania. Tree-planting addresses serious environmental challenges of land degradation and loss of soil fertility that most of the student teachers and other participants face and are aware of. Therefore, the choice of tree-planting as an example of an EE learning activity should have been both mentally and emotionally meaningful, as elaborated in our theoretical model.

Facilitation process

We conducted the research process in three phases. The first phase comprised of situation analyses. During the situation analysis student teachers, tutors and teachers were involved in walking and talking the open space of the teacher training college and Mkono wa Mara and Ilonga villages, followed by group discussions and reflections for the purpose of learning and making initial choices together based on a local understanding of environmental challenges. By experiencing environmental impacts in the local community, student teachers could form an emotional attachment to the local community and environmental challenges of the community and hence be willing to participate in solving the challenges (Bandura, 1986; Antonovsky, 1987). The student teachers' experiences of environmental challenges in the local community close to the college inspired them to learn more about EE topics to be able to teach the community members. Based on situation analysis, student teachers chose to learn to teach measurements, soil fertilisation, water conservation and school farming techniques.

The second phase focused on inquiry. College leaders in collaboration with researchers. The first author organised workshops to train in the skills and knowledge related to the use of tree-planting for teaching the selected topics. During the training workshop, which we organised following Kolb's learning model (Kolb, 1984) and which involved the actual tree-planting activities, the first author, in collaboration with the tutors, demonstrated examples of teaching using tree-planting activities. Teachers from two schools in the Uluguru Mountains with experience in the implementation of school farming projects discussed the strategies of using school farms as teaching and learning arenas (Ahmad, 2016; Jäckle, 2016). Furthermore, we engaged a local gardener who had implemented a tree-gardening project as a personal initiative to help the village to address land degradation. We selected these projects due to their realisation in communities with similar characteristics in recent times. Thus, they could serve as examples and motivators for the student teachers (Bandura, 1986; Dewey, 1938). Student teachers and tutors learnt by doing and tried their

approaches on each other under the guidance of the first author and the tutors to learn from their actions (Dewey, 1938).

The student teachers and tutors took part in reflection sessions. We continually adjusted the training to suit upcoming needs in dialogue with the student teachers and their interests. Therefore, training involved the analysis of Google maps and photographs taken with mobile phones as a way to get an overview of local environmental problems.

After the training, in the third phase, the application phase, the student teachers taught environmental topics of their choice at Ilonga Primary School, the practice school attached to the college. It seemed important to build confidence by starting to teach in the primary school where the student teachers had close access to supervision from their tutors. Later, student teachers taught EE in the other participating schools across the country for 16 weeks divided into two semesters. The first block was in April–June 2016 and the second was April-June 2017. Since the student teachers were scattered in a widespread area, the project leader and college tutors carried out facilitation of their teaching and supervision via mobile phones. Following each practice period, we conducted a reflection workshop to discuss the EE experiences gained and to modify plans for the following practice period. Furthermore, we organised a final workshop to reflect on the lessons learnt.

Ethical concerns

One of the pillars of participatory action research is democratic relations. When PAR is implemented in the context with hierarchical power relations there is always the danger of participants feeling disrespected or loosing authority, being annoyed or distressed. To address ethical concerns, we discussed the democratic ideals during the early phases of the project and together we agreed on pursuing basic democratic principles throughout the project. Yet, some teachers felt losing authority as pupils become more empowered. Since our workshops were always democratic, the participants slowly learnt and started to practice some democratic principles like respecting pupils' opinions.

Data collection and analysis

The first author collected the data through observation of student teachers' activities and then conducted open interviews involving student teachers, tutors and teachers in teaching practice schools. He documented the process through photographs, audio recordings and field notes, while focus-group discussions and workshops were documented through audio recordings and the participants' notes. Researchers and participants' diaries were also vital data. According to Yin (2014), such approaches provide researchers with the opportunity to establish an in-depth understanding of processes.

We transcribed the audio records. Thereafter we analysed them by organising themes using thematic and content analysis (Fereday & Cochrane, 2006; Ryan & Bernard, 2000). In the end, we interpreted the data in relation to our research question. We analysed teaching plans and EE reports. All data, audio and written text were in Kiswahili and the first author translated these into English as part of the analytic process.

Realisation of environmental education

We present a summary of EE units that the student teachers undertook during the second practice teaching session around the country. The summary of EE activities, as shown in Table 1, is followed by a short description. Thereafter, we relate the rest of the results to further analysis of the EE units in the discussion.

As shown in Table 1, the student teachers introduced EE activities in line with teaching demands in the Tanzanian primary school curricula and the need to address environmental challenges in the respective local communities.

Table 1. EE units, which student teachers initiated during practice teaching.

Units	Location	Nature of the project and activities
Tree-planting	Nyambululo Primary Geita region, North west Tanzania	The student teacher engaged pupils, teachers, villagers and parents in protecting their building from strong winds by planting and managing the planted trees. The activities included planting trees, fencing tree plots, raising seedbeds and forming environmental clubs. Student teachers also wanted to teach pupils how to plant fodder as a sustainable way to minimise land conflicts in their communities.
Tree care	Ilonga Primary School, Morogoro region, East Tanzania	The student worked with teachers to improve mathematics and science learning by integrating outdoor activities in teaching. The activities included tree-planting, compositing, team teaching and gardening.
Tree care	Kazuramimba Primary School, Kigoma region, West Tanzania	The student mobilised local communities to protect the school building from strong winds. Student teachers, in collaboration with pupils and community members, also planted trees to be used as organic pesticide.
Tree care	Lwemo Primary School, Geita region, North west Tanzania	The student mobilised local teachers to improve science and mathematics teaching using outdoor activities. Activities included team teaching and the collaborative evaluation of lessons.
Tree care	Ngudulugula Primary School, Mwanza region, North west Tanzania	The student engaged pupils, teachers, villagers and parents in protecting the school building against winds and in-school beautification to prepare shade for pupils. The activities included fencing tree plots, watering trees and planting new trees, and raising seedbeds and soil fertilisation. Pupils started their environmental clubs.
Gardening	Msimba Primary School, Morogoro region, East Tanzania	The student engaged the local community to protect the school building against winds. Activities included tree-planting, tree fencing of tree plots, gardening and nursing some local trees which had medicinal values. Pupils, in collaboration with the local community, also wanted to learn how to plant fodder as a way to minimise land conflicts between farmers and pastoralists.
Gardening	Mwambao Primary School, Coastal region, East Tanzania	The student mobilised the local community to raise trees for different purposes including trees for medicine. The student also managed to link with local experts. The local gardeners in this area have become learning agents in tree-planting.
Gardening	Msowero Primary School, Morogoro region, East Tanzania	The student engaged local actors to address the challenge of mosquito bites by bush clearance, planting mosquito-repellent trees like lemon grass, African basil trees and neem trees. They also planted fruit trees and a flower garden. The local community also wanted to learn how to plant fodder as a way to minimise land conflicts between farmers and pastoralists.
Ocean cleaning	Zanzibar, Bungi Primary School, Tanzania island	The student worked with the local community to address cholera by promoting ocean cleaning. They developed a plan to collect seaweed and make some ornaments for sale. The purpose was to help local villages to build an attitude of cleanliness.

We have grouped these learning activities into three major categories: tree care and planting activities, gardening activities and ocean cleaning activities. These learning activities reflect local needs. Tree care and planting activities seem to be important in almost all parts of Tanzania where the student teachers conducted their practice teaching and it reflects the local needs for firewood and medicine. Gardening seem to be important in areas where shortage of seedlings presented a challenge in sustaining tree planting and where tree planting had been commercialised. Ocean cleaning was important in Zanzibar were water pollutions is reported to pose a major threat to cholera control.

In line with the school curricula, the student teachers used the activities as teaching and learning arenas. Local leaders encouraged local community members to participate in these learning activities. In many schools, local leaders were part of the planning teams, which is what we trained

student teachers to do in the introduction phase. Local leaders became an important bridge to the rest of the community members. Local participants contributed materials and labour. Hence, they supported the teaching. Such collaboration motivated the student teachers and local communities to address problems like shortages of water, diseases and poor physical infrastructure as stepping stones for the meaningful teaching of EE in the student teachers' second practice teaching sessions. Together, they planted medicinal trees and trees to protect buildings against strong winds and trees for fodder.

Discussion

Our research question guides the discussion: How do the student teachers learn experiential teaching strategies and how does that influence their practice of EE in primary schools? In the previous part, we showed examples of how the student teachers engaged with the community and taught EE by building on shortages of water, diseases and poor school infrastructure. The discussion covers the phases of our theoretical model, beginning with the introduction, followed by implementation, reflection and, in the end, realisation, and relates to the theories of self-determination and the salutogenesis theory. Throughout the discussion, we relate to the main theories underlying our theoretical model and aim to explore how student teachers learnt and sustained their motivation for teaching EE.

Introduction phase: revealing needs for EE, building relations and initial skills

As mentioned earlier, the introduction phase included actions such as participatory situation analysis and training workshops. Through situation analysis, the student teachers mapped and experienced environmental problems, learnt to cooperate and acquired basic skills for the active teaching of environmental topics. For three months, they worked together with community members addressing problems that mattered in the College and the surrounding local community. In the workshop, student teachers learnt to know by doing and to do by knowing (Dewey, 1938). Hence,the teaching was exemplary. They experienced the teaching and learning strategy they could later use with their pupils, contrary to the traditional teaching methods. During the early phases of the project, student teachers started to use tree plots to teach geometry, measurements and counting in mathematics. Student teachers started to respect pupils' opinions and fostered democratic discussions. Their teaching deviated from the traditional teaching methods. Hence, they experienced a shift from traditional teaching by lecturing to a new teaching approach using real-life activities.

Moreover, the student teachers learnt to use their mobile phones to confer and reflect on the teaching processes. The mobile phone became an important tool to facilitate self-regulated learning (Bandura, 1986). Furthermore, the mobile phone served to document and archive teaching processes for future use.

These strategies transformed their competencies. The student teachers' ability to analyse the local environment improved as they participated in analysing the local environment of their college and the surrounding local communities. Their ability to plan and implement experiential teaching lessons improved as they participated in teaching with experienced teachers, tutors and researchers. The presence of experienced teachers gave an opportunity for student teachers to ask questions, observe and imitate EE practice from critical friends (Carr & Kemmis, 2004). This led to a sense of pride and confidence among student teachers and hence to the possibility of them stepping into the unknown (Vygotsky, 1978). Because of the acquired competence, the activities became meaningful, manageable and comprehensible (Antonovsky, 1987). Such a process builds confidence and increases inner motivation, which was important for the upcoming practice teaching where the researcher and tutors they knew would not be able to follow them as closely as in the first practice period. After the

first cycle of planning and teaching in the first practice period, we conducted a reflection workshop, in which student teachers realised that they did not succeed in relating treeplanting and subject teaching. In response to the training needs, we organised a training workshop where students learnt to relate some mathematics, science and geography topics to tree-planting.

Implementation and reflection phase: drawing on experiences from the first phase

During the second practice teaching sessions, the student teachers built on the examples of EE that they had implemented during the first practice teaching sessions. They had saved the teaching lessons on their mobile phones. Therefore, they could learn from previous lessons as they expanded their knowledge and skills by developing new plans in new situations and with new local participants, teaching and reflecting on their teaching (Beaches, 1999; Lave & Wenger, 2003; Piaget, 1964). The student teachers generated new knowledge that met contextual demands related to shortages of water, diseases and poor teaching infrastructure. Instead of continuing with tree-planting, one student teacher worked on cholera and health education; some other student teachers worked on tree-caring, while others undertook composting to make manure for planted trees. Even those student teachers who chose to plant trees indicated an adaption to new environmental challenges in terms of the choice of trees. The tree types met demands in particular communities. As shown in Table 1, some student teachers planted lemon grasses and African basil for use as mosquito repellents; others planted Neem trees for use as organic pesticide and others planted Leucaena for use as fodder plants.

The teaching of EE was tied to challenges deeply felt by pupils in those communities. The chosen activities triggered local participation and local processes to address problems that mattered in those communities such as diseases, shortages of fodder and social conflicts emanating from a shortage of pastures. Thus, student teachers indicated understanding and an expansion of their knowledge as they transected from a teacher training college where they were closely followed by tutors, to practice schools where they had to be more in charge (Beaches, 1999; Piaget, 1964).

The sustenance of EE activities during the second practice teaching sessions in the face of shortages of planting materials, water and poor physical infrastructure was a challenge for many student teachers. Still, they suggested and tried out new solutions to meet the challenges together with local participants. In addition, training on the skills to solve environmental problems sustained by advice from their mentors and the usefulness of planned EE activities in subject teaching both seemed to enhance their autonomy, competence and attachment: the three main conditions for inner motivation (Ryan & Deci, 2000).

In the next paragraphs, we will discuss the role of the training, sustained interaction and advice through mobile phones and the relevance of EE activities in subject teaching as ways to sustain motivation for active teaching of environmental topics among student teachers.

The training at the teacher training college gave the student teachers competence and confidence to play active roles during the second teaching practice sessions in the teaching practice schools, which to them were new communities of learning (Lave & Wenger, 2003). The teachers, pupils and community members relied on the student teachers for advice and inspiration to solve local challenges. The student teachers became facilitators of problem solving in respect to EE in their practice schools and the surrounding local communities. In collaboration with local leaders, they mobilised tree-planting materials and labour. The participation of the local community made the challenges manageable and meaningful not only to the student teachers, but also to the pupils who, in turn, valued the activities as teaching and learning arenas. We argue that this shows that although materials may be scarce, motivated teachers can mobilise resources among the local communities to

manage the challenges (Barret, 2010). Successful planting of trees resulted in positive feedback from the community, which fostered pride in the student teachers, and their expertise was valued. In this way, it seems the student teachers and the local actors engaged in mutual empowerment processes, which we assume will also empower pupils as the upcoming facilitators in their communities.

After initial training in the introduction phase, it was not that the student teachers were left without support from the researcher and college tutors. Rather, continuous interaction and support, with the use of mobile phones, increased the confidence of the student teachers during their practice teaching sessions as they tried to handle the teaching challenges. One of the student teachers reported that '[y]ou were like a father who let his children play but never left them alone.' They experienced the teaching positively and comfortably when there was someone to consult whom they trusted. Throughout the practice teaching sessions, they continuously tried to improve their teaching, as they could ask questions and receive advice from mentors and peers. The mobile phone enabled the students to engage in action learning processes, sharing experiences and reflecting on them. In addition, we were there to advise and give emotional support when they faced problems. The use of mobile phones enhanced the positive experiences of the fieldwork among students and pupils. We believe the use of these tools saved implementation time (Barret, 2007; O'Sullivan, 2004; Vavrus, Thomas, & Bartlett, 2011).

The student teachers further realised the pedagogical values of EE activities in teaching subjects such as science and mathematics. We will show one example from mathematics. In one of the lessons, the pupils drew trapezium-shaped tree plots before they redrew the maps on paper using appropriate scales and then found the areas on the drawn maps. The student teachers, tutors and teachers, in practice, reported that the pupils liked that way of teaching, as one of the student teachers reported during the focus-group interview: 'The pupils liked it and were excited to answer questions afterward because they had experience to draw on.' Another student teacher said:

> I have come to realise that pupils cannot learn anything if the teaching is done out of their context and that teaching requires commitment and innovative thinking (Workshop 25.9.2017).

The pupils' interest and active participation was a motivating factor in student teachers' learning.

Towards the end of the implementation phase, we organised a reflection workshop to learn from experiences gained since the first practice teaching to the second practice teaching sessions. Student teachers felt more concerned and connected to environmental problems that the local communities in Tanzania faced. They also felt an inner calling to take the lead and responsibility for the change process. This self-awareness coupled with the recognition of a number of achievements they had documented throughout the learning process raised a sense of pride and motivation for new activities in future jobs. The reflection seemed to promote self-awareness and a willingness to act for the betterment of others. Our study underlines the importance of tutor support, and that this is possible to sustain by mobile phones when positive relations have been established (Miettinen, 2000).

Realisation phase: looking to the future

The realisation phase is the phase where the participants use and act on knowledge gained in the reflection phase in coming situations. So far, we cannot say much about what the students will bring into their future jobs, but we do know how they will put their knowledge to use to enhance the EE practice in the college. This is what we will show and discuss in this part.

The students who participated in the project were empowered to improve college teaching and functioning. The training process transformed the student teachers' identity from being learners to

becoming facilitators, as they took responsibility for taking care of the college environment. One of the tutors commented in an interview on this change saying that:

> It used to be hard to motivate the students to keep the garden; now it comes from themselves.

The student teachers acquired the willpower to campaign for more trees through establishing student clubs, and to use their skills and knowledge to facilitate even broader community transformations. As one of the tutors explained:

> Student teachers have started environmental clubs under which they raise seedlings and learn together strategies to plant and take care of planted trees. These initiatives have influenced the whole college community to value our environment and use it sustainably to meet our needs for food, timber and firewood. (College leader, interview 25.9.2017).

The student teachers were no longer just teaching about environmental problems; they were living the changes in their own everyday lives at the college, influencing their peers to take responsibility and engaging in growing food, adding to the economy of the college. One of the student teachers explained:

> It is all the pride and happiness when I see all that I have achieved in this short period when I was with you in the project. I feel more respected by classmates and tutors who want to learn something from us. I am very thankful for the project and for being part of it. I have developed skills to do research and I feel professional. Peers are already imitating what I have done at the college and in the nearby schools. I think I am already a role model. I have something to be remembered by, even by our children, who would like to study in this college. (Student teacher, workshop 25.9.2017).

This student points to the fact that he is a role model. They felt more respected and valued as members of their communities because they were able to utilise skills acquired in training to solve community problems. Their actions show that they were empowered to take responsibility. We see this realisation as a way towards student teachers' self-actualisation (Maslow, 1971). First, the student teachers learnt skills, knowledge and attitudes that enabled them to manage environmental problems at the teacher training college and surrounding villages. Second, the student teachers gained social recognition from college leaders, community members and peers for participating in addressing complex environmental challenges in teaching practice schools. Throughout this process, the student teachers' willingness and ability to implement EE in favour of others seemed to increase. The student teachers became more interested in, and occupied with, improving the life situation of other community members such as by working with local communities to control diseases and secure public infrastructure. Social recognition and competence in solving environmental challenges seemed to promote an expansion of student teachers' ability to manage environmental challenges in other contexts and in favour of others. In this way, EE in teacher training colleges can train student teachers as transfer agents (Beaches, 1999).

Generally, the student teachers' continuous inner motivation for participation in the environmental activities was dependent on confidence in the project and the project leadership. Both unpredictability and the sudden abruption of projects are common in Tanzania. As a result, local confidence towards new projects is often weak and unstable. Withdrawal from projects is an understandable survival strategy. Thus, providing space for student teachers to comprehend the environmental conditions of their communities, to acquire initial skills for the management of the environmental conditions and to develop trust with project leaders and other actors are efforts that might support inner motivation of project participants in Tanzania.

To a large degree, the organisation of Tanzanian institutions and communities relies on hierarchical leadership with extended power given to leaders and political administrators. Therefore, the involvement of college leaders and local community leaders was crucial to the outcome of our project. Full student autonomy can be difficult to realise. Therefore, hierarchical structures and organisations, where the citizens and members have confidence in both leaders and projects, seem

to be a framework for the release of a culturally conditioned autonomy, and thus an inner motivation (Ryan & Deci, 2000). This reflects Freire's (1970) work, which emphasised the significance of internal motives as driving forces for the initiation of changes. This study shows that external actors with a willingness and real concern around local problems can prompt internal willingness to bring about change. Schabort, Sinnes, and Kyle (2018) found that lack of teacher attachment to local problems affects meaningful learning. We found that communal life built on the spirit of helping each other, as envisioned in the Education for Self-reliance policy of Tanzania (Nyerere, 1967), a useful empowerment approach since this era of turbulence requires learning with others for more resilience. At the end of the project, the gardens at the college bore witness to the power of doing EE together.

Conclusion

We have discussed how cooperation through mobile phones and support from tutors sustained the student teachers' inner motivation to create and implement outdoor teaching modules in contexts with limited resources and other socio-cultural limitations. The student teachers became change agents after a couple of workshops and a few weeks of closely tutored school and outdoor practice. This indicates the effectiveness of the intervention.

The student teachers were able to take responsibility for EE in new situations with new participants, with only limited support. However, it is too early to say if the student teachers will continue to develop their EE practice after finishing their education. Another concern is related to whether the community of college leaders, teachers, tutors and students will manage to sustain the obtained changes given the described socio- cultural conditions of the area with a prominence of social conflicts, limited resources and shortages of water. Follow-up studies are needed to establish whether the teacher training college and the teaching practice schools are able to sustain the experiential teaching approaches. Furthermore, a study is needed to establish a strategy for sustaining a mutual relationship between teacher training colleges and student teachers in safeguarding the valued knowledge related to EE. Nevertheless, the changes we witnessed were amazing and nurtures our hope that education can still play a role in changing the depressing prospects of the environmental degradation we are all facing (Wals & Benovet, 2017).

Limitations of the study and recommendation for further study

The study involved one college and a few primary schools. The conclusions derived from this study may not fully apply to other teacher colleges in the country of study and other parts of the world. To develop a broader understanding of how to promote meaningful EE in teacher education, we recommend studies that may involve more teacher colleges and schools emphasising influential social and cultural factors. We recommend more studies on institutional arrangement for promotion of active teaching of environmental topics, building on the promising results from this study.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Notes on contributors

V. J. Kalungwizi is a lecturer in the Department of Agricultural Extension and Community Development, Sokoine University of Agriculture, Morogoro Tanzania, and a PhD candidate in the section of Learning and Teacher Education, Institute of Mathematics and Technologies (IMT), in Norway. He holds Master's degree in Social Psychology from University of Dar e s salaam, Tanzania. He has researched and published in the areas of environmental education, communication and rural innovation. This article was part of his PhD project.

E. Krogh (PhD) has been a teacher educator for 19 years at the Norwegian University of Life Sciences (NMBU), especially related to environmental and agricultural education. His research is founded on social science and action research. Themes of research are development of experiential learning theories, school/farm cooperation, environmental management and experience of nature and landscape. Together with Sigrid Gjøtterud, he has worked with educational and cooperative action research projects in Nepal and Tanzania.

S. M. Gjøtterud (PhD) has been a teacher educator for nearly twenty years and is currently teaching at the Norwegian University of Life Sciences (NMBU). Her research centers on school improvement, improvement of teacher education and supervising pedagogy in Norway, Africa, and Asia. Action research is her main approach to research, both as a way of researching and enhancing personal competence and as co-operative research to understand and improve teaching and learning, and for community development.

A. Mattee (PhD) is an Associate Professor of Agricultural Extension and former Director of the Development Studies Institute, and the SUA Centre for Sustainable Rural Development (SCSRD) at Sokoine University of Agriculture. Dr. Mattee received his BSc in Agriculture (Hons) from University of Dar es Salaam in 1975, and his M.Sc. and Ph.D. in Continuing Education from the University of Wisconsin, Madison in 1978 and 1983, respectively. His teaching areas include Agricultural Extension, and Adult Education Methods. His research interests include adoption studies, farmers' organizations, participatory approaches for extension, formulation and evaluation of rural development projects, development of sectoral policies, strategies and programmes, and development of training materials and facilitation of capacity-building of change agents. Dr. Mattee has authored and co-authored more than 30 publications on Agricultural Extension and Rural Development in Tanzania.

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Democratic Processes to Overcome Destructive Power Relations and Sustain Environmental Education in Primary Schools: Implications for Teacher Education in Tanzania

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Democratic Processes to Overcome Destructive Power Relations and Sustain Environmental Education in Primary Schools: Implications for Teacher Education in Tanzania[2]

Vituce Jelasy Kalungwizi
Norwegian University of Life Sciences
vitucekalungwizi@yahoo.com

Sigrid Marie Gjøtterud
Norwegian University of Life Sciences
Sigrid.gjotterud@nmbu.no

Erling Krogh
Norwegian University of Life Sciences
Erling.krogh@nmbu.no

Abstract

This paper is based on a follow-up study of a participatory action research (PAR) project aimed at improving environmental education (EE) in teacher colleges and primary schools in Tanzania. The aim of the current paper is to discuss the power relations involved in sustaining the EE process initiated in the PAR project. We developed two research questions: "To what degree do the democratic processes in the PAR project enable the tutors, teachers, and local community members to continue developing EE while simultaneously addressing the environmental challenges?" and "In what ways do the power relations influence the further development of EE?" We conducted focus-group discussions and interviews with the college dean, tutors from the selected teacher college, and teachers from primary schools who had participated in the project, one year after the researcher left the project. In addition, we interviewed village leaders and local experts. Finally, we undertook nonparticipant observations. We found that, despite hierarchical decisions to transfer teachers, the EE learning processes started in the PAR project continued. We discuss the possibilities for strengthening democratic relations in the educational system in Tanzania through PAR, and recommend the inclusion of PAR in the teacher education curriculum in Tanzania.

Keywords: environmental education, educational governance, Tanzania, participatory action research, teacher education

[2] Ethical clearance number: 45240

Introduction: Environmental Education Revisited

Since the 1970s, environmental education (EE) has become an important theme in education curricula throughout the world to address environmental degradation and restore community vulnerability related to climate change (Gough, 2013). After the Rio Declaration in 1992, EE has emphasised the economic and social aspects of environmental degradation. There has been a growth in sociocultural approaches built on active participation, problem solving, critical thinking, reflections on real-life challenges, and the application of knowledge. The intention of the approaches was to challenge environmental degradation where economic, social, psychological, and human resilience are important EE outcomes (Mandikonza & Lotz-Sisitka, 2016). The Thessaloniki Declaration in 1997 stressed the need for connecting formal, informal, and nonformal education to create opportunities for everyone to acquire knowledge, skills, values, and the attitude needed to address environmental challenges and attain social and economic prosperity, restoring collective goods for peace and cultural diversity (United Nations Educational, Scientific and Cultural Organisation [UNESCO], 2014). In Tanzania, EE is an important part of education from primary to tertiary level, and it is emphasised in education policy.

Environmental degradation challenges the sustainability of Tanzanian communities. The deterioration in the quality of the soil and water threatens the survival of 70% of the Tanzanian population the segment of the population who depend on agriculture as their main source of livelihood. This is a major environmental concern that is addressed by the environmental topics in the school curriculum (United Republic of Tanzania [URT], 2010, 2013). Tanzanian educational policies emphasise the teaching of environmental topics across all levels of education as a sustainable strategy to address environmental challenges through educated citizens (URT, 1995, 2010). Around the world, educational policies highlight participatory teaching methods that encourage learners to experience environmental problems, and to share relevant knowledge and skills suitable for addressing these challenges. The policies also emphasise cooperation with local inhabitants through community activities that address environmental challenges. Accordingly, schools have responded to environmental challenges by integrating participatory approaches in the educational curricula. The rationale for participatory approaches stems from the possibilities for immediate application of ideas and the strengthening of local institutions. Hence, in the opinion of many authors, participatory teaching approaches are the ethical means to achieving sustainable community transformation through education (Nyerere, 1967).

After the Arusha Declaration (Nyerere, 1967), the Tanzanian government wanted to include schools in the process of social and economic change in Tanzania occurring at that time. During Nyerere's presidency in the 1970s and 1980s, the government considered the active participation of community members in local projects as the proper way to develop responsible citizens. Through meaningful learning activities, Nyerere wanted to develop collaborative education that was responsive to local conditions. Based on the philosophy of self-reliance, schools were intended to function as learning centres, not only for student teachers and pupils, but also for local community members.

To varying degrees, schools managed to serve their communities as local centres of excellence where community members learned about agriculture, livestock production, carpentry, and environmental sanitation alongside the basic skills of reading, writing, and arithmetic. The link between schools and local communities improved the literacy rates among adults, which became among the highest in subSaharan Africa during the 1980s. In addition, many local communities developed an increased environmental awareness and improved their strategies for coping with

environmental degradation. For example, Ngoro farming systems opted for soil–water conservation methods and practices, thus controlling erosion on the hills of the Luguru and Kaguru highlands. Although most of the links between schools and local communities disappeared during the 1990s (despite the emphasis placed on these links in the curriculum), the concepts still influence educational practice in some schools today. Ahmad (2014) considered these linkages an opportunity for the revitalisation of relevant learning. Against this background, we conducted a participatory action research (PAR) project, which is documented in two previous articles (Kalungwizi, Gjøtterud & Krogh, 2018; Kalungwizi, Gjøtterud, Krogh, Mattee, & Ahmad, 2017). The aim of the current paper is to discuss the power relations involved in sustaining the EE process initiated in the PAR project.

Background: Repositioning Teacher Education for Environmental Sustainability

The education of teachers is a focal point when it comes to initiating the active teaching approaches that are relevant when teaching environmental topics. Education for self-reliance, which is also founded on experiential learning, has been a foundation of the revitalisation of active teaching in Tanzanian teacher education (Dewey, 1938; Freire, 1970; Nyerere, 1967). An important aim is to educate professionals who can spearhead educational transformation in Tanzania, enabling citizens to face the demand for improved local life in a democratic society (URT, 2001, 2010). Thus, teacher education emphasises participatory teaching and practical activities (URT, 2001).

Tanzanian government initiatives in teacher education have focused on the use of participatory teaching methods in the hope of educating professionals who can spearhead these approaches and democratic ideals in schools and out into the wider community (URT, 2001). The government has taken these initiatives further by expanding teacher training through opening more teacher training colleges and by introducing teacher educational programmes into public universities. In addition, the government has expanded student loans to include more of the student teachers and has introduced private teacher training colleges to increase the number of teachers educated in participatory approaches. Although these initiatives have increased the enrolment rates of trainee teachers, the quality and content of teaching in the teacher training colleges has remained the same. According to Bhalarusesa, Westbrook, and Lussier (2011), the teaching in teacher training colleges still relies on lecturing and memorisation. Thereafter, the student teachers transfer those approaches to practice teaching and, later, into schools as employed teachers.

Since 2005, the government of Tanzania has taken further initiatives to strengthen in-service training programmes by introducing teacher professional development programmes seeking to strengthen the connection between teacher training colleges and primary schools. The initiatives work through decentralised education systems where district authorities, together with teacher resource centres (teacher training colleges, primary schools, and local communities), coordinate teachers' learning activities aimed at improving the quality of teaching and learning. These efforts provide a possibility for teachers to reflect upon the assumptions, concepts, and belief systems that guide teaching practice.

However, according to Mosha (2018), hierarchical power systems characterising educational governance that are ingrained into the culture of Tanzanian political governance are still the main challenge in terms of achieving interactive teacher development systems. In the same way, the relationship between the Ministry of Education, the district authorities, universities, teacher training

colleges, primary schools, and the local communities seems to build on the mentality of hierarchical power relations (Hardman et al., 2015; Mosha, 2018). In that context, decisions related to the mobilisation and dissemination of resources needed to transform educational systems are normally top down. Hierarchical power relations might demotivate and thus negatively affect the sustainability of interactive teacher development systems.

Considering the foundation of, and experiences with, Tanzanian teacher education and Tanzanian educational policy and its relevant research on EE, we regard the government initiatives as an appropriate point of departure for strengthening EE in present-day Tanzania (Hardman et al., 2015; URT, 2010). The vitalisation and achievement of democratic relations and decision-making systems among and between the stakeholders on different levels is a possible gateway for initialising cooperative and participatory approaches in teacher education for environmental sustainability.

The PAR project involved connecting a teacher training college with the environmental realities of primary schools where the student teachers practised their teaching. The intention was to create best examples of teaching practice that promote connections between teacher training colleges and the realities of teaching practice in primary schools, using student teachers as agents of change. Stenhouse (1975) commended this approach. According to Sterling (2010), initialising EE in a teacher training college can facilitate the transfer of knowledge, and therefore enable systemic change and environmental sustainability through the transferring of best practices by many educational professionals. Nevertheless, knowing that district authorities might remove teachers and headmasters from the schools, and wondering about the will to continue the work in the teacher colleges, we wanted to find out what had happened to established EE initiatives. We formulated two research questions:

- To what degree do the democratic processes in the PAR project enable the tutors, teachers, local community members to continue developing EE while simultaneously addressing the environmental challenges?
- In what ways do the power relations influence the further development of EE?

We address these questions in this paper. However, first we look into some theoretical perspectives on power issues relevant to the Tanzanian context. Based on a model of the social distribution of power developed by Bourdieu (1977; see Figure 1 below), we developed a contextualised theoretical model on power distribution and societal consequences (Table 1) that inspired our analyses of the follow-up study.

Theoretical Perspectives: Hierarchical Power and Democracy

Our main theoretical perspective on societal power structures and on the maintenance and functioning of such structures is informed by Bourdieu's (1986) theory, which connects societal power structures with cultural practices. In addition, we use Dewey's (1916, 1938) perspectives on democracy and experiential education and Freire's (1970) perspectives on conscientisation to discuss the potential influence on existing power structures through strengthening democratic processes.

Bourdieu (1989) suggested that the legitimacy of hierarchical power relations demands the existence of a societal doxa that often consists of an undisputable socially constructed worldview, and of uncontested and institutionalised social and cultural practices. Doxa appears to us as the unchangeable natural order of a society in accordance with its given rules, procedures, and the power of the authorities (Bourdieu, 1989). We show this structure in Figure 1. On the other hand,

democratic power relations represent discourses and a dynamic worldview in terms of the tentative state of the changes that move us toward constructing better world

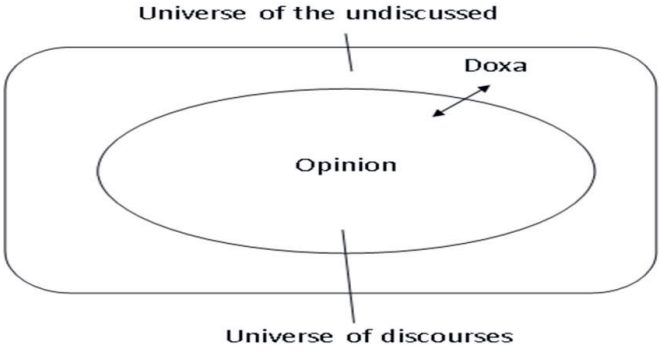

Figure 1: A Simplified Model of the Relation between Doxa and Opinion (developed from Bourdieu, 1977)

The two major types of power relations namely, hierarchical power relations and democratic power relations might exist simultaneously and side by side in the same society (Quicke, 1995). While hierarchical power relations espouse centralised, bureaucratic, and top-down decision making to achieve efficiency and cultural stability, democratic power relations espouse distributed power through majority decision making in order to achieve autonomy, self-control, distributed power relations, and cultural progression (Quicke, 1995).

According to Bourdieu (1986), proponents of hierarchical power relations and structure, and proponents of democracy and discourse tend to compete for domination of the social practices. Each legitimises its position through the acquisition of relevant capital and thus gains the power to squeeze, push, and establish said social practices. The two-sided arrow between doxa and opinion in Figure 1 illustrates the continuous, ongoing societal dispute and power struggle revolving around which themes belong to the natural order, and which themes are necessary to debate and negotiate. When a hierarchical power structure dominates, as indicated in Table 1 with the black arrow pointing downwards, emotional reactions characterised by disempowerment seem to prevail.

Table 1: Power Transaction Between Hierarchical and Democratic Power Systems

Hierarchical power systems Top-down system for decisions Supremacy of the central government Coercion, obeying, conformity, stable culture and rules, efficiency, control, competition, and individualism	**Democratic power systems** Distributed power through majority decisions Negotiable distribution of power to decide between municipalities, regional, and central authorities Negotiation, discussion, ability to change through majority decisions, autonomy, cooperation, collaboration, group activities
Prevailing emotions when hierarchical power systems are dominant • Apathy • Aggression • Othering • Resistance • Withdrawal	**Anticipated development of emotions when democratic power systems are dominant** • Feeling competent • Experiencing relatedness • Increased community resilience

The question is: "What might happen in the right column when the right arrow becomes stronger?" This paper discusses the potential of the democratic organisation of EE in teacher training colleges, in primary schools, and in their surrounding local communities. The authors have documented that reliable leaders who facilitate democratic decisions can motivate both student teachers to include EE in their practice schools and members of local communities to implement environmentally friendly practices (Kalungwizi, Gjøtterud, Krogh, Mattee, & Ahmad, 2017). Hierarchical power is an obvious part of the current hierarchical leadership in Tanzania; but even within this power structure, the facilitators might realise democratic processes within a framework of confidence and make room for self-determination among the participants. When the arrow turns rightwards, participants' selfesteem, self-efficacy, and united problem-solving efforts and capacities seem to increase. We return to the qualities of the right column in Table 1 later in this discussion.

In our opinion, habitus cannot totally determine a person's worldview and actions even in a system characterised by hierarchical power. Situated freedom (Merleau-Ponty, 1981) is a possibility, even in harsh environments. The facilitation of democratic processes might also enact itself as a gateway through which we move habitus, adding democratic social and cultural capital. Theoretically, added social and cultural capital are transferable to symbolic capital in the educational field. Bourdieu (1986, p. 257) defined symbolic capital as "the form that the various species of capital assume when they are perceived and recognised as legitimate." The access to, and disposition of, symbolic capital gives access to power. Still, the movement from left to right in Table 1 seems to be a challenge in terms of the Tanzanian context.

The Tanzanian composite power system is rooted in the historical context and development of the country, from the traditional governance of chiefs, through to colonial rule, and into Tanzanian independence under cooperative socialism and, later, under liberal democracy (Nkulu, 2005; Quicke, 1995). Julius Nyerere, the first president and a symbolic icon of the social practices of Tanzania, played his role by using both traditional tribal chieftainship and the proponing of democracy and

cooperative socialism (Nkulu, 2005; Swantz, 2001). During the establishment of Ujamaa [family] villages, Nyerere proposed democracy, the principles of the extended family, and equal rights for Tanzanian citizens.

Nyerere's Tanzania became an ideal location for the extension of democratic principles to other African countries, including Mozambique, Botswana, Zimbabwe, South Africa, and Angola, nations where Nyerere also assisted in the gaining of their independence and the establishment of democratic states. Both in the Arusha Declaration and throughout his presidency, Nyerere maintained that anyone who did not agree on the main democratic principles in the Declaration risked exclusion from the party. The government forced many Tanzanian citizens to leave their native villages and move into the new villages that the government created (Loiske, 1995). Several pastoralist tribes lost access to their land and water resources. For example, the Barbayiig who used the Basuto Plains before the establishment of huge state wheat farms, and the Parakuyo Masai in Bagamoyo who were banished due to the establishment of cattle farms (Swantz, 2001). The replacement policy created land use conflicts between pastoralists and agriculturalists and has contributed to environmental degradation. In this paper, we do not focus on these conflicts and the subsequent environmental challenges but use the examples to illustrate how Nyerere's Tanzania operated two different power systems simultaneously; the hierarchical and democratic power systems worked in unison.

The composite power system seems to be prevalent in the organisation of Tanzanian education. Decisions regarding the allocation of educational resources are hierarchically organised. The government recruits teachers, and district authorities distribute the recruited teachers to the large number of primary and secondary schools across the region. In a similar way, centralised top-down organisation characterises the distribution of books and other teaching and learning materials, curriculum development, the examination system, quality assurance, and the supervision of teachers as well as the quality of their teaching.

Initially, teachers are deployed to a teaching position by the government and district authorities, usually at a school far away from their place of residence. After a few years, the government might move a teacher to another region. Therefore, teachers and their pupils can only form temporary and loose connections with their local community and teachers can easily become foreigners in their working environment they often move away from, or quit, their teaching positions and, ultimately, abandon the profession (Mkumbo, 2012). There is limited room for questioning the existing EE rules including the curriculum development rules, examination rules, the allocation and distribution of teachers and other resources, the determination of the quality of teaching, and the power relations among institutions.

Beyond the framework of resource allocation, curriculum, and examination systems, communities hold some responsibility, along with the institutions, for democratic decision making that is related to education in the local primary and secondary schools. Parent and community representation through school boards and school committees can influence certain decisions, and support the schools where possible when they lack material resources, for example, through local school feeding programmes (Jäckle, 2016).

Considering the remaining tradition of self-reliance in Tanzanian education, which relates to experiential learning and conscientisation (Dewey, 1938; Freire, 1970), we suggest two interdependent gateways to extend and expand the student teachers' and, in the next phase, the

local inhabitants' situated freedom to develop EE in the framework of the Tanzanian hierarchical power structure.

The first gateway is to increase the local knowledge of environmental challenges and their consequences and, in addition, to suggest, discuss, try out, and evaluate the concrete efforts of local management in terms of the presented challenges. Dewey (1916) emphasised the educative significance of concrete management of experienced challenges, and Freire (1970) stressed how a raised consciousness in terms of societal and material living conditions and other common challenges in a group can enable united efforts directed toward realising changes. This leads us to the second gateway that we suggest, and which is illustrated by two Tanzanian sayings: Mtu ni Watu [A human being is a part of humanity] and Umoja ni nguvu [In union there is strength]. Through democratic processes, it is indeed possible to unify and coordinate environmentally friendly activities in local communities.

Cultivating an awareness of the power structures, and strengthening members' trust and confidence by demonstrating significant results from EE seems to be a stepping-stone in terms of addressing sustainable environmental activities. Given the challenges mentioned above, we think action learning and PAR is a good way to move forward, although there are some challenges that we also need to be aware of, as we discuss later in this paper. In the next part of the paper, we briefly recount the major features of the PAR project. The main issue is to explore to what degree the teacher training college, schools, and local communities sustained the established participative approach to EE one year after the researcher left the project, and what factors seemed to challenge sustained EE practice. But, first, we will discuss why we chose to base the PAR project in teacher education.

The Participatory Action Research Project: Content and Findings in a Nutshell

The PAR project initially focused on sharing relevant knowledge and skills about tree planting as part of the EE programme at Ilonga Teacher College and the surrounding primary schools and villages. In collaboration with pupils, the teachers and pupils' parents at local primary schools and other local stakeholders, student teachers, their tutors, and the researchers mapped environmental resources and challenges in the chosen area. Thereafter, the researchers organised and facilitated focus-group discussions and a workshop discussing the challenges and options at hand for the successful realisation of the project. Through the discussions, the participants developed a plan for implementing the EE project.

In collaboration with the first author, tutors and local experts, such as a gardeners and extension officers, taught the school and college leaders and other engaged local stakeholders strategies for the management of the environmental challenges they faced, and, in addition, how to promote further learning and the development of functional skills as a way to reinforce local capacities. The strategies aimed at facilitating the participants' competences to manage and conserve the soil by planting trees and making compost manure, and at using the activities as an arena for teaching and learning. In the first phase of the project, the student teachers also received training in participatory teaching methods connected to the practical EE activities. Through the PAR process, in their practice period in the schools close to the college, they learned by planning, acting, and reflecting together in action learning cycles. In addition, they learned how to involve pupils, teachers, and community members in EE. We expected the student teachers to realise the teaching approaches during their practice teaching, using tree planting as the teaching and learning arena, and engaging local

communities to address the environmental challenges that mattered in those areas. During the initial phase of the project, the researchers found that the local participants' trust in the project leaders, combined with their experience of the feasibility of practical activities, both motivated engagement in the collaborative planning and inspired learning through initial actions.

Thereafter, the student teachers planned EE projects and implemented them in nine primary schools in seven districts across Tanzania as a part of their second practice period. The student teachers involved members of the local communities in mapping environmental challenges and mobilising needed resources to address the challenges. Afterwards, they discussed the outcome of the practice with teachers, pupils, and parents in order to evaluate their own practice and to think about how to improve the teaching of environmental topics, thus transferring democratic processes into other communities.

The initial results indicated that the student teachers had committed to environmentally friendly practices and democratic principles. They were able to facilitate environmental care in the local communities and surrounding practice teaching schools, and stimulate discussions with school and college leaders. In one of the schools, the student teachers and pupils supported the local community members in reflecting on their environmental problems. The discussions resulted in the establishment of home gardens among interested parents, teachers, and tutors. In another school, the student teachers facilitated community members to discuss a conflict in their village between farmers, pastoralists, and school leaders. Through their joint efforts, they decided to plant fodder for their animals as a means to reduce conflicts resulting from lost pastures due to drought in the area. The community members enjoyed the activities and volunteered to fence the school garden in return. Dialogue and mutual problem solving reduced the level of hostility between the involved stakeholders and (probably) founded a future sense of democratic cooperation, and enhanced community resilience.

During the two years of project implementation, democratic relationships seemed to emerge among local actors and education institutions. Through their different roles in the implementation of EE, the student teachers seemed to build their self-esteem and sense of autonomy. The democratic processes improved the local communities' ability to manage environmental challenges, even from within the hierarchical Tanzanian power structure. This improvement reduced local dependence on limited and unreliable external resources, and yet, the sustainability of the process remained a major concern because the influence of central government authorities still determined most of the decisions.

Follow-Up Study of the Environmental Education Activities

In order to explore to what extent the beginning of the democratic process had prevailed, the first author undertook a follow-up study one year after ending the PAR project described briefly above. The teacher training college and the three surrounding primary schools in the PAR project took part in the follow-up study. The three primary schools had continued to receive student teachers from the college. From each of the three schools, we selected the headmaster and three active teachers as participants, and from the teacher training college, the dean and three tutors. However, we did not follow up the practice schools around Tanzania where the student teachers had their second practice period.

We collected data via focus-group discussions with teachers and the environmental committees at the primary schools, interviews with the deans, the administrators of the teacher training college, the village

leaders, the primary school headmasters, and the gardener, and, finally, through nonparticipant observations to get information about the status of the established project activities. The focus groups emphasised the key indicators of the project's sustainability, including the ability to mobilise resources and, hence, build social and symbolic capital. Therefore, the focus groups considered the challenges around sustaining environmental activities and the involvement of the participants in the management of the challenges, and the different roles played by different local actors. Among others, the interviews focused on the availability of the resources for sustaining EE activities in schools and in the teacher training college. The observation focused on the established EE activities such as the continuation of tree planting and gardening activities. The first author took notes of the observed activities and recorded the discussions and interviews. The observation checklist of activities started during the PAR provided the means to judge whether the EE activities had been continued or not.

The first author took notes and then transcribed all the audio recordings, organising them into themes and reflecting on our research questions (Miles & Huberman, 1998). The analysis of the data collected through focus-group discussions involved four steps: transcription, summarisation, coding, and categorisation (Miles & Huberman, 1998). We generated the categories through an analysis of the focus-group discussions (frequency in parentheses): "difficult to engage with new leaders (8)," "not involved in decision to transfer teachers (5)," and "unpredictability of resources (6)." The categories related to strategies in addressing hierarchical power structures included "unit of teachers (7)," "selfdetermination (6)," "commitment (3)," and "recruiting new participants (9)." The analysis of the interviews generated categories related to strategies to address resource constraints (frequency in parentheses): "cooperation with local community members (9)," "discussing the challenges with local authorities (6)," and "using available resources wisely (4)." The analysis of the observation logs generated categories of EE activities that were continued or improved after the researcher had left the project areas. Further analysis collapsed the categories into themes, which we discussed with the research questions.

Sustained Environmental Education Activities and the Challenges Encountered

We present here, the results of the democratic process based on the findings from the follow-up study. By synthesising the categories, we have organised the findings into three themes. First, we describe the status of the EE activities in the project area. Second, we explore how the previous participants in the PAR project continued a process of shared power and influence, sustaining the democratic power structures supporting the maintenance of the EE activities. Third, we elaborate on the challenges to the sustained process of meaningful EE and the emerging principles required to sustain a democratic process. We close the section with reflection on the follow-up study.

Ongoing Environmental Education Activities

During the follow-up study, only one of the practice schools had continued to plant trees, whereas all continued to care for the trees that they had planted. Gardening predominated in all the sites that we visited, with vegetable cultivation as the dominant crop. The teachers, pupils, and the student teachers visiting the schools from the teacher training college (during practice teaching) conducted the gardening nearby, or in the tree plot established at the participating primary schools, to facilitate the simultaneous learning of tree care and gardening. Gardening generated raw produce for their own school lunches, which motivated the student teachers and pupils to further participate

in the gardening activities and to take care of the planted trees. We also found new activities such as creating ornaments and plant pots for beautifying the school.

On all four sites (the practice teaching schools and the teacher training college), student teachers, together with tutors, teachers, and the pupils, had started to use animal manure and decomposed organic waste to fertilise the soil in their gardens. Soil fertilisation had become an important activity where they used their acquired knowledge to increase vegetable production. As a result, the community had become more self-reliant in terms of feeding its pupils.

In the schools we visited, gardening, tree care, and soil fertilisation had become major arenas for the teaching of environmental topics. The teaching had become oriented toward practical activities that addressed the community's needs. This change is contrary to the conventional teaching and learning approaches of Tanzania, approaches that emphasise the passing of examinations only (O-saki & Agu, 2002), and yet it is in line with the curriculum.

The Democratic Organisation of Teaching and the Support for Environmental Conservation

The participants organised activities according to the democratic principles of power sharing and mutual support. The teacher training college had organised planning and reflection workshops with primary school teachers and local village leaders. The intention was to discuss the participatory supervision of the student teachers, and to explore how both the teachers and the local communities could contribute to the improvement of teacher education in the local teacher training college. Thus, the locals' participation continued to ensure access to local resources that aided the practical teaching of environmental topics, and led to enhanced student teacher experiences of teaching environmental topics. The local participation in itself gave a positive contribution to environmental sustainability in the local communities surrounding the schools and the teacher training college. The practice sessions enhanced the learning experiences among the student teachers. In return, both the student teachers and the pupils had been teaching tree planting and gardening in their communities, showing that they had acquired a sense of self-confidence, and a sense of responsibility and autonomy during their previous activities. In the pupils' homes (which the first author visited), the members who were trusted by the community reported that the pupils had become very supportive, especially in terms of helping to establish vegetable gardens and in helping to manage pests and diseases.

Further, the teachers and tutors reflected on the possibility of becoming learners themselves, given that one of them acknowledged that she had learned about tree planting in her school days; only after she had participated in the project, however, had she acquired the ability to do the gardening practically. This shows that the participants realised the power of working together and learning from each other (Gaventa & Cornwall, 2001).

The democratic organisation of EE learning seemed to be interesting to both teachers and pupils in the study area because it encouraged autonomy and supported academic learning in the classrooms, as one of the teachers said: "The pupils seem to feel freer in the classroom. Now, they perceive us as friends."

Transfer of Teachers: Threatening the Process

The existing hierarchical power structure in Tanzania such as the regular transfer of teachers and school headmasters by central government authorities threatened the project. The transfer of teachers jeopardised the acquired knowledge and skills of both pupils and teachers, as well as the cultural capital necessary to sustain the development of EE. The district authorities had transferred

most of the teachers who participated in the participatory project from the beginning until when the first author conducted the follow-up study. However, there were still a few teachers left to keep on teaching new participants. Even when the headmasters who had supported the process were removed, the teachers took responsibility. This is a point that we revisit in the discussion section.

Reflection on the Follow-Up Study

The local schools and their surrounding communities had largely sustained and partly expanded their EE activities. Still, no one had planted new trees, even where trees had died. Instead, they had started gardening and facilitating the cultivation of vegetables, generating quick results and raw produce for school lunches. Despite the significant transfer of teachers, teaching had become more participatory both in the teacher training college and in the participating schools; the planning and implementation of EE activities continued through the active participation of pupils and student teachers. The pupils decided on the outdoor activities they wanted to implement and discussed their ideas with local community members in their student clubs, which met regularly. The pastoral communities participated in the activities, contributing materials and labour to the process. Both local leaders and community members regarded the process highly.

Discussion

The discussion departs from, and connects with, the two research questions: "To what degree do the democratic processes in the PAR project enable the tutors, teachers, and local community members to continue developing EE while simultaneously addressing the environmental challenges?" "In what ways do the power relations influence the further development of EE?" Regarding the first research question, we have shown above that the democratic processes in the PAR project enabled the tutors, teachers, and local community to continue developing EE in ways that addressed their local environmental challenges. The PAR project had lasting effects one year after the researcher had left the area. In this discussion, we focus on our second research question concerning the influence of the power relations in the further development of EE. We discuss the potential for PAR to build the participants' capacity such that they become less vulnerable to hierarchical power structures in the educational system.

In line with our contextualised theoretical model, our findings show the potential of PAR and action learning strategies in terms of sustaining the democratic teaching of environmental topics in the context of hierarchical structures. Although the authorities in charge of the primary schools and teacher training college regularly removed headmasters and college administrators, and thus created weakened access to key resources and decision-making members of their faculties, the teachers were not demotivated. Instead, they encouraged new teachers to join the process of change. These teachers intended to spread the teaching and learning strategies to more teachers in neighbouring schools to expand their newly created learning community. Teachers and local communities alike demonstrated a growing ability to improve EE by engaging the community members and sharing their knowledge and skills with pupils and student teachers. This ability is promising in terms of the communities' development of resilience against not only environmental degradation but also against conflicts between groups within the community, for example, between agriculturalists and pastoralists. Thus, the transition to democratic relations in EE seems to rely on an awareness of local environmental conditions, dynamic teacher identities, a sense of solidarity, and committed local leaders. In addition, awareness of the power structures of educational governance seems to have established cultural capital for sustaining democratic power relations (Bourdieu, 1986; Chevalier & Buckles, 2013). In line with Freire (1970), Ahmad (2014), and Jäckle (2016), the findings suggest that increased awareness of the dominant power structures of the EE practice and

educational practice can promote and stimulate community members' commitment to democratic processes that improve learning situations. The awareness stimulates self-determination, commitment, and the willingness to try new strategies, both individually and in collaboration, and can even foster the formation of dynamic teacher and teacher staff identities.

According to Wenger (1998), knowledge based on real-life experiences shapes human identity through the definition and redefinition of the member's roles in the community of practice. The practical EE knowledge realised in democratic PAR activities engaged the student teachers, as well as other teachers, and seemed to influence the development of their teacher identity. Teaching became a dynamic process that also involved learning. One of the tutors commented on this transformation, saying she had learnt about tree planting in her school years, but that it was during this project that she learned how to do it practically at home. The project gave her opportunities to learn from experienced student teachers. Such an identity transformation is important in the power-sharing process and, thus, in sustaining democratic relations. It can become a source of solidarity for pupils, community members, and teachers alike, who connect with each other through the fulfilment of personal as well as communal needs (Zuber-Skerritt, 2015).

Nyerere (1967), Noffke (1997), and Nkulu (2005) discussed the importance of a sense of collective solidarity for the realisation of collective actions among marginalised communities who want to use research to realise social change. In this study, collective actions and solidarity seemed to promote self-esteem among the local inhabitants, which encouraged them to continue the struggle, even under harsh conditions with limited resources and unstable local expertise. A collective solidarity composed of respect and responsibility toward others seems to be important to achieve environmental sustainability (Shumba, 2011). Yet, the solidarity is influenced by, and dependent upon, committed local leaders.

As Nyerere (1967) emphasised, qualified local leadership can be a key for the achievement of social transformation. In rural Tanzania, chieftainship means that encouragement from positioned and valued members of the community can be the main source of motivation. In this study, local leaders and school committees coordinated activities and encouraged the participation of parents in the sessions. In addition, the contributions of the local gardeners and extension officers seemed to be highly important. Together, the coordination done by local leaders and the instruction by advisors with relevant skills seemed to motivate local participants. The local leaders' willingness to share their authority with the teachers practicing PAR was a gateway to a more democratic structure that involved active teaching of environmental topics and active human agency (Bandura, 1986). In fear of losing their power to the other teachers, a few headmasters, to a lesser degree, were willing to share their authority. In this way, they seemed to slide back into doxa (see Figure 1). This kind of relationship reduced the flexibility of the school systems, rendering it difficult for these schools to integrate the changes into their learning methods.

The discussion's nuances demonstrate the earlier described tensions between a self-efficient local community and the framework of top-down hierarchical power relations from the government down to local communities and schools. Still, we have shown that within hierarchical power structures it seems possible to create arenas for the development of democratic power relations. The democratic organisation of EE in outdoor activities at schools like tree planting, based on action learning in a PAR project have the potential to influence the rigid top-down teaching regime in the classrooms in a democratic way. In accordance with cooperative action research, collaboration between different stakeholders, and the distribution of power from the experts to the locals and from the leaders to other citizens seems to motivate both individual and collective actions on a local level. To a degree, a lack of material resources and access to decision-making members of the faculty can be

counteracted by supplying cultural and social capital, satisfying the conditions for releasing inner motivations: selfdetermination, competence, and attachment or belonging, as demonstrated in Figure 1 and Table 1.

The critical environmental situation in Tanzania calls for effective collaboration between teacher education, primary schools, local communities, teacher resource centres, and local government authorities in order to create EE that can enable people to find new solutions in order to survive. We have argued that teacher education is a key to the transformation of teaching in primary schools. The student teachers' role as practitioners gives them the opportunity to bridge teacher education and local EE and environmentally friendly practices. A level of active participation from the abovementioned institutions can address challenges such as limited resources, which are a norm in many teacher training colleges in Tanzania (URT, 2001). Hence, a balanced power relationship between teacher training colleges, primary schools, and district authorities might be key in terms of developing the quality of teacher training programmes and the implementation of the EE curriculum, which often demand active teaching and experience in fieldwork. We have argued that PAR in teacher education is a way to achieve such a power balance.

Concluding Reflections and Recommendations

We have shown that by using action learning and action research as an approach to EE, it was possible to foster democratic practices within the frame of hierarchical structures. The results from our study suggest that teacher education might promote democratic processes in schools when local leaders are engaged in the process from the planning stage. We have shown an example of how the integration of PAR and action learning can be possible in the context of Tanzanian teacher education and schools and, given that the situation is similar in a range of countries, we believe the results are also useful in other contexts.

Based on the discussion in this paper, we suggest that there is a need for teaching PAR and action learning during the education of teachers as a means to move power relations from hierarchical to democratic structures. PAR and action learning approaches provided us with the possibility to mobilise resources in local communities in order to address the sustainability of management of the environmental problems faced in this project. We therefore recommend the integration of PAR and action learning in the teacher education curriculum.

Further, we recommend holistic and system-oriented EE, addressing the leadership of teaching processes. It seems crucial that leaders at different levels of the educational system should own the process and encourage teachers in order to sustain the changes that are made. Preservice training is not enough to initialise such a holistic change in EE when there are so many teachers who are not educated in holistic ways of EE teaching. There is a continual need for in-service training to equip teachers with the knowledge and skills to facilitate such processes of change. And, EE learning is a dynamic process, which faces continuous challenges because the environmental challenges themselves are changing. Follow-up education and support for the new teachers who address new challenges in local communities and the teaching system are crucial.

This project had very little funding. The local leaders and community members supported the maintenance of EE activities in their schools and in their local communities because of the small incomes that were generated from selling vegetables and seedlings these were some of the immediate gains from engaging in EE activities. We have shown that the participants were motivated to achieve a functioning democratic process that connected them with the fulfilment of their

immediate needs. We therefore recommend further studies that emphasise EE to include more transformative changes alongside the formation of new and progressive values.

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Errata list

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Thesis: Teacher education as key to adaptation to environmental degradation in Tanzania: Development of environmental education through participatory action research Date:17. 8. 2020

Side	Line	Original text	Corrected text
1	Cover page Title	Teacher education as key to adaptation to environmental degradation inTanzania: Development of environmental education through participatory action research	Teacher education as key to adaptation to environmental degradation in Tanzania: Development of environmental education through participatory action research (insert a space between IN and TANZANIA
2	Page 20 Paragraph 1 Line 6	Somekh (2009) cited but not in the reference list	Somekh (1994) as appears in the reference list
3	Page 38 Paragraph 2 Line 3	Naryan 1993 cited, but misspelt and not included in the reference list	Narayan 1993, How native is a native anthropologist. American anthropologist 95(3), 671-686
4	Page 11 Paragraph 2 Line 8	Kyburz-Graber 1999 cited but not in reference	Replace Kyburz-Graber 1999 with Kyburz-Graber 2013 as it appears in the reference list
5	Page 50 Paragraph 3 Line 5	Citation Deci & Ryan 2000	Rearrange the authors as they appear in the reference list (Ryan & Deci 2000)
6	Reference list page page 60 Line 22	The reference UNESCO-UNEP wronged placednot alphabetically approapriate	Place the reference in their respective alphabetical order (at page 67)

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Norwegian University
of Life Sciences

Postboks 5003
NO-1432 Ås, Norway
+47 67 23 00 00
www.nmbu.no