Editorial

I should like to thank all the members of the Editorial board for their hard work. My thanks are also due to the contributors to this issue for their forbearance and patience in the necessarily long process of preparing papers for publication.

This issue of the JTEFS consists of seven papers that deal with issues ranging from dialogical models and interactive patterns in education for sustainable development to indigenous perspectives in the Western environmental education for sustainability. The papers provide ideas and results from a number of different national and cultural perspectives.

The paper by Pipere and Mičule highlights individual in-depth, semi-structured interviews with three mathematics teachers, which were conducted to investigate the dynamics of their life-long relationships with mathematics, synthesised as mathematical identity from different identity positions in the context of dialogical self. The qualitative data were scrutinised employing interpretive phenomenological analysis that displayed mostly positive instrumental relationships with mathematics and explicit connections between the teachers’ life experiences and their distinct identity voices that surfaced in interviews. The teachers’ accounts contain various models of relationships between the other-motive and the self-motive as reflected in their pedagogical approaches. The dialogical models and interactive patterns show alignment with one of the core competences for educators in education for sustainable development, that is, achieving transformation in what it means to be an educator.

The paper by Keinonen aims to find students’ perceptions of environmental issues as presented in the media and how students in Finland, Lithuania and Sweden used these media sources in the matters related to environmental issues. The most important source of environmental knowledge was found to be the Internet, followed by newspapers, television and school. In their own lives, students discussed environmental issues every day and, to some extent, in social media, discussion forums and blogs. In Finland, newspapers represented the most important source of environmental knowledge; in Lithuania, environmental organisations were the most prevalent, and, in Sweden, it was in a school or educational context. Based on these results, it was concluded that, in order to reach both genders of students in different countries and to more greatly benefit from all sources of information, a variety of media should be used in education for sustainability.

The paper by Egne investigates how the multi-ethnic and multicultural characteristics of the diverse Ethiopian society are incorporated into the current secondary teacher education curricula of the country. To that end, both qualitative and quantitative content analyses were used as tools for data collection. This study exhibited an increasing ambition to address issues of multicultural education into the Ethiopian general national secondary teacher education curricula framework. Nevertheless, elements of multi-ethnic and multicultural education are, to a great extent, missing in the specific secondary teacher education curricula. Implications which are assumed to improve fair representation of the ethnic and cultural diversity of the Ethiopian peoples into the entire secondary teacher education curricula are presented in this paper.

The paper by Ruokonen discusses the five-string kantele as an example of the Finnish national heritage, a school instrument and an example of sustainable design.
A qualitative case study was made by collecting the data from the Finnish students – prospective teachers – and the sixth form pupils, who had designed and carved their own five-string kanteles. The purpose of this research was to find out which aspects of five-string kantele design are considered the most important for sustainable principles and design among these youngsters. The elements and principles of designing the five-string kantele are discussed and its relevance to five sustainable characteristics (creative, ecological, economic, aesthetic and socio-environmental) is presented. The sustainable values of the kantele and the purpose for which it is made are also considered.

The paper by Soobik focuses on teachers’ assessment of craft and technology education, from two different periods of time, which are compared in light of two different national curricula in order to explain possible changes in teachers’ conceptions related to the teaching methods of technology and examines teachers’ opinions on the methods of technology education. This research attempts to find answers to the questions: What are teachers’ attitudes towards teaching methods at the two different periods of time? What changes occurred in the teaching methods of the syllabi in light of the curricula adoptions in 2004 and in 2011? The research is based on questionnaire surveys administered across Estonia in 2004 and 2011. Findings indicate that during the two periods in question the teaching methods used by the teachers of technology education in Estonian schools shifted from the traditional approach to teaching towards a more constructivist approach.

The paper by Pontes-Pedrajas and Varo-Martínez presents an educational experience developed in several biology and environmental teacher training courses and focused on the treatment of environmental education as a transversal educational topic. For that aim, text analysis techniques, concept mapping and informatics tools have been used to represent individual and collaborative knowledge about environmental topics. The outcomes of this study reveal that future teachers and environmental educators consider that concept mapping is a valuable tool to represent their knowledge about environmental education, to encourage reflexive and collaborative learning, to improve teaching communicative abilities and to use effectively ICT in the classroom.

The paper by Chandra highlights the importance of integrating indigenous perspectives on environmental sustainability into mainstream education as a way of bridging the gap in the understanding of indigenous knowledge systems into Western science explanations of sustainable development in education. The first part of the paper attempts to explore the issue of sustainable development through Western and indigenous perspectives and will emphasise on the model of strong sustainability (in theory). The importance of traditional ecological knowledge is examined and justified through case studies on Aboriginal peoples of British Colombia and Roviana people of Solomon Islands in achieving goals of sustainability. Challenges for traditional ecological knowledge are investigated and some possibilities of protecting the rapid disappearance of indigenous knowledge are dealt with. Lastly, a pedagogical approach to sustainability is provided that postulates the relevance of indigenous pedagogy to formal and informal education.

Editor-in-chief
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Mathematical Identity for a Sustainable Future: An Interpretative Phenomenological Analysis

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Abstract
Individual in-depth, semi-structured interviews with three mathematics teachers were conducted to investigate the dynamics of their life-long relationships with mathematics, synthesised as mathematical identity from different identity positions in the context of dialogical self. The qualitative data were scrutinised employing interpretive phenomenological analysis that displayed mostly positive instrumental relationships with mathematics and explicit connections between the teachers’ life experiences and their distinct identity voices that surfaced in interviews. Similarly, teachers appeared to be experts in different professional spheres: pedagogy, subject or didactics. The teachers’ accounts contain various models of relationships between the other-motive and the self-motive as reflected in their pedagogical approaches. Emergent patterns resulting from the interaction of the teachers’ mathematical identity and their perception of students’ mathematical philia/phobia included the humanistic approach with an instrumental interpretation of mathematics and its teaching methods, self-actualisation in achieving success in mathematics through hard work and the issue of attribution of failure in mathematics either to external or internal factors. Moreover, these dialogical models and interactive patterns show alignment with one of the core competences for educators in education for sustainable development, that is, achieving transformation in what it means to be an educator, in teaching and learning, as well as in the entire education system. Practical implementation of findings and limitations of the study are outlined along with venues for future research.

Keywords: mathematical identity, mathematics teachers, dialogical self, competences for educators in education for sustainable development, interpretative phenomenological analysis, social constructionism

Introduction

In order to reach sustainability in education in a broad sense, we have to seek untraditional and creative solutions, such as interdisciplinary approaches and innovative ways of dealing with routine problems. One of the possibilities in this regard is to look at educational discourse through the lens of an individual’s identity as it gradually shapes synergetic relationships with the surrounding world in general and with specific areas of knowledge in a particular sense.
The recent message of bringing sustainable future through education (Fien, 2003; Katzschner, 2011; United Nations Economic Commission for Europe [UNECE], 2011), changing educational system in general, transforming pedagogy, didactics or specifics of any subject, frames the global and local context of presented study. So far, mostly the specifics of subject content and teaching methods have been empirically studied in relation to different aspects of education for sustainable development (ESD) (Gerretson, Howes, Campbell, & Thompson, 2008; Illeris, 2012; Jonåne, 2008; Renert, 2011; Sánchez, 2011). However, according to Reunamo’s four-fold model for ESD research (Reunamo & Pipere, 2011), the focus on the subject’s content aligns solely with an assimilative orientation of the model, using mostly theoretical and quantitative points of view while an accommodating stance on understanding the motifs and discourse of sustainable development as a meta-content or meta-message (Salóte, Gedžüne, & Gedžüne, 2009; Sund & Wickman, 2011) could be found in qualitative research of individual participants’ interactive processes (Reunamo & Pipere, 2011).

Unfortunately, there are different avenues through which education often fosters unsustainable living. One of the most challenging issues in this regard is the competences of educators at all levels of education on how to implement ESD (UNECE, 2011). The UNECE Steering committee on ESD recently proposed guidelines for all educators in order to set the framework for their professional development since educators can become the main agents for change if they feel able and supported in their endeavour. In short, the UNECE (2011) guidelines “Learning for the Future” contain the core competences in ESD for educators. 1) A holistic approach seeks interrelation between integrative thinking, inclusivity and dealing with complexities. Within this approach, an educator comprehends the inclusive nature of education, the complexity of our life and its issues, the interrelation and interdependence of all existing. 2) While learning from the past, engaging with the present and exploring alternative futures, educators need to envision a change that can be reached by critically assessing different processes and inspiring hope for their learners. 3) Teachers need to participate in achieving transformation in what it means to be a educator, in teaching and learning and in the entire education system. Teachers need to become critically reflective practitioners who challenge unsustainable practices at all systemic levels. Since these competences were mandated quite recently, our study would be among the first to use them in empirical exploration of school teachers’ experience (see also Sims & Falkenberg, 2013; Van Poeck, & Vandenabeele, 2013).

The sustainable identity of teachers could serve as a powerful tool for sustainable learning of their students. The teachers’ identity molds their students’ learning achievements and, ultimately, their own identity, and a path of life. Though the connection between the teachers’ identity and ESD is a rather new departure in a field currently undergoing major revisions (Katzschner, 2011), it is urgent to observe these connections in a context of a socially and individually challenging discipline such as mathematics. The rational application of wisdom coming from science and mathematics might help us in designing a sustainable future if these disciplines are able to provide means to deal with specific environmental (or even social) issues endangering the future of our planet. At the same time, a global trend of the new millennium shows a sharp decrease in the number of students accessing mathematics undergraduate courses or entering professions connected with mathematics and natural science (Di Martino & Zan, 2010). Thus, we need to find a way to make these areas of learning more in line with the capacities and
needs of society, meanwhile fostering the social, cultural and psychological changes in educational processes aligning with the principles of sustainability.

In this paper, among other things, we attempt to show if and how the teacher’s individual life experiences translated in terms of mathematical identity and dialogical self, if and how related patterns of personal pedagogical theories, in the context of mathematics teaching and learning, align with the competences for educators in ESD as mandated by UNECE. Initially, we shall examine the notion of mathematical identity, then the dialogical self as an intersection of different identity voices will be analysed in detail. The studies regarding the students’ mathematical philia and phobia, in addition to teachers’ perception of it, will be discussed. The idea about the teachers as reflective practitioners challenging unsustainability through the prism of their life and work will bridge agap between the teachers’ personal reflections and the focused change necessary for sustainable practice. Furthermore, a qualitative approach to the study will be substantiated right before presentation of the aim and research questions. The traditional review associated with the research method will be followed by the results and a discussion containing illustrative descriptions and analyses of the three teachers’ cases. The paper will end with conclusions on the topic, concluding with limitations of the study, practical implications and suggestions for further research.

Mathematical Identity

Today, in a situation of increasing ontological insecurity, existential uncertainty (Kinnvall, 2004) and exponential growth of knowledge, it seems more and more obvious that learning is not so much about obtaining knowledge as about the developing healthy, productive, adaptable identity (Pipere, 2003). Following the recent trends in educational research observing the notion of identity as a powerful and promising analytic tool (Gee, 2001; Kaplan & Flum, 2012; Sfard & Prusak, 2005), studies in mathematics education show a growing interest in identity as a structure helping to understand learners’ engagement with mathematics. Although the main focus of identity research in mathematics education has been the identity of students (Anderson, 2007; Browne, 2009; Darragh, 2013; Esmonde, 2009; Nyamekye, 2010), several studies have been aimed also at identifying the mathematical identity of pre-service and in-service teachers (Brown, Jones, & Bibby, 2004; Kaasila, 2007; Kaasila, Hannula, Laine, & Pehkonen, 2006; Stinson, 2009) as it may be comprised among the agents of successful teachers’ performance and students’ positive mathematical identity.

In this study, engaging the phenomenological foundation for the understanding of more rarely studied in-service teachers’ relationships with mathematics, we shall draw on the definition of mathematical identity, reaching beyond the mere practices of doing school mathematics (Browne, 2009). In general, we shall position mathematical identity as a construct that describes the relationship of a person with mathematics (Bikner-Ahsbahs, 2003). Taking a more detailed view and following Martin (2007), mathematical identity will be considered as the dispositions and beliefs regarding an individual’s ability to participate and perform effectively in mathematical contexts as well as to use mathematics to change the conditions of her/his life.

To explain the emergence and development of mathematical identity, we shall use the standpoint of social constructionism, occasionally used in research in the field of teacher education and training (Bainbridge & Macy, 2008; Dobozy, 2012; Hawley,
Crowe, & Brooks, 2012). From this viewpoint, an identity is formed in relationships with others, extending from the past and stretching into the future (Wenger, 1998). In this regard, relationships with mathematics for the majority of adults in the Western world usually start during early childhood and are closely connected with main autobiographical turning points (for instance, preschool, elementary school, secondary school, university, workplace etc.). In the years of formal education, as well as in non-formal and informal ways, learners come to know themselves in relation to mathematics through relationships and experiences with their peers, teachers, family and community (Anderson, 2007).

In terms of mathematics teachers, we may hypothesise the further development of their mathematical identity after the secondary school, in the university context while studying to become mathematics teachers and mainly in relationship to university teachers, peers and community; then, during the novice years, in a school context of interacting with mentors, colleagues, students, parents, school administration etc. Later, as experienced professionals, mathematics teachers can become involved in professional development courses, research, textbook writing, projects, preparing students for mathematics competitions, communicating with professionals and developing their own mathematical identity in a wide diversity of contexts. However, as all these relationships and interactions are in a continuous state of change, the content of the socially constructed mathematical identity evolve.

Drawing on an existent knowledge to grasp the content of a mathematics teacher’s mathematical identity, we use the recent findings from Anderson (2007), Di Martino and Zan (2010) and Kaasila (2007). In line with Wenger (1998) and Gee (2001), Anderson (2007) describes four faces of mathematical identity. In the context of this paper, we adapt these faces to the “body” of in-service teacher’s mathematical identity. 1) **Engagement** refers to the direct experience of teacher’s engagement with mathematics – her/his self-recognised and socially acknowledged level of competence in mathematics. 2) **Imagination** relates to how mathematics fits into teacher’s other activities in the present as well as the future, and it also relates to what a deeper meaning of mathematics in a broader context of life is. 3) **Alignment** means that a teacher aligns his/her energy within institutional boundaries and requirements. In the case of in-service teachers, this could mean that those who consider, for instance, the latest developments in didactical approaches direct their energy towards changes in their teaching. 4) And the **nature** face of identity considers the teacher’s biological inheritance (for instance, gender and race), which is beyond the teacher’s control.

Di Martino and Zan (2010) in their study of students’ relationships with mathematics highlight the three themes: emotional disposition towards mathematics (positive or negative), vision of mathematics (relational or instrumental) and perceived competence in mathematics (high or low). In a similar vein, Kaasila (2007) discerns the pre-service mathematics teachers’ views of 1) themselves as learners and teachers of mathematics, 2) mathematics and its teaching and learning and 3) the social context of learning and teaching mathematics.

Therefore, in integrating these suggestions, we can assume that the mathematics teacher’s mathematical identity as based on biological inheritance would include: 1) relationships with mathematics in a broader context of life of its teaching and learning; 2) self-recognised and socially acknowledged competence as a mathematics’ learner and teacher and 3) the social and institutional context of learning and teaching mathematics.
Since social constructionism emphasises the use of language as a tool for social interaction and construction of identity in describing the procedural and expressive nature of mathematics identity, we should conceive of it as a constantly developing narrative designating both a person’s self-understanding as well as how others see that person in the context of doing mathematics. Mathematical identity results from the negotiation of our own assertions and the external evaluations of others (Martin, 2007). It is a context bound as people justify, explain and make sense of themselves in relation to mathematics and to other people acting in mathematical communities, depending on the audience and social conventions of how language is used (Kaasila, 2007).

The temporal context of mathematical identity, moving from the past, through the present, and to the future, indicates the suitability of autobiographical reflections to deconstruct the relationships and institutional contexts in relation to the identity of the teacher. These reflections can serve, in a practical sense, as an interpretative framework for professional actions explained as “tacit knowledge,” where a self-image and task perception have roots in early childhood relations, interactions with significant others throughout the teaching career and critical periods of life (Swennen, Volman, & van Essen, 2008).

The teacher’s autobiography bound to mathematical identity involves personally meaningful episodes, important persons and institutions, rationalisations and explanations, as well as the development of his/her beliefs about learning and teaching mathematics. Our task as the researchers is to elaborate on how a person’s earlier experiences influence his/her past and present mathematical identity (Kaasila, 2007).

As the mathematical identity certainly is not the singular identity of a mathematics teacher, the dialogical character of a teacher’s identity voice is described further.

**Dialogical Self of the Teacher: Interaction of Identity Voices**

Dialogism is conceived as an explicit attempt to rise above the intersection between identity and learning. Education can develop identity through specific learning mechanisms, and this development can become an important goal for education. The approach of Dialogical Self Theory (DST) can be very useful for education as it focuses on the self as influenced by context and social interaction (Ligorio & Cesar, 2012). According to DST, the self is a polyphony of voices or different I-positions constantly striving for change and for a balance between various tensions among them (Hermans & Dimaggio, 2004; Hermans & Hermans-Konopka, 2010). The DST is also applicable when shifting a focus from the student to the teacher.

In their profession, teachers interact with different groups of people (for instance, students, parents, colleagues, administration and researchers) within different contexts (for instance, school, society, further education) and sub-identities (for instance, teaching, counselling, research) (Vloet & Jacobs, 2013). At the same time, in terms of the content, a teacher’s professional identity can be related to core teaching aspects such as didactical and pedagogical expertise as well as the subject matter. A teacher, as an expert in the subject, has a profound knowledge base in his/her subject(s). As an expert in didactics, he/she knows how to teach specific subject-related content, emphasising creation of learning environments that support the pupil’s learning process, and, as an expert in pedagogy, a teacher understands human thought, behaviour and communication to support the child’s development as a human being (Beijaard, Verloop, & Vermunt, 2000).
The interactive, processual and contentwise aspects of a teacher’s professional identity mentioned above participate in a constant interplay with other sub-identities or possible teacher’s voices, unremittingly searching for the meaning of these interactions. According to Hermans (1991), while constructing the meaning of the self, the individual grounds the self on two basic motives: the self-motive aims towards self-expression, self-development and self-defence while the other-motive strives towards the unity with others and belonging to a larger entity. The experiences of these motives can elicit positive, negative or ambivalent feelings (Hermans, 1991). Revealing the basic motives would help to understand mathematics teachers’ personal philosophy of education and, specifically, their relationships with a concrete discipline.

In our study, the “self” of the mathematics teacher is reflected both within a phenomenological tradition as an experienced and enlived reality and constructed as a narrative in a specific context and at a given time (Hermans & Hermans-Jansen, 1995). According to Vloet and Jacobs (2013), a professional identity can be seen as a constructed set of stories told by the teacher in relation to others. We resort to the single, yet inter-related, aspect of mathematics teachers’ professional identity, that is, their mathematical identity as embedded in a specific scientific discipline and a subject taught at school.

**Teachers’ Perception of Students’ Mathematical Phobia and Philia**

In the context of this qualitative study, we ground the notion of mathematical phobia in a broader discourse, binding it not only to affect-oriented constructs like mathematical anxiety, as generally displayed through the physiological symptoms of negative emotions (e.g., fear) having to do mathematics (Hembree, 1990; Ashcraft, 2002) or of negative attitudes towards mathematics as conceiving its emotional, cognitive and conative aspects (Di Martino & Zan, 2010; Domino, 2009; Hannula, 2002; Zan & Di Martino, 2007; Zan, Brown, Evans, & Hannula, 2006), yet embracing all complexity of factors that causes failure dealing with mathematics in different contexts. In a similar way, the notion of mathematics philia will be connected with a wide array of factors fostering the successful mastering of mathematics not only in the classroom, but in all life situations.

The literature does not bring us thorough empirical evidence of the causes of mathematical phobia, though some studies find it rooted in early school experiences (Humphrey & Hourcade, 2009; Pan & Tang, 2004) or connected with teaching based on high demands and little support (Turner et al., 2002). Some studies dealing with mathematical phobia (Humphrey & Hourcade, 2009; Woolfolk, 2007) mainly advocate for a change in teaching and learning to reduce competition, clarify instructions, minimise time and other pressures, collaborate with a skilled partner, start with small achievements to generate initial success etc. Also, to invoke mathematical philia, passionate teachers with love towards the subject are needed (Rameau & Louime, 2007). Very few studies focus on the mathematical teachers’ perception of their students’ mathematics phobia and philia (Insook, 2009; Wilbert, 2008; Zan & Di Martino, 2007). In general, teachers attribute the causes of a negative attitude towards mathematics to students’ characteristics and behaviours, for instance, lack of interest and effort by students, thus hiding the teacher’s responsibility for creation of such an attitude. While Zan and Di Martino (2007) reveal that teachers’ diagnosis of students’ “negative attitude” (p.162) towards mathematics presumably is a final result of teachers’ interpretation of students’ issues,
in our study, we went further and directly asked teachers to explain their view on the causes of the students’ mathematical phobia and philia.

**Teachers as Reflective Practitioners: Challenging Unsustainability**

As mentioned in the introduction of this paper, only by becoming critically reflective practitioners teachers will be able to challenge unsustainable practices at all levels of the educational system, ranging from identity development of the learner to the inclusive societal contexts of economic, cultural and political evolution.

The term “reflective practice” has multiple meanings that range from the idea of professionals engaging in solitary introspection to that of engaging in critical dialogue with others (Finlay, 2008). In this study, we are looking at teachers as reflective practitioners in a collaborative dialogue with the researcher. Moreover, according to Larrivee (2000), the examination of one’s teaching from the position of a reflective practitioner enriches one’s professional identity. The literature about reflective practice starts from Dewey (1933) and is followed by Schon’s (1983) seminal work that emphasises the development of reflective practitioners and suggests two types of reflection: reflection-on-action and reflection-in-action. The presented study is linked with teachers’ reflection-on-action, namely, thinking after the event, where teachers consciously review, describe, analyse and evaluate their past practice with a view to gaining insight to improve their future practice (Finlay, 2008). In some cases, in developing educational systems, the system itself is not conducive for such a kind of reflection-on-action, limited by, for instance, a lack of teachers’ autonomy, the absence of a culture of openness and questioning, time, the lack of financial and other resource constraints, among other things (Sangani & Stelma, 2012).

The plethora of literature points to the connection between the professional’s reflection and change in his/her practice. As Kemmis (1985) already noticed, reflection is “action-oriented, social and political. Its ‘product’ is praxis (informed, committed action), the most eloquent and socially significant form of human action” (p. 139). A more detailed account on reflection perfectly matching the context of our study is provided by Johns (2000), who compares reflection with a window through which the practitioner can view and focus self within the context of his/her own lived experience in ways that enable him/her to confront, understand and work towards resolving the contradictions within his/her practice between what desirable and actual practice is. Through the conflict of contradiction, the commitment to realise desirable work and understanding why things are as they are, the practitioner is empowered to take more appropriate action in future situations.

In the context of the research, it is important to stress that teachers’ reflections during the research can lead teachers to their personal and collective growth and, therefore, to change their unsustainable practices into more sustainable ones.

**Qualitative Phenomenological Approach to the Study**

In the field of ESD and also in mathematics education, qualitative methods are used quite extensively since they display the tacit knowledge that is hard to obtain through more objectivistic and quantitative means (Buttigieg & Pace, 2013; Di Martino & Zan, 2010; Pipere, Reunamo, & Jones, 2010). Interpretive Phenomenological Analysis (IPA),
currently widely used in the fields of health and psychology, is very new to education research, with only a couple of studies available on teacher education and professional development using IPA (Bailey, 2011; Bainger, 2011; Bleiler, 2012). This study tries to search for the ways to bridge this gap using IPA in the field of mathematics teachers’ professional development, focusing on their mathematical identity and further consequences on professional practice in the context of ESD. IPA sees the participants as experts at knowing about and describing their own experiences (Reid, Flowers, & Larkin, 2005) and, in this way, helps to find out how individuals are perceiving the particular situations they are facing, how they are making sense of their personal and social world (Smith & Osborn, 2008). Hence, IPA can be an ideal tool to use for a study in the field of education.

The methodological distinction between this study and quantitative research in the field of ESD or qualitative research that focuses directly on the assessment of educational content or pedagogical methods for ESD should be noticed. In this respect, our research draws on the phenomenological approach within a paradigm of critical constructivism (Goodman, 2008; Kincheloe, 2005) – a variety of social constructivism. Collaboration between the researcher and the teacher (co-researcher) during the interview, fostering self-reflection on the teacher’s personal and professional development, allows for the creative organisation and navigation of process where the interviewee can independently arrive at constructing a unique critical discourse at personal, institutional, community and societal levels. For the researcher, it only remains to evaluate how close these reflections are to the essential principles of sustainability and formalised requirements for ESD competences.

One of the strengths of qualitative research, which is particularly beneficial for this study, is indirect and unobtrusive inquiry into the subjects’ views on the research problem. Hence, the deep phenomenological interviews that elicit lengthy (in comparison with other methods) and deep self-reflection scale up the scientific rigour of this study in terms of credibility and confirmability (Lincoln & Guba, 1985). If an experienced professional is allowed to reflect extensively and in detail on his/her life and professional activities, reacting to the researchers’ incentives, he/she will reveal aims, meanings, values, content, competences, methods and an impact of this work on the interviewee, other people, his/her community, society etc. In this way, such interviews can be used to provide insight into the sustainability of teachers’ personal and professional activities in social and institutional context.

In summary, the aim of this study is to explore the dialogical models of mathematic teachers’ life-long relationships with mathematics, towards uncovering interactive patterns emerging between the teachers’ mathematical identity and their perception of factors influencing the mathematical philia/phobia of their students in relation to ESD competences for educators. The analysis of qualitative data will help to find out the answers to the following questions: 1) What are the major features of interviewed mathematics teachers’ mathematical identity?; 2) What kind of dialogical models emerge for making sense of mathematics teachers’ mathematical identity in a life-long perspective?; 3) What interactive patterns can be observed between the mathematical identity of teachers and their perception of students’ mathematical philia/phobia? and 4) How do these dialogical models and interactive patterns align with the ESD competences for educators?
Method

Sampling

A large number of participants is not necessary for IPA to obtain sensible data; consequently, three mathematics teachers, who are doctoral students doing research on mathematics education, were recruited for individual in-depth, semi-structured interviews. The search for the relevant research participants lead to these persons with a unique configuration of identities in relation to mathematics teaching, learning and research. Several other studies using IPA have been published using three participants (Bainger, 2011; Bates, 2012).

Smith and Osborn (2008) advise that an IPA sample should consist of relatively similar (homogeneous) cases rather than extremely different examples. So, first of all, the selection of gender was determined by the domination of women in mathematics teaching in Latvia. An overview of the participants’ real-life experiences shows a similarity of the main facets of personal history being students enrolled in a mathematics enrichment class at school, university students at mathematics teacher education and training programmes, school teachers of mathematics and doctoral students in pedagogy. The aim of sampling was to recruit a purposive sample as opposed to a strictly representative sample. The results in this study represent the specific group of mathematics teachers and are not representative of all mathematics teachers in Latvia.

The first participant (a pseudonym – Ann) is a 45-year-old woman with a university diploma in secondary school mathematics/physics teaching. She is holding a master’s degree in pedagogy. She has 10 years teaching experience at school and 3 years at the university level, as well as 8 years experience as a school principal. Ann has designed many in-service teacher education and training courses, and she is the co-author of textbooks on mathematics. The second participant (a pseudonym – Irene) is a 37 years old woman with a university diploma in teaching secondary school mathematics, physics and information technology (IT) and a master’s degree in mathematics, specifically geometry. She has 17 years of teaching experience at school. The participant has been engaged in several European Union projects and gained recognition as one of the best elementary school mathematics teachers in terms of her students’ achievements at national mathematics olympiads. The third participant (a pseudonym – Elsa) is a 37-year-old woman with a university diploma in elementary school mathematics and IT and a master’s degree in pedagogy. She has a lengthy teaching experience of 15 years.

Procedure and an Interview

The participation in the interview was voluntary, anonymous, confidential and based on the written consent. The date, time and location of the interviews were arranged at the participants’ convenience. An interview schedule was prepared prior to the interview, starting with a wider picture and then focusing on the details (Howitt, 2010). Specific open-ended questions reflecting the research objectives were generated on the basis of a review of the relevant literature. The main areas of interview schedule were the following: mathematics and its meaning to the participants (general context); doing mathematics: social, institutional and self-evaluation; relationships with mathematics in different social roles and mathematics phobia and phobia in an educational context: concepts, causes, fostering and impeding factors (Appendix). Throughout the interviews,
a process of probing was adopted, and the interviewer often requested further details to obtain rich accounts. All interviews were recorded on an audio recorder with the participants’ permission and transcribed verbatim by the first author. The questions were flexibly adapted to the direction and pace of an interview for each participant.

The interviews were conducted by the first author of the paper, a female academic researcher at university while delivering a doctoral programme (n=2) and a teacher at school where one participant was working. The interviews lasted for between 67 and 90 minutes. The atmosphere during the interviews was open, friendly and motivating.

Analysis

IPA intends to explore how research participants experience their world and, consequently, provides an insider’s perspective of the phenomenon under investigation. The rigorous analysis derives themes from the data itself, as opposed to categorising data on the basis of pre-determined categories or a priori assumptions (Dickson, Allan, & O’Carroll, 2008). The analysis process for each transcript was based upon a model developed by Smith, Flowers and Larkin (2010): 1) reading and re-reading of transcription; 2) initial noting based on free associations using descriptive, linguistic and conceptual comments; 3) developing emergent themes and 4) searching for connections across emergent themes, considering subordination, contextualisation, numeration and a function of themes.

The three transcripts consist of 32,363 words in total. Initially, the first interview’s transcript was analysed by the two researchers (the authors of this paper). During several readings, emergent comments on the semantic content and language were noted in the margins alongside the text. These notes were listed separately and searched for patterns, repetition or connections while creating a table of themes. The two researchers compared their findings and agreed upon a preliminary framework of themes and sub-themes. It is a common practice within IPA for an indepth analysis of a subset of interviews to form the basis for an analysis of the remaining transcripts (Adams, Rodham, & Gavin, 2005). Therefore, both authors returned to the remaining transcripts and, guided by the preliminary framework, created an analysis of the two remaining interviews, including additional themes as required. Afterwards, the authors coordinated and finalised the analysis of the three interviews, looking for patterns across cases. Some progress was reviewed by both authors to ensure that there was an agreement between the thematic interpretations and their reflection in the teachers’ personal narratives.

Results and Discussion

Although presentation of IPA results is usually based on emergent themes (Smith & Osborn, 2008), in order to provide systematic answers on the four research questions, the further account will be structured in a more deductive way. The answers to each research question will be grounded on the emanated subthemes acknowledged as important by the researchers and illustrated with exact quotes from the interviews’ transcripts (Howitt, 2010). It should be noted that, during the process of inductive analysis, the researchers were not guided by any preconceived categories or theoretical structures. The theoretical insights provided at the beginning of the paper were induced basing on the results of IPA.
The Mathematics Teachers’ Mathematical Identity

The major features of mathematics teachers’ mathematical identity are displayed in line with a theoretically developed structure of mathematical identity: 1) relationships with mathematics; 2) competence and 3) social and institutional context.

Relationships with Mathematics. Following the study by Di Martino and Zan (2010), relationships with mathematics teaching and learning are analysed in a broader life context, highlighting their properties and emotional tone. For all the interviewed teachers, these relationships differed to some extent. In Ann’s case, we observed the positive instrumental relationships with mathematics, using it as a lifebuoy in practical life situations that were atune with her general positive social and emotional orientation during the interview. In Irene’s case, her love towards mathematics as a unique exclusive subject, positive relationships as well as instrumental relationships are apparent, though not so much as to helping in daily hassles, but as to developing the entire personality and, especially, cognitive processes.

... yet mathematics is a queen, and my great wish is to serve the queen, not to the science, just helping other sciences to process data or likewise. Mathematics is too beautiful to be just a supplementary aid, it is not enough to see it as conceived just for some practical purpose. (Irene)

As for Elsa, the instrumental relationship with mathematics is particularly strong, though. It serves more as a general coping strategy in life. Her overall emotional attitude towards mathematics is ambivalent and changing.

These perspectives coincide with the conclusions drawn by Kaasila et al. (2006) that different views about mathematics may be explained by the socially emotional orientation and coping strategies of research participants. Hence, the common theme for all three teachers was instrumental relationships with mathematics, although using it for different purposes: to solve professional and life situations, to develop cognitive skills and the entire personality or to aid as a psychological coping strategy. None of the teachers admitted to negative relationships with mathematics regardless of mentioned hardships while learning or teaching it.

Competence as learners and teachers of mathematics. Many authors (Anderson, 2007; Gee, 2001; Wenger, 1998) stress the main role of self-recognised and socially acknowledged competence as learners and teachers of mathematics in the construction of mathematics identity for teachers and students. Although the interviewer did not ask direct questions about the teachers’ mathematical competence, an analysis of the transcripts reveal it as a very small detail, yet showing significant variations in this area. Di Martino and Zan (2010) observe patterns in the essays of students that lowly perceived competence often correlated with an instrumental vision of mathematics. Similar patterns are noticed in the teachers’ interviews: those teachers whose answers revealed competence perceived comparatively lower focused their narratives on an instrumental vision of mathematics at a larger extent. Ann’s answers show an alternating level of perceived competence: a solid confidence at primary school, some hardships with mathematics during secondary school and university, complemented with attempts to justify these hardships mainly by external factors (for instance, overly theoretical studies at university). The high level of self-recognised and socially acknowledged competence was noticed in
Irene’s narrative, dovetailing with her love for mathematics as an exclusive science. As for Elsa, it seems that her pattern somewhat matches with that of Ann, showing confidence at primary school and some problems at secondary school and university.

In primary school, I had a teacher who was very clear in her instructions. I had only the highest marks. The teacher explained to us (the material), and, probably, because of my auditory memory, I could literally repeat everything in an hour or three hours. Then the teacher changed, and we let things slide… I let my knowledge slide… (Elsa)

In this specific case of a vacillating level of competence, one can recognise the constant efforts to find some person or institution responsible for causing strong emotions.

Social and institutional context of learning and teaching mathematics. The societal attitude towards mathematics was evaluated by the interviewees as mostly negative since society views mathematics as a dry, unnecessary science disconnected with life. It seems that Irene’s competence in mathematics allows her to set higher expectations towards a career in mathematics that has, yet, to be fulfilled because of the unsustainable status of mathematics as a fundamental science in Latvia and lack of economical benefits of a career in mathematics. She also emphasises the unsustainability in education caused by a negative economical situation that leads to extensive migration.

Each year, I see 2 or 3 pupils in every form to go abroad. Those who intend to leave do not plan to go deep in mathematics. They think more about languages… Nowadays, thinking about mathematics is pointless… We need to think about how to raise the children abandoned by their parents (going abroad), and the majority of them will leave (the country) while at school or before or after university. (Irene)

In terms of the influence of the surrounding people, all teachers acknowledge a lack of their parents’ restrictions regarding their professional choices. In Ann’s and Elsa’s cases, strong emotional and material support from family while completing an education is evident from time to time. In Ann’s and Irene’s stories, the personalities mentioned most often are teachers at school and lecturers at university; but for Elsa, it is her father who awakened her interest in mathematics during early childhood (Swennen et al., 2008).

I remember, when I was a child, we drove as a family around a lot (in a car). My father, all the time, proposed that I do mental arithmetics: if we are driving at 40 km per hour, how much do we have to increase our speed to get to your aunt’s place or elsewhere in two hours? […] I always had to ground and explain the invented result to him. (Elsa)

Teachers’ Mathematical Identity and Other Identity Voices: Dialogical Models

To reveal what kind of dialogical models emerge for making sense of teachers’ mathematical identity in a life-long perspective, we shall turn to 1) a dialogue between the identity voices of teachers; 2) interplay of the subject, didactics and pedagogical identity (Beijaard et al., 2000) and 3) the self-motive versus the other-motive and psychological functions of elicited themes.
Dialogue between the identity voices. As the description of the sample shows, the participants had a lively bouquet of various sub-identities or identity voices. However, not all of them are reflected in the interviews, only the most salient voices surface and are elaborated in detail. For Ann, the most engaging dialogue is observable between her identities as a pedagogue and as a mathematics teacher, where a pedagogue’s identity took a dominating role.

…but, really, I wanted to become a pedagogue, definitely. In what subject – this could be played out differently. (Ann)

In all her identities, except the role of a school principal where mathematical skills help to deal with practical problems and view them from different angles, the emphasis is on non-mathematical aspects. To Ann, mastering mathematics is determined by responsibility towards learners and a wish to feel secure and confident as a teacher.

Irene stressed her desire to study mathematics at university; the pedagogical subjects in the teacher education and training programme were just a supplement to the serious mathematical courses. Her main identity voices, intertwined in a balanced dialogue, were the voices of a mathematics teacher and a mathematician. In terms of social identity theory (Turner, 1982), both Ann and Irene as mathematics teachers show notable in-group favouritism of taking pride in their identification with mathematics teachers whom they perceive as an elite subgroup of teachers. Stronger in-group favouritism is observed in Irene’s case, who cares both for the image and future of mathematics teachers and is proud of mathematics teachers of her town in the times of insecurity and threat (Voci, 2006).

Speaking about the mathematics teachers’ level of knowledge, they are elite, they know very much, they have studied a lot – 2–3 times more than all other teachers, and, now, at schools they work 2–3 times more than other teachers because to prepare for mathematics lessons is harder than to prepare for, let’s say, sports.

Because of a few ignorant teachers, all teachers have been scolded. For a long time, I could not understand why mathematics teachers have been criticised (in Latvia). When attending teachers’ professional courses, I suddenly realised that the mathematics’ teachers of our town and those coming from rural areas are two absolutely different worlds. And I do not know how to change it because nobody wants to work as a mathematics teacher in the country. (Irene)

As for Elsa, her sub-identities as a teacher and a doctoral student are entangled with deeply hidden voices of family members and women. She acknowledges her extensive quest before arriving at her current identity: initial rejection of the teaching profession, changes in professional choices (i.e., psychology, forensic medicine, teacher of chemistry and physics, teacher of IT) and experimenting with teaching elementary grades before realising that she wishes to work at primary school. Possibly, because of this quest, her identity of a mathematics teacher is not so salient and pride-evoking as it is for Ann and Irene.

Interplay of subject, didactics or pedagogical identity. The identity voice similarly important for all the interviewees was their professional identity pertaining to core
teaching aspects such as the subject matter, didactics and pedagogical expertise (Beijaard et al., 2000). For Ann, the prevalence of pedagogical and didactics expertise depicts the dominating position of her identity as a teacher.

... However, that can be with mathematics, but we need to see that we teach a person. And the teacher needs to be so intuitively wise so as not to miss the moment when mathematics becomes unattainable for the person. The person can master some basic knowledge in this field, but you should not tear him/her down to reach more. Maybe he/she will be able to deal with it somehow differently. And, maybe, this way, we would make his/her life cooler. (Ann)

In Irene’s case, the internal dialogue between the mathematician and the teacher of mathematics leads towards the expertise in the subject matter as a core aspect of her teaching, especially evident in her successful preparation of pupils for the mathematics olimpiads. For Elsa, her emerging teacher’s identity in professional terms was mostly grounded on her ideas for changing teaching methods, thus designating her expertise in didactics.

Self-motive versus the other-motive and psychological functions of themes. This facet of dialogical models is the most individualised, showing the psychological commonalities and differences of participants. Some linguistic features discovered in the narratives will also be compared to provide a hint about the personality of each teacher.

The prevalence of the other-motive over the self-motive eliciting mostly positive feelings is observed in Ann’s answers. The themes elicited from her answers are regarded as self-defense from some failures in mathematics at school and university, boosting the teachers’ self-esteem as well as showing a high level of responsibility and hiding insecurity in front of her students while expressing empathy towards them, probably caused by the ability to put herself in their situation. The terms and expressions she used most often are saturated with compliance and immersion (i.e., “a little bit”, “sniff it out”, “to work it through”, “to dig it out”). As for the use of pronouns, the usage of “we” dominates over the usage of “you”, while “I” is applied more seldom than in the answers from other teachers, also stressing the other-motive.

In Irene’s case, her self-motive, which is exposed in her strive for constant self-development, is well-balanced with the other-motive (identification with mathematics teachers, care for children’s future lives etc.). However, if the self-motive elicited mostly positive feelings, the other-motive produced the ambivalent affection that is discernible in the psychological functions of her themes. In these themes, in the same manner as Ann, Irene boosts her self-esteem by reflecting on her past achievements, but her disappointed mood is revealed in her disillusionment about the educational system and economical benefits of the chosen discipline and in her critique of conservative teachers and administration avoiding the self-development and intolerance towards lazy learners. The term used more often was “tricky”, while the use of the pronoun “I” dominated over the use of the pronoun “we”.

In turn, Elsa’s self-motive dominates over her other-motive, and both motives arouse ambivalent feelings. The themes noticed in her reflections, even to a greater degree in comparison with Ann, serve as self-defense as for her failure of mathematics at school and university, though sticking to external attribution. Similary, as in Ann’s and Irene’s cases, this helped her to build up her self-esteem; only in her case, it is with the help of
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external factors. Elsa’s other-motive is significantly dominated by the critique of her own teachers, both the educational system in general and some specific aspects of it. However, the positive relationship with her father, taking pride in a “top level” commission on the graduation examination, “showing off” her mathematical skills in front of handsome boys at school and helping a lawyer to solve a simple mathematical problem disclosed the masculine and power-related discourse of her identity construction process. Such terms as “awful/awfully” and “dear” when addressing somebody were used quite often, and, similarly as in Irene’s case, the usage of “I” dominated over the usage of “we” and “you”.

The relationships between the self-motive and the other-motive can be included in a list of features to illustrate a person’s orientation towards sustainability, and it seems that a permanent domination of the self-motive would lead to unsustainable relationships with the surrounding world and specific areas of knowledge. According to Linde (1993), defending one’s self through explanations is an important part of any type of autobiography. Kaasila et al. (2006) found that the largest number of explanations in stories of pre-service teachers regress to negative views of mathematics. Although none of the interviewed teachers expressed a negative view of mathematics, as in the study by Kaasila et al. (2006), we encountered a lot of explanations as well as critical views.

Teachers’ Mathematical Identity and Their Perception of Students’ Mathematical Philia/Phobia: Looking for Interactive Patterns

The non-traditional aspect of the analysis was the cross-checking for the coherence or collisions between the teachers’ mathematical identity and the way they see mathematical philia and phobia in their students. For each teacher, we shall define their pedagogical “slogan”, the main approaches to deal with the mentioned issue, possible causes for these approaches found in their past experience and a direction of their critique.

Ann’s pedagogical ‘slogan’ sounds like this: The key value – a person, not mathematics. She sticks to a humanistic approach (freedom, avoiding pressure, respect for diversity, humane attitude, dignity, responsibility for the learners’ path of life, pedagogical optimism, cautious teaching methods) and instrumental interpretation of mathematics and its teaching methods (practical applicability in life, a career, gradualness/a spiral approach), not to the excellence in mathematics at any cost. Ann feels great satisfaction from pedagogical work and being accepted as she is.

In the morning, I go to the class in total turmoil and with conflicts inside, and then, in a moment, I see the children, and all these conflicts fade away and in three minutes. I do no recall any of the things that bothered me. I have this specific situation, all these specific people who need me exactly as I am and everything happens. (Ann)

She votes for stability, consistency in teaching and suggests that greater efforts can gradually build the learners’ motivation.

The roots of this approach can be traced back to the very friendly classmates at school, sincere and understanding teachers at school and university as well as the fact that she was not forced to choose mathematics for her career or to master mathematics at a high level. This approach coincides with her positive instrumental relationships...
with mathematics and general positive socially emotional orientation. Since Ann encountered some trouble with mathematics at school and university, it is more natural for her to feel empathy towards all learners having some problems with mathematics. With a dominating teacher’s identity (and) having strong didactical and pedagogical expertise, she lays emphasis on her pupils’ achievements as well as on their life quality, not that much on the subject matter. At the same time, she suggests the gradualness and placing efforts in dealing with mathematical tasks as she admits her own fighting spirit and perseverance dealing with hardships. Ann is strongly convinced about mathematics as a subject securing the learners’ future life and takes pride in her ability to use mathematics in different identity positions (working as a principal, a teacher at school, university, writing textbooks etc.). Her answers do not contain the pupils’ critique, while the required performance of teachers is described at length.

Irene’s pedagogical message can be regarded as a self-actualisation, achieving success through hard work. She lays emphasis on continuous educators’ self-development, individual learners’ psychological peculiarities, the roles of surrounding people, hard work and perseverance. Although she admits that the main goal of education is to find oneself, not necessarily to master mathematics, her own success has been connected with her love towards mathematics, overcoming the difficulties and reaching a high competence in it. Irene discerns the causes of mathematical phobia related to both internal factors (learning difficulties, laziness, lack of regular practice, a wish for immediate results etc.) and external factors (learning for exams or for parents, parents’ hindrance of children’s self-esteem in mathematics etc.). To ensure philia of mathematics, Irene suggests perceiving mathematics as a hobby. Regarding the teacher’s performance, she lays emphasis on clear instructions and a positive attitude towards children, a need to instill love of mathematics in her pupils (Rameau & Louime, 2007).

Irene’s expertise as a mathematics teacher is high, and her life story is interspersed with challenges and the thrill of overcoming difficulties with mathematics, creating a kind of addiction to success.

If you succeed in mathematics, your psychology changes. You want to reach the same outcome again, then even a more significant one, then you understand that you change. Probably, mathematics changes the entire person, his/her way of thinking, the whole process of thinking. The first time success in an olympiad or some difficult test make you think that you are special and that not everybody can do this, and this self-confidence changes your life. (Irene)

Changes in her self-esteem and the entire personality have occurred not only through hard work and accomplishments, but also because of her openness, curiosity and a critical mind. Pupils’ and their parents’ as well as other mathematics teachers’ critique is noticeable in the texture of Irene’s answers, though the teacher’s positive input is emphasised more.

The major challenge observable in Elsa’s life story is a matter of attribution of achievements and failures in mathematics. Are they caused by external or internal factors? She calls for radical changes in the Latvian educational system/structure, ensuring the adequate function of both external factors (parental influence, material resources, standards etc.) and internal factors (the development of learners’ cognitive strategies, a possibility to use mathematics to deal with real-life problems etc.). Unlike Irene, Elsa does not speak so much about the necessary changes in teachers and herself. The main
transformational emphasis is on the factors external to her as a person or the entire professional group of teachers, protecting her self-motive. Speaking about pupils’ learning, she looks at cognitive factors, such as thinking strategies, discovery approaches, development of algorithms, from an affective point of view. She also talks about a rising interest towards the application of mathematics in real life, such as taking pleasure in doing sums, developing a humane attitude, as well as an opportunity for the learner’s individual expression. She also criticises parents for their influence on pupils’ external motivation and for attribution of their children’s failure to heredity, overemphasising the fourth face of mathematical identity – nature (Anderson, 2007).

I wonder how it is possible that a parent can come to me and, in front of her child, announce, “You know, I have never understood mathematics, and my child will not understand it.” And the child sits there and listens, and he is given the green light not to understand mathematics because of his mother. And, then, I am telling her, “Imagine, you will need to look for a special school for your grandchildren since learning difficulties will progress, not regress, with each generation. (Elsa)

In Elsa’s case, it is evident that her tale about the love of mathematics in childhood because of her father and her disappointment later in life at not being able to restore these loving relationships at the same rate call for some explanation and defence. She actively criticises her teachers, her pupils’ parents, the school environment; she is probably instinctively aware of her own difficulties with mathematics. However, she is quite approving towards her father’s individualised, but authoritarian pedagogical approach, as it formed her strategies of logical thinking and fostered her love of arithemtics. In her work with learners, she is trying to mould similar strategies, speaking in favour of rather individualised approaches. Elsa’s answers contain a critique of diverse factors external to the teacher: pupils, parents, school system etc.

Dialogical Models and Interactive Patterns: Alignment with the Competences for Educators in ESD

To see how the revealed dialogical models of teachers’ identity and their pedagogical theories align with the educators’ competences in ESD, we examined the detailed table of educators’ competences (UNECE, 2011) and summarised the parts and elements of table corresponding to the approaches explicitly or implicitly encountered in the interviews. Eventually, the three teachers’ approaches coincide with the third feature of ESD, namely, achieving transformation in teachers, learners, pedagogy and educational systems. The strongest association with this feature is noticed in Ann’s humanistic theories and Elsa’s critical outlook for unsustainability around her. It is observed in Irene’s subject-oriented pedagogy. In the text, the competences, as included in the UNECE document, are italicised.

All three teachers, from the position of critically reflective practitioner, both in their dialogical models of identity and pedagogical mentality, enounced how engagement in real-world issues enhances learning and makes difference in practice.

We need to do it a little bit differently. There should be some real possibility to apply what you know, a possibility to direct your mathematical knowledge
to be able to engage in some entrepreneurship and mathematically calculate your business activities. We (as society) lack this initiative ... to be responsible for something from the beginning to the end. (Ann)

Several competences for ESD were exposed by two of the teachers: for instance, both Ann and Elsa show understanding of a need to transform the way we educate/learn and demonstrate their attempts to facilitate participatory and learner-centred education that develops critical thinking and active citizenship.

I have a very good game related to the theory of probability that grounds the games of chance ... [describes the collective game with candies]. And pupils are so extremely excited about this game, and they say, “Thank you, teacher, for this lesson. Now I shall not buy lottery tickets at all!” Afterwards, we work on this theory of probability, and children grasp it easily. They are interested. They come to me with single-handedly calculated enormous figures, and they are so delighted: teacher, can you imagine such a probability! (Elsa)

In her answers, Ann revealed the importance of building on the experience of learners as a basis for transformation, perceiving herself as a facilitator and a participant in the learning process when she told about her learning together with her pupils at school and students at university. As it was already mentioned, her interactive pedagogical model emphasised the necessity for the engagement with learners in the ways that build positive relationships more often than the two other teachers. As for Ann’s point of view in the context of ESD is concerned, it can be stated that such an approach does not reach beyond the anthropocentric horizon of humanity as an ultimate aim; however, the social orientation – all for humans – could serve as an initial point of sustainability, which is clearly better than pure selfishness or egocentrism (Salóte & Pipere, 2006). Possibly, overall respect towards external entities, in this case another person, will lay the foundation for reaching the aims of sustainable development to ensure an individual’s qualitative and sustainable interaction with the social, cultural and natural world.

Elsa’s answers, in their turn, contained a strong wish to challenge assumptions underlying unsustainable practice. Synthesising her approach, it should be admitted that search for unsustainable practices and active critique of the surrounding world are positive goals to encourage further development, but only if we are able to complement this with adequate self-analysis, self-criticism and a quest towards the changes in ourselves.

In Irene’s case, we also found a stronger social orientation and motivation to make a positive contribution to other people and their social and natural environment, both locally and globally, which is included in the section of ESD competences related to envisioning change. In general, the interviewed teachers want to transform something or somebody. Their transformations implicitly suggested the aim of mastering the subject to use it in life or to develop specific skills or even a mathematician personality; however, the meta-content or meta-message (Salite, Gedžüne, & Gedžüne, 2009; Sund & Wickman, 2011) regarding sustainability are not so evident.
Conclusions

In this paper, we have presented an extensive qualitative study aimed to explore mathematics teachers’ mathematical identity by utilising dialogical models of teachers’ relationships with mathematics. Interactive patterns emerged between this identity and teachers’ perception of factors influencing the mathematic philia/phobia of their students. These models and patterns are also explored in relation to the competences for ESD educators in order to verify possible evidence of these competences in the answers from teachers as a meta-content implicated in motivations, values and main discourses.

We summarised the findings in relation to each research question framed as much as possible for a phenomenological study valued for the richness of specific details. Each question and its interpretation can serve as a foundation for further inquiry to be based. The common theme of teachers’ mathematics identity was their instrumental relationships with mathematics using it to solve their professional and life situations, to develop cognitive skills and the entire personality or to aid as a psychological coping strategy. As nuanced as they were, none of the answers expose clear negative relationships with mathematics notwithstanding the differences in the obtained level of competence. However, competence perceived comparatively lower is related to the instrumental vision of mathematics to a large extent. In general, a generally negative societal attitude towards mathematics and a positive impact of the family and surrounding people on the choices, interests and the teachers’ identity development were reported.

The dialogical models, emerged in relation to the teachers’ mathematical identity, show how different life experiences can lead to different identity voices surfacing in the interviews: for one teacher it was a domination of a pedagogue’s identity over the identity of a mathematics teacher; for another, it was a balanced dialogue between the voices of a mathematics teacher and a mathematician while, in the third case, we can speak about the sub-identities of a teacher and a doctoral student entangled with several other hidden voices. The interviews also contain striking in-group favouritism of mathematics teachers, taking pride in their self-identification with this specific group perceived as an elite subgroup of teachers. The most salient identity voices guiding the dialogical processes become apparent as the priorities in the area of teachers’ professional expertise: one teacher appears to be an expert in pedagogy and didactics, another – in the subject matter and the other – in didactics. Interestingly enough, the accounts of the three teachers contain all possible variations of relationships between the other-motive and the self-motive. For the placidly-oriented expert in pedagogy and didactics, the prevalence of the other-motive over the self-motive elicited mostly positive feelings. For the subject expert, with her strive for self-development, the self-motive was balanced with the other-motive, and the self-motive elicited mostly positive feelings while the other-motive elicited contending passions. For the didactics expert, with a strong inclination towards self-defence, the self-motive dominated over the other-motive arousing ambivalent feelings. These uncommon entanglements ask for a deeper investigation although we already could question the sustainability of the dominance of the self-motive for the teacher. As in several other studies (Bainger, 2011; Kaasila, 2007), this study also reveals a serious drive towards defending the self through explanations. Furthermore, the elaboration, orientation and content of these explanations differed in each account.

The patterns displaying the interaction of the teachers’ mathematical identity and their perception of learners’ mathematical philia/phobia included, for instance, a
humanistic approach and their instrumental interpretation of mathematics and its teaching methods as practised by the teacher with expertise in pedagogy and didactics having a dominating teacher’s identity, the other-motive and positive affective orientation. She did not emphasise mathematics as the development of motivation and life quality of the learner so much and kept avoiding serious critique towards any subject, yet, still, illustrating the required professionalism of teachers.

The life story of the other teacher is full of excitement and explanations of challenges dealing with difficulties in mathematics and arriving at success that requires relentless development to reach. Being a mathematician deep in her heart and having strong expertise in the subject matter, she summons towards self-actualisation of achieving success through hard work, stressing the need for an educator’s continuous self-development and knowledge of students’ individual psychological peculiarities. Although she affords to critique pupils, parents and teachers of mathematics, the positive input of teachers is also recognised.

As for the third teacher, she struggles with the dilemmatic issue of attribution of failure in mathematics either to external or internal factors. It is especially hard for her because of her emergent mathematics teacher’s identity that tries to find its place among the other identity voices, with dominance of the self-motive and a lower perceived level of mathematical competence. After all, positioning herself as an expert in didactics, she deviates from the required changes in mathematics teachers or herself as a teacher by actively and elaborately criticising and calling for transformation of the factors that are external for her or her current professional group, such as her own teachers, pupils, parents and the school environment.

The hallmarks embedded in the biographical reflections of experienced teachers show partial alignment between the dialogical models and the interactive patterns found in the accounts of teachers and competences for educators in ESD mandated by UNECE. Remarkably, all three teachers emphasised the sole feature of ESD competences for teachers: achieving transformation in educators, pedagogy and educational systems in all aspects of learning to know, learning to do and learning to be (UNECE, 2011). As critically reflective practitioners, they all reported the connections between knowledge and its practical application for life issues and acknowledged their wish to transform education, facilitate participatory and learner-centred education towards developing higher-order thinking. Some of the teachers reported on the transformation based on their experience as learners, perceiving themselves as facilitators and participants in the learning process. Moreover, positive relationships with learners, challenging assumptions that underly unsustainable practice and motivation to make a positive contribution to other people were noticed. All in all, the life experiences of all interviewed teachers created the transformative disposition of their mathematics identity although, in the context of sustainability, this disposition lacks the meta-orientation towards higher-order goals rising above mastering the subject matter as a simple tool to improve one’s own life and oneself. Among others, one strength of this qualitative research could be its tactical and catalytical authenticity (Guba & Lincoln, 1989), envisaging that engagement in extensive collaborative professional reflection could lead to the teachers’ personal and collective growth and, therefore, to changes in teachers’ practices.

We conclude with a reflection on the limitations of the present study. They include: 1) a small sample that is typical for IPA studies and, therefore, the contextual nature of obtained data; 2) situational bias related to the emotional and cognitive context of the
teacher on the day of the interview; 3) social desirability or wish to present themselves in a more positive light to the researcher; 4) some psychological issues (for instance, self-esteem, personal and professional insecurities) impinge on the content and form of participants’ verbal expressions during the interview (Bainger, 2011). However, at least in terms of generalisation, it is not a serious issue as IPA does not claim to create general or grand theories (Smith et al., 2010). One more limitation, especially visible in the case of IPA, concerns the fact that the analysis of the results is influenced by “the researcher herself; her own experiences in the field, her beliefs, biases, tolerances, prejudices, preconceptions and motivations” (Bainger, 2011, p.33). This issue was partly dealt with by using the integrative point of view from two independent researchers during the data analysis and interpretation. Due to space constrains, only some of the most important facets of analysis and quotes from the interviews are included in this paper.

To use the qualitative study in other contexts, replication needs to be wisely adapted to the local circumstances. The results of this study provide some implications for practice, at least on the Latvian scale. Initially, implementers of the ESD competences for teachers would utilise already existent aspects of transformation, within any sphere of educators’ competence, as the grounds for implementation of two other features: a holistic approach and envisioning change. Strong in-group favouritism of mathematics teachers would be a good sign for the educators of future mathematics teachers to recruit new students into these programmes, demonstrating excellent professional role models and attesting to the high professional status of mathematics teachers. Teachers’ pedagogical theories explaining students’ mathematical phobia and philia can be used by designers of teacher education programmes and by mathematics teachers’ educators to show future teachers the potential diversity of approaches and emphasise their explicitly contextual nature. To conclude, these findings state a suggestion for educational philosophers and politicians to consider an appropriate immediate aim for all stakeholders in education in order to enhance its share in the sustainable future. Another option would be to stress the importance of specific areas of knowledge in order to create a sustainable society and realise an individual learner’s achievements in a particular area as a prerequisite of personality development.

This study calls for further research using the theory of dialogical self in the area of teacher education and empirically observing the correspondence between the existing competences of teachers and the ESD competences constructed by UNECE, which seem more like an ultimate aim to be adapted for the current situation. This area needs a more profound and detailed research, employing also quantitative approaches to grasp the ways in which teachers’ mathematical identity can influence their students’ mathematical identity and, ultimately, not only their achievements in mathematics, but also their life skills, cognitive strategies and the development of personality. It would be useful to conduct further research to reveal and compare the general attitude towards mathematics in different social groups not connected with mathematics in their professional or daily activities. Another avenue of inquiry is the integration of ESD competences in in-service and pre-service teacher education programmes on local and global levels.

Transformation is not an easy job and asks for the right tools and proper virtues. Stinson (2009), in his qualitative self-reflective dissertation about the mathematics teachers’ journey of identity construction, stresses the power of self-examination in constructing his identity and points to the “humility, desire, courage, and honesty necessary for change” (Stinson, 2009, p. 5). Ultimately, this study is not so much about grasping
some school subject’s content as about our prospects to reach sustainability during our lives in the immediate and distant future, or not at all. Yet, we would like to ask: What kind of teacher would you choose to master mathematics with?

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Appendix

Mathematics and its meaning (general context)
1. What is mathematics? What concepts, images and associations come to your mind?
2. What do you feel when you are doing or teaching mathematics, or carrying research on the issues related to mathematics?

Doing mathematics: social, institutional and self-evaluation
1. How did/do your contemporaries perceive you as a university student of mathematics, a teacher of mathematics, an author of teaching aids, a researcher in the field of mathematics?
2. How did/do you perceive it?
3. How does society in Latvia perceive doing mathematics in present economic conditions (before the crisis and during the crisis)?

Relationships with mathematics from different social positions
1. Please, characterise your personal relationships with mathematics beginning from the kindergarten/school until the present moment.
2. What changes happened in your personal relationships with mathematics due to changes in your social positions (a pupil, a university student, a teacher, a doctoral student, a university teacher etc.)?
3. Which positions brought the largest changes in your relationships with mathematics?
4. What factors had the strongest impact on these changes?

Mathematical philia and phobia: Concept, causes, fostering/impeding factors
1. How could you comment on mathematical philia/phobia?
2. Suggest the causes of your own mathematical philia (or phobia).
3. Characterise mathematical philia/phobia in your social surroundings and institutional context (your classmates, group mates, colleagues, subordinates, students, scientific advisors, colleagues in doctoral studies etc.).
4. What factors did you notice as eliciting their specific attitude towards mathematics?
5. What would you suggest sustaining the mathematical philia and avoiding the mathematical phobia for mathematic learners at different levels?
6. What are you future plans and intentions in relation to mathematics?
Environmental Issues in the Media – Students’ Perceptions in the Three Nordic-Baltic Countries

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Abstract

The media, as a source of information, is supposed to have a significant role in effecting people’s environmental knowledge and attitudes. The purpose of this study was to find students’ perceptions of environmental issues as presented in the media and how students in Finland, Lithuania and Sweden used these media sources in the matters related to environmental issues. The most important source of environmental knowledge was found to be the Internet, followed by newspapers, television, school and education. In their own lives, students discussed environmental issues every day and, to some extent, in social media, discussion forums and blogs. In Finland, newspapers represented the most important source of environmental knowledge; in Lithuania, environmental organisations were the most prevalent, and, in Sweden, it was in a school or educational context. Based on these results, it was concluded that, in order to reach both genders of students in different countries and to more greatly benefit from all sources of information, a variety of media should be used in education for sustainability.

Keywords: higher education, sources of environmental knowledge, educational use of media, environmental issues
Introduction

In the rapidly changing information-based media society, media literacy is becoming increasingly important. Media literacy can be defined as the ability to create meaning from verbal and visual symbols; to choose, question and criticise the information created. It is a skill, a process and a way of thinking (Hansen, 2010; Nurminen, 2001). Much of what most people hear about various issues, such as the greenhouse effect, global warming, ozone depletion, water and air pollution and environmental threats, is likely to come from the media (Esa, 2010; Khalid, 2003). Nurminen (2001) states that the interpretation of media is culturally bound and depends on what individuals have previously experienced.

The mass media range from entertainment to the news media, spanning television, films, books, flyers, newspapers, magazines, radio and the Internet. It can also include publishers, editors, journalists and others who produce, interpret and disseminate information through these tools (Boykoff, 2009). In the 1970s and 1980s, television was the main source of information for both the general public as well as for pupils (Fortner & Lyon, 1985; Ostman & Parker, 1986). This continued up into 2000s (Lewis, 2008). The new media such as the Internet, for instance, have changed students’ culture in relation to information. For Finns under 35, for instance, the Internet is nowadays the most followed news channel (Finnish Communications Regulatory Authority [FICORA], 2011).

With relation to social media, for instance, about 15% of American young adults (ages 12–29) are bloggers; adults of 18 upwards use Twitter, but teenagers (aged 12–17) do not use it in large numbers. Facebook has taken over as the social network of choice, and 73% of adult profile owners use it (Lenhart, Pursell, Smith, & Zickuhr, 2010). However, American university students anticipated that in the future, less of their news and information would be gathered from social networking and more from traditional news sources (Lewis, 2008).

There are a number of studies that attempt to explain the characteristics of young peoples’ environmental knowledge in relation to the effect of the media (Rickinson, 2001). Differences between students’ environmental knowledge are often discussed in terms of the differences in media coverage in varying geographical places. Misunderstandings, evident in students’ thinking about environmental issues, are commonly attributed to the nature of media-provided information. Although studies have tended to focus mostly on secondary school pupils, there are also studies on primary school children (Rickinson, 2001). Relatively few studies (Kukkonen, Kärkkäinen, & Keinonen, 2012) have discussed the sources of environmental knowledge among higher education students.

The aim of this study is to analyse university students’ use of media as a source of environmental knowledge. There has been little discussion about students’ use of media in their studies, particularly in the context of education for sustainability. This being the case, we particularly focused on these questions and concentrated on university students from three different countries. Our goal is to identify from which the media the students primarily obtained information concerning environmental issues and how they used it in learning and teaching.

The following research questions guided this study:

1. What media do students use to get information about environmental issues?
2. How do students use the Internet in discussion about environmental issues?
3. How do students use the media in education in relation to environmental issues?
4. How important do students perceive environmental information obtained from the media to be in relation to their own perception of environmental issues?
5. What kind of similarities and differences can be found between the Nordic-Baltic countries?
6. What kind of similarities and differences can be found between female and male students considering their use and perceptions of the media in relation to environmental issues?

Sources of Environmental Knowledge

Environmental knowledge most frequently comes from the media (Asunta, 2003; Boykoff, 2009; Lee, 2008). Television and radio were found to be the main sources of information for Finnish pupils aged 12–15; next in priority were the science teachers, newspapers and magazines, parents, other pupils and the Internet. After these sources came movies, friends, conservation organisations, Greenpeace or World Wide Fund for Nature (WWF), municipalities and consumer organisations. In regard to environmental problems, most Finnish pupils had more trust in the information they got from television than from what their science teachers had told them. They also seemed to have more trust in newspapers and the Internet as knowledge sources than did the German pupils. 10% of Finnish pupils and 7.6% of the German pupils taking part in the research gained their information about environmental issues through the Internet. Importantly, as the role of the Internet has grown, the role of television, radio, newspapers and parents, has noticeably diminished. The older the pupils are, the more meaning the Internet has for them (Asunta, 2003).

The most popular form of media among young Hungarian people aged 13–17 was found to be television and the Internet (Katona, Kárász, & Leskó, 2008). Predictably, films on nature and documentaries were not as popular as music TV, serials and cartoons. Significantly, however, when students were asked what they thought about environmentally related programmes on television, about a third of the students thought that there should be more of them. However, the printed media on environmental issues such as local and international nature journals were not popular at all. Only a few students said that they read these, and most of them did not even know they existed. While most students thought that the media did affect their environmental awareness, they did not know whether the effect was positive or negative (Katona et al., 2008).

Recently, Finnish university students’ main sources of information about environmental issues were found to be television, newspapers and the Internet; the role of these was about the same (Kukkonen et al., 2012). Television was also the college students’ major source of information on environmental news concerning local, national and global environmental problems (Lee, 2008). The Internet was the second one, and daily newspapers and government sources were the students’ least used sources. In relation to local and national issues, the third source was family and friends, although, concerning global issues, multiple sources were used (Lacy, Riffe, & Varouhakis, 2007; Lee, 2008).

The growth of the Internet may well be reshaping patterns of media use. At the global level, respondents who used the Internet were most likely to use television news as an additional environmental news source (Lacy et al., 2007). Riffe and Reimold (2008) referred to the increasingly potential role for the Internet to serve as an environ-
mental news source, especially for young people, as well as for environmental news on a national and international scale. The Internet was more frequently cited as being the most useful environmental news source for the youngest respondents (18–24 year-olds). However, based on their study, Riffe and Reimold (2008) also agreed that, even in the Internet Age, newspapers are significant for delivering more localised environmental news and information; television is still the primary news source for young people.

**Media in Education for Sustainability**

In education for sustainability, the media have been used in several ways. Newspaper articles have been published on environmental issues, and these have been used in schools, although newspapers do not appear as a particularly attractive resource because they are typically printed in black and white (Jarman & McClune, 2004). Nature documentaries with pictures, sounds, sources and information about natural environments are more attractive and have been used to enhance environmental sensitivity (Barbas, Paraskevopoulos, & Stamou, 2009; Bahk, 2010). The non-verbal, less conventional documentary is more effective in the development of environmental knowledge and feelings, but equally effective in changing attitudes and beliefs as those that are verbal and ‘traditional’ (Barbas et al., 2009). Harness and Drossman (2011) reported on a filmmaking project in which students produced two short documentary films: one on recycling and the other one on water conservation. The project promoted students’ awareness of environmental issues and increased their environmental literacy. In the case of television, there is a clear differentiation between the direct effects on pro-environmental behaviour of factual-based, versus fictional-based television use, factual-based television use being a significant positive predictor of the criterion variable (Holbert, Kwak, & Shah, 2003). According to Shanahan, Morgan and Stenbjerre (1997), there is essentially no bivariate relationship between television viewing and perceptions of specific threats to the environment such as industrial air pollution or greenhouse effect.

Video presentations have widely been used to facilitate sustainable behaviour, especially in the context of conservation. Regarding the orangutan, Pearson, Dorrian and Litchfield (2011) used visual media to increase knowledge, attitudes and conservation behaviour amongst university students. Using knowledge-based and emotive educational presentation available through the Internet, they found some change in students’ behaviour. Conversely, the film “Sharkwater” attempted to negotiate many different problems encountered in the effort to raise an appropriate awareness of environmental issues and to stimulate active engagement in the solution of problems (Hughes, 2011). The employment of video podcasts was also used to support learning and teaching about exotic ecosystems. As the students were able to watch video podcasts as often and whenever they wanted, they preferred to watch podcasts at home and make notes at the same time (Hill & Nelson, 2011). In the undergraduate field course, Roberts (2011) found that the video diary technique was more successful in capturing the development of students’ sustainability-related learning than written reflective accounts.

Perhaps, the most well-known film concerning environmental issues is entitled “An Inconvenient Truth”. Several countries have even proposed using the film as an educational tool in school classrooms (Nolan, 2010). Watching this film increases knowledge about the causes of global warming, concern for the environment and willingness to
reduce greenhouse gases. This willingness to take action immediately following movie viewing does not, however, necessarily translate into action later (Nolan, 2010). The cinema/movie has also been used as a part of a larger community communication project regarding conservation of the wolf (Bizerril, Soares, & Santos, 2011). With rural communities, using a traveling cinema as an educational tool presented a number of very positive results, the main one being its ability to bring people together, and the whole process involved an increase in affectivity and knowledge. The educational potential of photographs has been studied, and it has been suggested that a discursive use of photographs could be used for conservation purposes (Farnsworth, 2011).

Today, the Net Generation’s learning needs demand that educators find innovative ways to teach. Arnold (2011) states that this Net Generation often prefer autonomy when shaping learning experiences, along with the flourish of collaborative learning, the value of online education and enjoying investigative learning that requires extracting information from many sources, in addition to embracing technological innovation, readily asserting opinions, easily using the network and rejecting delayed gratification. In higher education, blogging, online journalism, in which individuals record their learning process on a webpage, has been used in several contexts (Ellison & Wu, 2008; Halic, Lee, Paulus, & Spence, 2010; Kukkonen, Kärkkäinen, Valtonen, & Keinonen, 2011). Facebook has been used as a forum for stories and discussion about news concerning post climate change and using information taken from other websites (Robelia, Greenhow, & Burton, 2011). According to Robelia et al. (2011), people using this social networking application demonstrate an above-average knowledge of climate change science as well as self-reported environmental behaviour that increases during young people’s involvement with the Facebook application.

Method

Participants

The participants were comprised of 429 students from three different countries: Finland (n=307), Lithuania (n=59) and Sweden (n=63). The main group of students were pre-service teachers (55.7% of the whole sample), and 75.1% of the participants were female (Table 1). 31.9% of the students were less than 22 years old, 29.6% were aged 22–24, 11.4% were aged 25–26 and 26.6% were over 26 years. Almost half of the students (46.9%) had grown up in rural areas, 24.9% – in a small town (under 50,000 inhabitants), 14% – in a medium sized city (50,000–100,000 inhabitants) and 14.2% – in big cities (over 100,000 inhabitants).

Table 1

<table>
<thead>
<tr>
<th>Study Programme</th>
<th>Gender</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Subtotal</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>n (%)</td>
<td>Count</td>
<td>n (%)</td>
<td>Count</td>
</tr>
<tr>
<td>Teacher Programmes</td>
<td>51</td>
<td>48</td>
<td>253</td>
<td>79</td>
<td>304</td>
</tr>
<tr>
<td>Other Programmes (Social Science, Engineering, Forest Science)</td>
<td>56</td>
<td>52</td>
<td>69</td>
<td>21</td>
<td>125</td>
</tr>
<tr>
<td>Subtotal</td>
<td>107</td>
<td>100</td>
<td>322</td>
<td>100</td>
<td>429</td>
</tr>
</tbody>
</table>
Data Collection

This study is both quantitative and qualitative in nature. Data was collected through an internet-based or paper questionnaire that contained a total of 21 questions. This involved both multiple choice and open-ended questions. In 2010, a pilot study of 63 students was made; the questionnaire was tested and subsequently reformed for use in this study.

The questionnaire began by asking for demographic information; namely, the university, study programme, gender, age, how many years of studies and where the participants had grown up. The English questionnaire, which had been developed by the researchers, was translated into the three different languages (Finnish, Lithuanian and Swedish). The Swedish version was used both in Sweden and in the Swedish speaking area in Finland; the rest of the Finnish participants answered using the Finnish version of the internet-based questionnaire. Data was collected from three different Finnish universities and from one university in Sweden and Lithuania, respectively. Lithuanian pre-service teachers were able to answer the questionnaire in a computer classroom. In one of the Finnish universities, students were given the opportunity to answer the questionnaire during the lectures. It took 15 to 30 minutes for students to fill in the questionnaire. Data collection took place in the winter of 2012. In this paper, we report the findings related to 7 of the questions, and the questions are shown in Table 2.

All the participants in the study were informed about the study; the participation was voluntary, and the questionnaires were completely anonymously. The empirical data was available only for the researchers on the project.

Table 2
The Seven Questions Asked and Reported in This Study and the Multiple-Choice Alternatives

<table>
<thead>
<tr>
<th>No</th>
<th>Question</th>
<th>Response form and alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Have you used information from the media for environmental issues in school or educational courses?</td>
<td>Examples</td>
</tr>
<tr>
<td>2</td>
<td>Where do you get information about environmental issues from?</td>
<td>Newspapers; the Internet; radio; television (including the Internet-television); journals/ magazines; books; information pamphlets; political parties; friends; family; school; environmental organisations etc.</td>
</tr>
<tr>
<td>3</td>
<td>Write the names of the three types of media you most often use, when you get information about environmental issues.</td>
<td>Open answer</td>
</tr>
<tr>
<td>4</td>
<td>Do you discuss environmental issues?</td>
<td>Every day; once a week; once a month; seldom or never; in real life; on social media; on a blog; on a discussion forum etc.</td>
</tr>
<tr>
<td>5</td>
<td>If you discuss environmental issues in social media, which environmentally related topics do you discuss?</td>
<td>Environmental problems; sustainable lifestyle issues; technology and environment; man-nature relationship etc.</td>
</tr>
</tbody>
</table>

Sequel to Table 2 see on p. 38.
Sequel to Table 2.

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>How important is the information you get from the media for your</td>
<td>Open answer</td>
</tr>
<tr>
<td></td>
<td>own perception of the environmental issues mentioned in the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>preceding question?</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>What kind of source do you find the most reliable as far as</td>
<td>Newspapers; the Internet; radio; television (including the</td>
</tr>
<tr>
<td></td>
<td>information about environmental issues is concerned?</td>
<td>Internet-television); journals/magazines; books; information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pamphlets; political parties; friends; family; school; environmental</td>
</tr>
<tr>
<td></td>
<td></td>
<td>organisations etc.</td>
</tr>
</tbody>
</table>

Analysis

The analysis focused on the ranking of the most important sources used by the students relating to environmental issues as well as the students’ educational use of media. Due to the nature of the variables, the chi-square test was used. A scheme for coding the open answers was data-based, developed by one research institute and refined by the others. The result was a manual for constructing categories from the open answers, and each answer was read through by at least two researchers to ensure reliability in the interpretation and coding. An exception was made concerning the Lithuanian responses as only one researcher understood this language.

Results

In the following chapters, the descriptive statistics and frequencies will be shown to present how students generally used the media and how they used it in education. A comparison between countries, females and males will also be shown.

Forms of Media Used by Students to Get Information about Environmental Issues

Students’ most important source of environmental knowledge was the Internet, and newspapers, including the web versions of them, were sources of secondary importance (Figure 1). The next most important sources were television, including the Internet-television, school education and journals. The role of blogs, Facebook, Twitter and emailing lists was very insignificant in terms of priority. However, according to the students, as a source of information, the Internet was five times more important than books.

In the open questions, when students were asked to name the three types of media they most often used to acquire information about environmental issues, the students most frequently named newspapers as one (Figure 2), followed by television and the Internet; Wikipedia was mentioned in particular. The radio and social media (including blogs and other forms of media) were also chosen to be among the three most used sources of information, even though they were low in priority compared to other sources of information.
Some of the students (8.2%) discussed environmental issues every day, mainly ‘in real life’ (Figure 3). Even though the role of social media was small in terms of being a source of environmental knowledge, some students (1.2%) conversed on environmental issues every day, also ‘in social media’. A few students brought up environmental issues
once a week ‘in discussion forums’ and ‘blogs’ whilst almost all the students at times discussed environmental issues ‘in real life’, but fewer – on the Internet forums.

Figure 3. Frequency of students’ (n=429) discussions on environmental issues in four different forums

In social media, students talked a lot with their friends about ‘sustainable lifestyle’ issues (61.5 %), ‘environmental problems’ (61.3 %), ‘man-nature relationship’ (58.2 %) and ‘technology and environment’ issues (53.4 %) (Figure 4). Only a few of the students discussed these issues openly on the Internet, and the vast majority of students did not discuss these issues in social media at all.

Figure 4. Environmental issues discussed by students (n=429) in social media

Students’ Educational Use of Media in Relation to Environmental Issues

Of all the students, either in school or in study courses in higher education, 55 % had used the media as a source of environmental knowledge. In their answers to the open-ended question, students described in a multifaceted way where and how they used information from the media in relation to environmental issues. The purposes of
students’ use of media in relation to environmental issues were categorised and shown in Table 3. ‘Frequency’ expresses how many of the students who answered this open-ended question described the use of media in the category at stake.

Table 3
The Ways or Purposes the Students (n=177) Used the Media in Relation to Environmental Issues

<table>
<thead>
<tr>
<th>Category</th>
<th>Description of the Category</th>
<th>Frequency</th>
<th>Excerpt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media</td>
<td>Students informed how they had got information or used the media.</td>
<td>43.5%</td>
<td>All my knowledge is, in some way, based on the media, mainly on the series “Avara luonto” and different non-fiction books. Articles in newspapers are beneficial, for example, about environmental history and teacher training.</td>
</tr>
<tr>
<td>Assignment or some theme</td>
<td>Students mentioned an assignment or a theme.</td>
<td>20.3%</td>
<td>Assignment in chemistry: pollutants resulting from home and the environment. The source has been found on the Internet.</td>
</tr>
<tr>
<td>Course</td>
<td>Students named the course in which they had used the media.</td>
<td>6.2%</td>
<td>On a biology course, we had a task to collect information. There was also environmental news.</td>
</tr>
<tr>
<td>Interest or information</td>
<td>Students expressed that the media has aroused their interest or provided additional information.</td>
<td>5.6%</td>
<td>Large-scale natural catastrophes, such as tsunamis. For the first time, I have found out about them through the media. After that, I have clarified the theory related to them. I take some part of the information from the media though there are issues not mentioned by the media at all.</td>
</tr>
<tr>
<td>Teacher training</td>
<td>Students mentioned training.</td>
<td>2.8%</td>
<td>I became familiar with arguments about climate change, and it was related to lessons that I have given during teacher training.</td>
</tr>
<tr>
<td>Qualification</td>
<td>Bachelor’s or a master’s thesis</td>
<td>2.3%</td>
<td>I am preparing my master’s thesis on environmental issues, and, being related to this, I have also considered the coverage of these issues in the media. My major subject is environmental policy and law, and therefore I frequently use information from the media in my studies.</td>
</tr>
<tr>
<td>Critical thinking</td>
<td>Students expressed criticism or critical thinking concerning the media.</td>
<td>1.7%</td>
<td>It is important to keep in mind that there is a lot of inaccurate information on the Internet. Rumours spread faster than the truth. I am very critical, and I continue to search for information until I am sure that the information is reliable.</td>
</tr>
</tbody>
</table>
Students used the media in a multifaceted way; they considered that, although the media are a source of information, the information provided should be critically evaluated. For some students, the media aroused interest in environmental issues or motivated them to search for more information about the issues under consideration. Students mentioned several forms of media: newspapers, documents, non-fiction books, Internet, blogs, Youtube as well as several higher education study courses in which the media were used in relation to environmental issues.

Students’ Perceptions of the Influence of Media

In the open-ended question, students were asked how important they considered information obtained from the media to be in relation to their own perception of environmental issues. In their answers to this question, students described the role of media and its influence. The answers were grouped into six categories (Table 4): information, motivation, criticism, positive effect, negative effect and modification of views. The media mainly provided information for students, but it also got them to think about environmental issues, pointing out that the information which is gathered though the media should be considered critically.

Table 4
The Importance of Environmental Information in the Media Regarding Students’ (n=212) Own Perceptions

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency</th>
<th>%</th>
<th>Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>70</td>
<td>33.0</td>
<td>It provides the most recent information, for example, concerning the development of science and technology. You get facts and good arguments through the media.</td>
</tr>
<tr>
<td>Motivation</td>
<td>48</td>
<td>22.6</td>
<td>The media partly provides information that is political/distorted. I familiarise myself with the issue on my own and through several sources. The media contributes and calls attention to current environmental problems. Because of that, the media plays an important role in making us discuss environmental issues.</td>
</tr>
<tr>
<td>Criticism</td>
<td>45</td>
<td>21.2</td>
<td>Information from the media should be considered critically. The media often only point out negative issues. There is seldom anything constructive about what everyone of us could do for the issue. I often trust (believe) what is written in the media, but not always. It depends on what the subject is about.</td>
</tr>
</tbody>
</table>

Sequel to Table 4 see on p. 43.
Information allows me to consider the consequences of my own actions. In some way, my actions have an influence all around the world, and observing this effect without the media would be impossible. The information I have got has opened my eyes and has made me think about my own lifestyle.

The information I have got has opened my eyes and has made me think about my own lifestyle.

Rather little, the media is used to increase and colour the issues. Not very important, we have the right to think what we want to think about different things. The media often exaggerate everything.

Through the information acquired from the media, I construct my conception of the issue, thus it influences me totally. The influence of media on my own conceptions is rather big, because I daily read either newsletters or their versions on the web. Even though I always read critically, the media is able to make me believe the validity or harmfulness of the issue. Important. Through the media, you form your opinion.

Through the prioritising of given forms of media, students were further asked to assess the reliability of the sources of information in the context of environmental issues (Figure 5).
Students perceived school/education to be the most reliable source of information concerning environmental issues. The next most important in terms of reliability were newspapers, environmental organisations, books, television, radio, journals and pamphlets. According to the students, although family and friends were not reliable sources of environmental knowledge, the least reliable were Internet forums: YouTube, emailing lists, blogs, Facebook and Twitter.

Differences and Similarities between Countries

In Finland, newspapers (including web-versions) were perceived as being a more important source of information about environmental issues than in Lithuania and Sweden (Table 5). The Swedish students perceived newspapers as being slightly more important than the Lithuanian students.

Table 5
Newspapers as a Source of Information, as Perceived by the Students (n=426) in the Three Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Count</th>
<th>Lithuania</th>
<th>Sweden</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least important</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>% within country</td>
<td>3.3%</td>
<td>11.9%</td>
<td>6.6%</td>
<td>4.9%</td>
</tr>
<tr>
<td>Less important</td>
<td>43</td>
<td>6</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td>% within country</td>
<td>14.1%</td>
<td>10.2%</td>
<td>16.4%</td>
<td>13.8%</td>
</tr>
<tr>
<td>More important</td>
<td>109</td>
<td>24</td>
<td>27</td>
<td>160</td>
</tr>
<tr>
<td>% within country</td>
<td>35.6%</td>
<td>40.7%</td>
<td>44.3%</td>
<td>37.6%</td>
</tr>
<tr>
<td>Most important</td>
<td>144</td>
<td>22</td>
<td>20</td>
<td>186</td>
</tr>
<tr>
<td>% within country</td>
<td>47.1%</td>
<td>37.3%</td>
<td>32.8%</td>
<td>43.7%</td>
</tr>
<tr>
<td>Total</td>
<td>306</td>
<td>59</td>
<td>61</td>
<td>426</td>
</tr>
<tr>
<td>% within country</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Furthermore, radio was considered to be a more important source of environmental knowledge in Lithuania (22.0%) than both in Finland (5.9%) and Sweden (17.5%) \((\chi^2=31.614; \, df=6, \, p=0.000)\) (Table 6). Likewise, information pamphlets, the Internet forums, family and environmental organisations, were statistically significant in terms of more important sources of information in Lithuania than in Finland and Sweden. The roles of radio and school/education were important in Sweden, as was the case in Finland where, after newspapers, the second most important source of information was school/education.

Table 7 presents the reliability of newspapers as a source of information, as perceived by students in the three countries. 42% of the Finnish students perceived newspapers as being the most reliable source of information about environmental issues, and, in all countries, newspapers were considered to be fairly reliable.
Table 6
Information Sources Ranked according to Their Importance by the Students (n=429) in the Three Countries

<table>
<thead>
<tr>
<th>Media (most important)</th>
<th>Finland</th>
<th>Lithuania</th>
<th>Sweden</th>
<th>$\chi^2$ (df=6, p&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>47.1</td>
<td>37.3</td>
<td>32.8</td>
<td>12.867</td>
</tr>
<tr>
<td>Radio</td>
<td>5.9</td>
<td>22.0</td>
<td>17.5</td>
<td>36.614</td>
</tr>
<tr>
<td>Information pamphlets</td>
<td>2.6</td>
<td>17.2</td>
<td>6.7</td>
<td>31.928</td>
</tr>
<tr>
<td>Blogs</td>
<td>2.9</td>
<td>11.9</td>
<td>3.3</td>
<td>44.186</td>
</tr>
<tr>
<td>Facebook</td>
<td>2.9</td>
<td>13.6</td>
<td>10.0</td>
<td>18.485</td>
</tr>
<tr>
<td>Twitter</td>
<td>1.3</td>
<td>10.2</td>
<td>1.7</td>
<td>57.830</td>
</tr>
<tr>
<td>Emailing lists</td>
<td>0.7</td>
<td>6.8</td>
<td>3.3</td>
<td>27.381</td>
</tr>
<tr>
<td>Youtube</td>
<td>1.3</td>
<td>12.1</td>
<td>3.3</td>
<td>44.587</td>
</tr>
<tr>
<td>Political parties</td>
<td>1.0</td>
<td>5.2</td>
<td>5.0</td>
<td>15.622</td>
</tr>
<tr>
<td>Family</td>
<td>7.8</td>
<td>18.6</td>
<td>13.1</td>
<td>29.280</td>
</tr>
<tr>
<td>School/education</td>
<td>20.9</td>
<td>33.9</td>
<td>36.9</td>
<td>18.271</td>
</tr>
<tr>
<td>Environmental organisations</td>
<td>5.6</td>
<td>45.8</td>
<td>16.9</td>
<td>82.308</td>
</tr>
</tbody>
</table>

Table 7
Reliability of Newspapers as Information Sources, as Perceived by the Students (n=382) in the Three Countries

<table>
<thead>
<tr>
<th>((\chi^2=29.526; \text{ df}=6; p=0.000))</th>
<th>Finland</th>
<th>Lithuania</th>
<th>Sweden</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Least important</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>5</td>
<td>1</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>% within country</td>
<td>1.6%</td>
<td>6.2%</td>
<td>8.5%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Less important</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>27</td>
<td>5</td>
<td>13</td>
<td>45</td>
</tr>
<tr>
<td>% within country</td>
<td>8.8%</td>
<td>31.2%</td>
<td>22.0%</td>
<td>11.8%</td>
</tr>
<tr>
<td>More important</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>146</td>
<td>8</td>
<td>28</td>
<td>182</td>
</tr>
<tr>
<td>% within country</td>
<td>47.6%</td>
<td>50.0%</td>
<td>47.5%</td>
<td>47.6%</td>
</tr>
<tr>
<td>Most important</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>129</td>
<td>2</td>
<td>13</td>
<td>144</td>
</tr>
<tr>
<td>% within country</td>
<td>42.0%</td>
<td>12.5%</td>
<td>22.0%</td>
<td>37.7%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count</td>
<td>307</td>
<td>16</td>
<td>59</td>
<td>382</td>
</tr>
<tr>
<td>% within country</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 8 presents the differences found in students’ perceptions of reliability: television is slightly more reliable in Sweden than in Finland, but less reliable in Lithuania; journals/magazines are more reliable in Lithuania than in other countries; information pamphlets are not reliable in Sweden, but more reliable in other countries; blogs and emailing lists are more reliable in Lithuania than in Finland, completely unreliable in Sweden; political parties are the most reliable in Sweden, less reliable in Lithuania; friends are more reliable in Sweden than in other countries; family is the most reliable in Sweden; environmental organisations are more reliable in Lithuania, less reliable in Finland.
Table 8
Reliability of Information Sources, as Perceived by the Students (n=382) in the Three Countries

<table>
<thead>
<tr>
<th>Media (most important as far as reliability is concerned)</th>
<th>Finland</th>
<th>Lithuania</th>
<th>Sweden</th>
<th>χ² (df=6, p&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>42.0</td>
<td>12.5</td>
<td>22.0</td>
<td>29.526</td>
</tr>
<tr>
<td>Television (including the Internet-television)</td>
<td>27.1</td>
<td>17.6</td>
<td>30.5</td>
<td>17.578</td>
</tr>
<tr>
<td>Journals/magazines</td>
<td>22.7</td>
<td>29.4</td>
<td>19.0</td>
<td>17.672</td>
</tr>
<tr>
<td>Information pamphlets</td>
<td>18.7</td>
<td>17.6</td>
<td>5.3</td>
<td>37.734</td>
</tr>
<tr>
<td>Blogs</td>
<td>0.3</td>
<td>5.9</td>
<td>0.0</td>
<td>23.199</td>
</tr>
<tr>
<td>Emailing lists</td>
<td>0.3</td>
<td>6.2</td>
<td>0.0</td>
<td>28.668</td>
</tr>
<tr>
<td>Political parties</td>
<td>3.0</td>
<td>1.7</td>
<td>6.9</td>
<td>30.799</td>
</tr>
<tr>
<td>Friends</td>
<td>5.0</td>
<td>6.8</td>
<td>13.6</td>
<td>14.171</td>
</tr>
<tr>
<td>Family</td>
<td>6.6</td>
<td>13.6</td>
<td>20.7</td>
<td>24.166</td>
</tr>
<tr>
<td>Environmental organisations</td>
<td>25.2</td>
<td>64.3</td>
<td>43.1</td>
<td>40.435</td>
</tr>
</tbody>
</table>

Importance of Sources of Information as Valued by Males and Females

Newspapers were the most important source of information for 45.3% of females and 38.7% of males and the least important source of information for 3.4% females and 3.4% males (χ²=9.950; df=3; p=0.019) (Table 9).

Table 9
Importance of Newspapers as a Source of Information for Males and Females

<table>
<thead>
<tr>
<th>Newspapers</th>
<th>(χ²=9.950; df=3; p=0.019)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Least important</td>
<td>Count</td>
</tr>
<tr>
<td>% within gender</td>
<td>9.4%</td>
</tr>
<tr>
<td>Less important</td>
<td>Count</td>
</tr>
<tr>
<td>% within gender</td>
<td>18.9%</td>
</tr>
<tr>
<td>More important</td>
<td>Count</td>
</tr>
<tr>
<td>% within gender</td>
<td>33.0%</td>
</tr>
<tr>
<td>Most important</td>
<td>Count</td>
</tr>
<tr>
<td>% within gender</td>
<td>38.7%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
</tr>
<tr>
<td>% within gender</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

In comparison with the male students, the female students placed more importance on all sources of information (Table 10).

Here too, in comparison with the male students, the female students perceived newspapers as being a more reliable source of information, however, according to the scale used, not the most reliable (Table 11).
Table 10
Importance of Media for Both Genders (n=429) as an Environmental Information Source of Environmental Issues

<table>
<thead>
<tr>
<th>Media</th>
<th>Male</th>
<th>Female</th>
<th>(\chi^2) (df=3; p&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>38.7</td>
<td>45.3</td>
<td>9.950</td>
</tr>
<tr>
<td>Journals/magazines</td>
<td>9.4</td>
<td>19.8</td>
<td>17.297</td>
</tr>
<tr>
<td>Blogs</td>
<td>0.9</td>
<td>5.3</td>
<td>8.960</td>
</tr>
<tr>
<td>E-mailings lists</td>
<td>0.9</td>
<td>2.2</td>
<td>8.929</td>
</tr>
<tr>
<td>Friends</td>
<td>3.7</td>
<td>15.0</td>
<td>17.367</td>
</tr>
<tr>
<td>Family</td>
<td>4.7</td>
<td>11.9</td>
<td>10.031</td>
</tr>
<tr>
<td>School/education</td>
<td>17.9</td>
<td>27.3</td>
<td>18.123</td>
</tr>
<tr>
<td>Environmental organisations</td>
<td>7.6</td>
<td>14.5</td>
<td>13.006</td>
</tr>
</tbody>
</table>

Table 11
Reliability of Newspapers as an Environmental Information Source, as Perceived by the Students (n=429)

<table>
<thead>
<tr>
<th>((\chi^2)=20.030; df=3; p=0.000)</th>
<th>Gender</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Total</td>
<td></td>
</tr>
<tr>
<td>Least important</td>
<td>Count</td>
<td>8</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>% within gender</td>
<td>7.8%</td>
<td>1.1%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Less important</td>
<td>Count</td>
<td>19</td>
<td>26</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>% within gender</td>
<td>18.4%</td>
<td>9.3%</td>
<td>11.8%</td>
</tr>
<tr>
<td>More important</td>
<td>Count</td>
<td>46</td>
<td>136</td>
<td>182</td>
</tr>
<tr>
<td></td>
<td>% within gender</td>
<td>44.7%</td>
<td>48.7%</td>
<td>47.6%</td>
</tr>
<tr>
<td>Most important</td>
<td>Count</td>
<td>30</td>
<td>114</td>
<td>144</td>
</tr>
<tr>
<td></td>
<td>% within gender</td>
<td>29.1%</td>
<td>40.9%</td>
<td>37.7%</td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>103</td>
<td>279</td>
<td>382</td>
</tr>
<tr>
<td></td>
<td>% within gender</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

There were also differences between the genders when perceiving the reliability of other sources of information (Table 12). The Internet was perceived to be more reliable by males rather than by females, but female students perceived the other media to be more reliable, ranking the media according to its reliability as follows: school/education, newspapers, environmental organisations, books, journals/magazines, radio, the Internet, political parties, emailing lists. Males ranked the media as follows: newspapers, school/education, books, radio, TV, journals/magazines, Internet, political parties. Emailing lists were not perceived as being reliable at all.
Table 12
Reliability of the Sources of Environmental Information Ranked according to Gender (n=429)

<table>
<thead>
<tr>
<th>Media</th>
<th>Male</th>
<th>Female</th>
<th>$\chi^2$ (df=3; p&lt;0.05)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newspapers</td>
<td>29.1</td>
<td>40.9</td>
<td>20.030</td>
</tr>
<tr>
<td>Internet (other sources than newspapers)</td>
<td>10.7</td>
<td>6.5</td>
<td>9.813</td>
</tr>
<tr>
<td>Radio</td>
<td>17.5</td>
<td>24.7</td>
<td>10.927</td>
</tr>
<tr>
<td>Television (including the Internet-television)</td>
<td>14.6</td>
<td>31.9</td>
<td>31.613</td>
</tr>
<tr>
<td>Journals/magazines</td>
<td>11.9</td>
<td>26.3</td>
<td>21.654</td>
</tr>
<tr>
<td>Books</td>
<td>24.5</td>
<td>36.0</td>
<td>8.165</td>
</tr>
<tr>
<td>Emailing lists</td>
<td>0.0</td>
<td>1.1</td>
<td>8.023</td>
</tr>
<tr>
<td>Political parties</td>
<td>1.9</td>
<td>3.8</td>
<td>16.442</td>
</tr>
<tr>
<td>School/education</td>
<td>27.2</td>
<td>43.2</td>
<td>25.209</td>
</tr>
<tr>
<td>Environmental organisations</td>
<td>14.7</td>
<td>39.0</td>
<td>44.951</td>
</tr>
</tbody>
</table>

Discussion and Implications

The main purpose of this study was to describe how university students in three different countries use the media in relation to environmental issues. The results from the multiple-choice questions demonstrated that the Finnish, Lithuanian and Swedish students valued the Internet as being the most important source of environmental knowledge, followed by newspapers, television, school/education and journals. The importance of the Internet was higher than previously found among younger learners (Asunta, 2003) and university students (Kukkonen et al., 2012). Also, in the open-ended question and in accordance with most of the studies carried out in the 20th century (Asunta, 2003; Boykoff, 2009; Lee, 2008; Oztas & Kalipci, 2009; Riffe & Reimold, 2008), the Internet was named as one of the three main sources of information. The most often used sources of information to obtain environmental knowledge were, however, newspapers, whereas school/education was perceived to be the most reliable source of environmental knowledge. Television has already been an important source of environmental knowledge for a long time, but the role of the Internet has increased in the 20th century (FICORA, 2010). The Internet has increased potential as a source of environmental news, especially among young people (Lacy et al., 2007; Riffe & Reimold, 2008). Although five years ago, young adults had anticipated that, in the future, they would get less information from social networking and more from traditional news sources (Lewis, 2008), this study did not confirm that prediction. However, it confirmed the significance of newspapers and the importance of television in the present Internet Age.

There were also differences between the three countries. The Finnish students preferred newspapers as being the most important source of environmental knowledge, the Swedish students – school and education, whereas the Lithuanian students also named other sources, including Facebook, Twitter and YouTube. This may be due to the interpretation of media which, according to Nurminen (2001), is culturally bound and dependent on what the individual has previously experienced. Although there were some differences between the perceptions of the Finnish and Swedish students, they were more similar to each other when compared with the Lithuanian students. Like people in general (Esa, 2010; Khalid, 2003), the students seemed to gain a lot of environmental knowledge...
from the media; its use in education is facilitated by the fact that, in the three countries, information and communication technology is integrated into all school subjects.

Some of the students reported daily discussions on environmental issues, mainly in everyday situations, but, also, to some extent, in social media, discussion forums and blogs. In social media, they talked with their friends about sustainable lifestyle issues, environmental problems, man-nature relationship, technology and environmental issues. Although in this study discussion in social media played a minor role, it should be critically considered by educators as a future source of environmental knowledge for students, at least in terms of being an activator of interest in environmental issues. It has been stated that the Internet can be used in education for sustainability to promote awareness, knowledge and actions (Hill & Nelson, 2011; Hughes, 2011). Social networking through blogging, for instance, has been seen as a new way of changing students’ environmental sensibility (Arnold 2011) and, to some extent, their understanding of environmental issues (Ellison & Wu, 2008; Halic et al., 2010; Kukkonen et al., 2011). Facebook has also been a powerful tool to promote environmentally responsible behaviour and learning about practical environmental issues (Robelia et al., 2011). Students’ environmental awareness and action competence (Chawla & Flanders Cushing, 2007; Mogensen & Schnack, 2010) could be further developed by integrating different kinds of media use in outdoor education, i.e. real-life projects. Whether these forms of media are applicable for future use in higher education for sustainability are to be evaluated later.

More than half of the students used information from the media in relation to environmental issues, either in school or particularly during study courses in higher education. The media were considered to be a general source of environmental knowledge, but one that demands critical approval. The use of newspapers in different ways could also be beneficial in environmental education, including critical thinking (Jarman & McClune, 2004). Students highlighted knowledge gained from television programmes, confirming previous findings concerning the use of visual media in education (Bizerril et al., 2011; Pearson et al., 2011), and some also mentioned examples of the positive effects of media (Holbert et al., 2003). One interesting point was that students described a lot of university study courses in which they had used environmental knowledge which was acquired from the media. In contrast to the previous results, this indicates that environmental issues actually have been considered in university education, particularly in teacher education (Hofman, 2012). Nowadays, active teachers create their own blogs as well as those used by the class, and the use of Facebook has become a popular tool in formal education. The Internet sources provide additional learning material, both for general school education as well as for higher education.

Regarding gender preferences, in comparison to males, females considered newspapers to be more important and reliable sources of information, whereas males perceived the Internet to be more reliable than females. The cultural context may have had an effect on the answers. As in most comparative research, the data may have been affected by small differences in the three languages used, the two differing methods of gathering data (online versus face-to-face) or the differing number of participants from the three countries.

The Finnish students perceived newspapers to be the most reliable source of information about environmental issues. The least reliable sources were the Internet forums, such as YouTube, emailing lists, blogs, Facebook and Twitter. According to
these findings, social media should not be used in the future, at least not as the only source of environmental knowledge, because there are no ways to secure the reliability of information. Newspapers may continue to maintain their reputation of reliability among university students, and the students must continue to rely on their own critical thinking abilities in relation to all sources of information.

As an implication for education, it can be concluded that different forms of media should be used concerning environmental issues in order to attain the benefits from all sources of information and to reach both genders. Furthermore, the Internet could be a powerful tool to reach students and motivate them to learn through the use of blogs and discussion forums. It is necessary, however, to teach students to critically analyse information obtained from the Internet.

Conclusions

This research increased our understanding of how students use the media and the role of media in education for sustainability. The Finnish, Lithuanian and Swedish students valued the Internet as being an important source of environmental knowledge. Although they also used newspapers as a source of environmental knowledge, school/education was perceived to be the most reliable source. The differences between the three countries were also apparent: the Finnish students expressed a preference for newspapers, Swedish students for school/education, whereas Lithuanian students also valued social media. Female students considered newspapers to be a more important and reliable source of information, and, unlike males, they considered the Internet to be less reliable.

Some of the students discussed environmental issues daily, mainly in everyday situations and, also, to some extent, in social media, discussion forums and blogs. During study courses in higher education, students used a variety of media to search for information about environmental issues.

The media as a source of environmental knowledge play a significant role in the three Nordic-Baltic students’ lives. Information gained from various sources of information was used in their studies. Based on this research, it could be concluded that different forms of media should be used to obtain environmental knowledge in order to attain the benefits from all sources of information and to reach both genders. Furthermore, the Internet could be a powerful tool to reach students and motivate them to learn through the use of blogs and discussion forums. It is necessary, however, to teach students to critically analyse information obtained from the Internet.

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References


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Introduction

According to Wagaw (1981), Ethiopia, with its recorded history of at least two and a half millennia, is one of the three oldest nation-states in the world and certainly the oldest in Africa. He adds that, in Ethiopia, many of the problems associated with ethnicity could have been solved long ago, and the country ought to resolve other economic, social and political problems at a higher level. Nonetheless, the core issue that has the most important bearing on both the immediate and the long-term stability of the country depends on how the amalgamation of the different interests, expectations and ambitions of the various ethnic groups are resolved (Wagaw, 1981). Similarly, Semela (2012) states that “the reality in Ethiopia today demands the adoption of democracy and the recognition of both individual and group identities. It calls for more intercultural understanding and respect for people with different racial, ethnic, linguistic, and religious backgrounds” (p. 1).
Diversity is a fact of life in the Ethiopian society. Based on this premise, one could argue that, as a country in which more than 80 ethno-cultural as well as linguistic groups (Semela, 2014) live together and as a country with a total population of 73,918,505 (Federal Democratic Republic of Ethiopia Population Census Commission, 2008), it is important for Ethiopia to implement multi-ethnic and multicultural education at all levels of education to make education accessible to its people in a fair way. This is due to the fact that this type of education underpins the assumption that education has a cultural component and is not simply an information transfer (Masemann, 2007).

In attempting to exercise multi-ethnic and multicultural education in Ethiopia, one would expect that teacher education is used as a means to an end. One fairly common rationalisation for addressing multiculturalism in teacher education in general and in pre-service teacher education programme in particular grows out of a recognition that the cultural diversity of a population and the rates of cross-cultural interaction, both domestically and globally, are increasing dramatically. In such growing global interconnectedness, all teacher education programmes, especially pre-service programmes, need to adopt multicultural teacher education as a means of preparing all future teachers to help all children and youth to develop the skills which this type of society and the world require (Garcia & Pugh, 1992; Sleeter, 2008).

This attempt, amongst other things, may ensure fair representation of multicultural societies in the teacher education curricula, which, in turn, is important for sustainability. In other words, the curricula which ascertain fair representation of multicultural societies are assumed to serve the interests of all groups of people as well as ensure the preservation and sustainability of the cultures, languages, histories, traditional values of all members of society. Concerning this claim, Banks (2010) contends “... the purpose of education is not to eliminate differences but to respond to diversity in ways that enhance all students’ growth and development” (p. 358).

It could be argued therefore that the curriculum of teacher education is expected to be responsive to diversity. The curriculum is at the heart of every educational enterprise (Karseth, 2004) and sets up a standard against which educational initiatives are judged (Goodson, 1988). According to Goodson (1988), the written curriculum is an important part of a consolidated state system of schooling; it defines statements of intent and provides clear rules of the game for educators and practitioners, although the ground rules are not prescriptions but parameters. This means, though the written curriculum serves as a guide in the teaching-learning process, there is always a room for entertaining relevant issues in the instruction process. Moreover, Apple and Christian-Smith (1991) assert that texts not only signify how reality is constructed but also influence the creation of knowledge that society has accepted as legitimate and truthful.

Since 1991, Ethiopia has been a federal state, comprised of regional states that are organised on the basis of ethnicity (Hussein, 2008; Semela, 2014; Wagaw, 1999). In relation to this change, a new constitution which states that “the government shall have the duty to support, on the basis of equality, the growth and enrichment of cultures and traditions that are compatible with fundamental rights, human dignity, democratic norms and ideals, and the provisions of the constitution” (Federal Democratic Republic of Ethiopia, 1995, Article 91) was introduced in 1995. In addition, the same constitution underscores “education shall be provided in a manner that is free from any religious influence, political partisanship or cultural prejudices” (Federal Democratic Republic of Ethiopia, 1995, Article 90, p. 133). Similarly, the education and training policy of
Ethiopia pinpoints “... to provide education that promotes democratic culture, tolerance and peaceful resolutions of differences that raises the sense of discharging societal responsibility” (Federal Democratic Republic Government of Ethiopia, 1994, p. 10). One of the strategies which are expected to facilitate the successful implementation of the reforms is the curriculum. With regard to the curriculum, the education and training policy of Ethiopia states that it is necessary to “ensure that the curriculum developed and textbooks prepared at central and regional levels are based on sound pedagogical and psychological principles and are up to international standards, giving due attention to concrete local conditions and gender issues” (Federal Democratic Republic Government of Ethiopia, 1994, p. 12–13).

This implies that the curricula developed for the various educational levels are expected to address the diverse nature of the Ethiopian society in a reasonable way, apart from entertaining relevant international issues. This, in turn, is expected to contribute to the efforts being made by the Ethiopian government to ensure sustainable development in the country (Egne, 2010; Mergo, 2006, 2010). However, research conducted on issues of diversity (Hussein, 2008; Kenea, 2010; Mergo, 2008; Wagaw, 1999) suggests that the Ethiopian education system is not sensitive to the diverse nature of the country. This, in turn, raises the question whether this is also the case for the secondary teacher education curricula. This makes analysing the current Ethiopian secondary teacher education curricula interesting and timely. According to Harber (1994), Kenyan school textbooks give a high profile to aspects of ethnicity and tribe. What about Ethiopian school textbooks? Overall, this paper is a curiosity-driven study which aims at exploring the extent to which the diversity-oriented policies of the Ethiopian government are transferred and reflected in the national secondary teacher education curricula of the country. In a nutshell, this paper attempts to answer the following key question: How are the multi-ethnic and multicultural characteristics of the diverse Ethiopian society addressed in the current secondary teacher education curricula?

Background and Context:

Development of Ethiopian Teacher Education Curricula

In Ethiopia, formal teacher education started for the first time in 1944 with the launching of a primary school teacher education and training programme in the premise of Menelik II School in Addis Ababa through the assistance of the British Council (Semela, 2014; Wagaw, 1979). Nevertheless, a fully-fledged teachers’ training institute was later inaugurated at Gulele in Addis Ababa in 1946/47 (as cited in Semela, 2014). According to Semela (2014), this particular time marks the beginning of a period of reform in the teacher education system of the country.

As stated by (Wagaw, 1979), out of the 32, first batch, prospective teachers who joined the teacher education and training programme at its inception, 24 graduated in 1946. Due to scarcity of trained teachers, the graduates were assigned to teach in different provinces and were also assigned to serve as officers. The two year programme was an effective means of producing qualified teachers. Nonetheless, its capacity was very limited, and it was a slow process. As a result, from 1947, the institute undertook a series of three-month refresher courses for some of the existing elementary school teachers. In the meantime, the Ethiopian Ministry of Education and Fine Arts made summer courses compulsory for all teachers to attend (Wagaw, 1979).
In general, the launching of formal teacher education in Ethiopia in the mid-1940s marks the beginning of the British influence in the Ethiopian education system (Semela, 2014). However, the British Council withdrew from the project in 1947 after which a Canadian teacher educator named Steinmann was appointed director of the teachers’ training institute in the same year (Wagaw, 1979). His arrival marked a new phase for Ethiopian teacher education. The director gradually shifted the teacher education curricula to professional courses. Beginning from 1949, the Ethiopian Ministry of Education and Fine Arts raised the level of the institute’s entry requirements and, at the same, time introduced more advanced courses. The central motto of the institute was clearly expressed.

A teacher training institute should be a place where men are trained and men are made. None but the best should be entrusted with the education and care of the children of Ethiopia. Remember that you must be a man yourself before you train a man (Wagaw, 1979, p. 63).

From the mid-fifties to the mid-sixties, education and training of Ethiopian teachers at all levels was below standard (Bowen, 1976). Though commendable progress was made, there was a long way to go to adequately serve the country. In support of this claim, Semela (2014) states “until the early 1970s, the system had been modestly expanded with the opening of [only] three new TTIs in Harar, Dabre-Berhan, and Jimma Towns” (p. 122). According to Bowen (1976), in 1965, the Division of Secondary Education, under the Ethiopian Ministry of Education, produced the first guidebook on curriculum policies and standards for teacher training institutes. In general, the development of Ethiopian teacher education curricula could be examined in terms of three regimes.

**Ethiopian Teacher Education Curriculum during the Haile Selassie Regime**

During the Haile Selassie I regime (1930–1974), Ethiopian pre-service teacher education programmes for government schools followed two patterns depending on the educational level. Elementary teachers were trained at teachers’ training institutes whereas secondary teachers were trained at the Faculty of Education, Addis Ababa University (Bowen, 1976). According to Semela (2014), secondary teacher training programme began in a single classroom at the then Haile Selassie I University (now Addis Ababa University) in 1959. However, due to the expansion of modern schools, the programme upgraded first to the Department of Education and then developed the Faculty of Education in 1969. Moreover, Negash (1996) underpins that “under the leadership of Haile Selassie I, who held the portfolio of the Ethiopian Ministry of Education until 1966, the education sector functioned without curriculum guidelines and relevant textbooks” (p. 103).

In general, during the imperial regime, moral education was emphasised and was used as an instrument of nation building underpinned by the cultural and religious values of the ruling class (Semela, Bohl, & Kleinknecht, 2013). As part and parcel of the overall education system, Ethiopian teacher education curricula used to reflect this moral education during the Haile Selassie I regime. In sum, the curricula during the imperial period were targeted at instilling in the prospective teachers traditional values such as devotion and loyalty to the emperor and to the country, national pride and patriotism.
Ethiopian Teacher Education Curriculum during the Military or Dergue Regime

After taking power in 1974, the Dergue regime (1974–1991) introduced a socialist-oriented curriculum by leaving aside the cultural values and heritages embodied in the school curriculum during the imperial period. The regime used political education for the nation building project. During the regime, the central foci of the Ethiopian teacher education curricula were imparting communist values, attitudes and world outlook to the prospective teachers because of its strong ties with the Soviet Union, Eastern Germany and some other socialist countries. With regard to this claim, Semela (2014) contends “the military leaders managed to live up to the demands of Soviets and their allies by redesigning the school curricula along the principles of all-rounded socialist personality” (p. 125).

Courses like Marxist-Leninist philosophy and political economy were compulsory subjects in all institutions (Negash, 1990). The general guiding principles of the education system of the country were education for production, social consciousness and scientific inquiry. But, following the fall of the Berlin Wall in 1989, the Dergue government had to reluctantly abandon its communist ideology which subsequently resulted in the elimination of political education from the Ethiopian school curricula (Semela, 2012).

In general, according to Semela (2014), the Ethiopian teacher education system which enjoyed a high prestige as well as status compared to other professions during the Imperial era due to the relative higher salary that teachers used to earn, lost its social acceptance and prestige during the Military government. This is due to the fact that, in contrast to the recruitment policy of the Imperial regime that selected the best and the brightest teacher candidates, the criterion to join the profession dropped to GPA of 0.6 in the Ethiopian School Leaving Certificate Examination during the Military regime. Low teachers’ salary combined with loses of social respect has made the teaching profession to be the least preferred among the Ethiopian youth.

Ethiopian Teacher Education Curriculum under the Leadership of the Ethiopian People’s Revolutionary Democratic Front

With the coming to power of the current Ethiopian government or the Ethiopian People’s Revolutionary Democratic Front in 1991, all socialist-oriented elements were avoided from the school curriculum and a new education and training policy was formulated in 1994. The current government claimed that the Dergue government did not do justice to the nations, nationalities and peoples of Ethiopia (Semela, 2014), and it envisaged readdressing this situation through formulating a new education and training policy in 1994.

One of the strategies designed to implement the education and training policy was the curriculum. Some of the central tenets of the curricula are promoting democratic principles, respect for human rights, using the Ethiopian nations and nationalities languages as media of instruction until the end of primary education (Federal Democratic Republic Government of Ethiopia, 1994).

In Ethiopia, secondary education is expected to be taught by teachers who have a first degree in their respective disciplines (Federal Democratic Republic Government of Ethiopia, 1994). When it comes to secondary teacher education programme, from 1994 to 2002, it was a four-year programme. Nevertheless, with the introduction of a new
teacher education policy called “Teacher education System Overhaul” (TESO), that initiated a wide-ranging reform in the Ethiopian teacher education sector in 2003 (Ethiopian Ministry of Education, 2003), the secondary teacher education programme was reduced from four years to three years. Again, in 2009, the Ethiopian Ministry of Education replaced TESO with a new secondary teacher education programme entitled “Postgraduate Diploma in Teaching” (PGDT) where prospective teachers undergo professional courses for one year after finishing their undergraduate studies in applied disciplines (Ethiopian Ministry of Education, 2009). The teacher education curricula of this programme entirely focus on professional courses.

In Ethiopia, pre-primary and primary teacher education curricula are usually developed at the respective regional education bureaus. In contrast, secondary teacher education curricula are usually designed at the national level by a team of experts working at the Ethiopian Ministry of Education, subject matter specialists from universities and consultants who prepare an overall curriculum framework for the entire country. The curriculum design is usually done centrally under the guidance of the Ethiopian Ministry of Education. In addition, there is a tradition of preparing modules or study materials that are used across the entire secondary Teacher education Institutions. According to Hussein (2006), the Ethiopian Ministry of Education is guided by the assumption that in addition to ensuring standardised education, modules/study materials ease learning and mastery of knowledge.

On the other hand, he argues that modularised education controls students’ minds and makes them see what is presented in the module/study material as a legitimised and highly valued knowledge. This, in turn, implies that, if the Ethiopian education system is to serve the public good, the country’s secondary teacher education curricula, more than the other teacher education curricula, are expected to be prepared with great care and in ways that address the diverse nature of the Ethiopian society in a fair manner. These curricula are used across the country’s secondary teacher education institutions.

Teacher Education Curriculum and Multicultural Education

Education is often considered as the best means to instil in the new generation basic humanitarian values such as peace, tolerance and equality (Serbessa, 2006). Drawing on Harber (1994), schools have an important role to play in creating a culture that is more tolerant and trustworthy and less sharply divided along ethnic lines. Of course, there is no consensus among scholars regarding schooling. For instance, according to Apple and Christian (1991), for some people, schooling is seen as a vast engine of democracy-opening horizons, ensuring mobility and so on. For others (Apple & Christian, 1991), it is seen as a form of social control or, perhaps, as the embodiment of cultural dangers, an institution whose curricula and teaching practices threaten the moral universe of the students who attend it. This paper takes the first stance as its starting point.

The aforementioned fundamental humanitarian values are argued to be comparatively more important in countries characterised by diversity. To address the needs and interests of students coming from such diverse backgrounds, the training of teachers, who are expected to teach those students, is assumed to take into account the experiences and backgrounds of the learners. In so doing, the curricula that are being used in the
training of prospective teachers are expected to be designed in a way that reflects the students’ needs and interests. In line with this notion, Chan (2007) argues that the curriculum may be interpreted as the intersection of the students’ home and school cultures.

Multiculturally responsive teaching is often considered as a pedagogical paradigm that enables teachers to utilise students’ cultural strengths in his/her teaching (Gay, 2000). This is grounded in the notion that culture and education are strictly intertwined, one being necessary for the continuing existence of the other. Learning is culture dependent. Culture has impacts on identity construction. Supporting this argumentation, Bruner (1996) asserts that learning and thinking are always situated in a cultural setting and always dependent upon the utilisation of cultural resources. According to him, education does not stand alone, and it should not be designed without considering the culture of the beneficiaries.

Moreover, Gagliardi (1995) claims that “different cultures have different learning styles. Adapting teaching to pupils’ learning styles can facilitate learning and solve some of the pupils’ learning difficulties” (p. 4). Similarly, Schofield (2010) underpins that “… students use widely differing styles in classroom discussion and that misunderstanding the cultural context from which students come can lead peers and teachers to misinterpret involvement for belligerence” (p. 274). Young people who experience cultural discontinuity between home and school may perceive themselves as poor learners and may develop a negative self-concept (Souto-Manning & Mitchell, 2010). Besides, it has long been clear that the school and the curriculum usually reproduce social class differences mainly, because they value the knowledge and skills that the dominant class holds in abundance (Fenwick, 2011).

The importance of designing a culturally responsive curriculum comes into play particularly in ethno-culturally diverse nations’ teacher education programmes. This is due to the fact that teacher education has a multiplying effect, and, for relevant multiplication to take place, the prospective teachers are assumed to be introduced to the essence of multicultural education while they are still in teacher education institutions. This means that having academically qualified and professionally responsible teachers is very important to provide relevant education to a society characterised by diversity. In this regard, Gay (1986) asserts that

... professional preparation programmes should help pre-service and in-service teachers to understand the concept of multicultural education, acquire some basic cultural knowledge about ethnic pluralism, learn how to analyse their own and students’ ethnic attitudes and values, and develop different methodological skills for implementing multicultural education in the classroom (p. 161).

Strategies to Accommodate Multicultural Perspectives in Curricula

Different scholars suggest different strategies to entertain ethnic pluralism and cultures in curricula in a diverse society. According to Gay (2000), educators are supposed to be diligent in ensuring that curriculum content about ethnically diverse groups is accurate, authentic and comprehensive. In addition, culturally responsive curriculum content is expected to deal with concepts, principles and ideas generalisable across
ethnic groups and knowledge about the particular lives, experiences and contributions of specific ethnic groups. Therefore, curriculum designers are always expected to use a variety of content sources from different genres and disciplines, such as textbooks, literature, mass media, personal experiences and research findings. Similarly, Purnell, Ali, Begum and Carter (2007) state that “a culturally responsive curriculum is designed to recognize and accept the wide range of cultural differences that exist in every classroom” (p. 420).

Curriculum sources and contents that provide accurate presentations of ethnic and cultural diversity offer several benefits in improving students’ achievement. First, they provide those who have never had close personal contact with members of ethnic groups other than their own with opportunities to communicate and engage with diverse people. This experience, in turn, may calm down certain fears, dispel some myths and produce learning that may not be grasped from books and other sources. This, in turn, may enhance receptivity and mastery of concepts. Second, students will actively participate in their learning as interpersonal problems will be minimised. Third, students will have real power to structure their own learning. As a result, they will have control over their own academic destinies (Gay, 2000). These overall advantages are assumed to foster better students’ learning outcomes.

**Approaches to the Inclusion of Culture into Teacher Education Curriculum**

There are three approaches (Banks, 1986) in the selection and inclusion of culture into a teacher education curriculum: the assimilation approach, the cultural pluralism approach and the multiculturalism approach. The assimilation approach encourages the incorporation of one dominant culture into a curriculum that is expected to be adapted by the various ethnic groups of society. Supporters of this approach believe that the major goal of education for ethnic and cultural minorities is to help them to acquire the knowledge, attitudes and skills needed to participate in the mainstream society.

The cultural pluralism approach emphasises the existence of different ethnic group cultures on an equal footing. Individuals within ethnic groups all have the same basic civil rights. Society is viewed as a plurality of different groups. The identity of the individual is an extension of the identity of the group to which he/she belongs. Therefore, schools and curricula are expected to express and reinforce ethnic identities depending upon the dominant group. In short, cultural pluralism holds the view that each individual without self or group identification is given respect, dignity, freedom, and citizen rights (Stevens & Wood, 1995).

Lastly, multiculturalism is an approach that fosters the inclusion of various ethnic group cultures into curricula and teaching materials in a fair way. The curricula would include teaching and learning about various groups’ cultures as well as the shared common culture. As in society, students interact with more than one set of cultural values. Teachers take ethnic differences among students into account when selecting and applying teaching approaches and learning styles (Banks, 2006; Stevens & Wood, 1995). This last approach is the one I adopt in this paper as it underpins the assumption guiding this research.
Approaches to the Integration of Multicultural Education into Teacher Education Curriculum

In assessing the degree to which multicultural education is addressed in a teacher education programme, different scholars emphasise different dimensions (Gay, 1986). Nevertheless, in this paper, the four approaches to the integration of ethnic and multicultural contents into teacher education curricula suggested by Banks (1993, 2001, 2006) were used as core analytical frameworks due to the fact that they are time-tested as well as because of their wider application in the study of multicultural teacher education curricula. The four approaches are: the contributions approach, the addition approach, the transformation approach and the social action approach.

The contributions approach is mainly used when a teacher education institution attempts to integrate ethnic and multicultural contents into the mainstream teacher education curricula for the first time (Banks, 1993, 2001, 2006). It involves the incorporation of various ethnic group cultures and other forms of ethnic identities into the existing teacher education curricula as supplements. According to Banks (2006), through this approach, discrete cultural elements, such as the foods, dances, music and artifacts of ethnic groups, are studied, but little attention is given to their meanings and importance. In addition, ethnic content is limited primarily to special days, weeks and months related to ethnic events and celebrations. This approach, as Bokhorst-Heng (2007) argues, involves the ‘surface culture’ that does not get to the heart of cultural meanings, i.e. the ‘deep culture’. In this paper, the key indicators I used with respect to this approach are assessing the extent to which the cultures as well as artifacts of, at least, the major ethnic groups of Ethiopia are incorporated as supplements to the current secondary teacher education curricula.

The addition approach deals with the insertion of ethnic contents, concepts, themes and perspectives (Banks, 1993, 2001, 2006) into the existing teacher education curriculum without changing its basic purposes and structures. According to him, this approach is often practised by the addition of a book, a unit or a course to the existing teacher education curriculum without changing it drastically. The core indicators of this approach for my research involved analysing the extent to which the objectives, contents, learning activities and modes of assessments that reflect the Ethiopian people’s cultures are addressed in the secondary teacher education curricula without completely changing their basic aims, structures and frameworks.

The transformation approach emphasises changing the basic components of the existing teacher education curricula so as to enable prospective teachers to view things from several perspectives of ethnic groups. According to Banks (1993, 2001, 2006), it is neither possible nor desirable to view every issue, concept, event or problem from the point of view of every ethnic group. Rather, the central goal is to enable prospective teachers to view those issues from more than one perspective. As stated by Banks (2006), in this approach, the key curriculum issues involved in a multicultural teacher education curriculum reform are the infusion of various perspectives, frames of references and contents from different groups that will extend prospective teachers’ understandings of the nature, development and complexity of ethno-culturally diverse society. The key indicators used in this study regarding this approach are examining the degree to which attempts are made to change the objectives, contents, learning activities, instructional resources and assessment methods of the current secondary teacher education curricula.
of Ethiopia by infusing multi-ethnic as well as multicultural contents into them. This is assumed to make the curricula representative of the cultures of the various ethnic groups of the country, thereby encouraging prospective teachers to have in-depth understanding about the multiplicity of Ethiopian cultures from different angles.

The last approach is the social action approach. This approach emphasises competencies that require teacher candidates to make decisions and take actions based on what they studied in a given teacher education curriculum. The central intent of the teaching and learning process is to educate prospective teachers in how to analyse their social realities using appropriate decision-making skills (Banks, 1993, 2001, 2006) to enable them to take action ultimately. Furthermore, teaching and learning activities aim at empowering students to become reflective and active participants in social change. The core indicators used in this research with respect to this approach are evaluating whether contents of the current Ethiopian secondary teacher education curricula help the prospective teachers to become change agents.

To sum up, the four approaches are used as the core analytical tools to assess the extent to which the multiplicities of the cultures of the Ethiopian society are represented in the secondary teacher education curricula. Moreover, the four approaches were used to analyse whether multi-ethnic and multicultural contents are entertained in the Ethiopian secondary teacher education curricular elements, such as objectives, contents, learning activities, instructional resources and evaluations (Stark & Lattuca, 1997), in a harmonised manner.

Methodology

This study assesses how the multi-ethnic and multicultural characteristics of the diverse Ethiopian society are incorporated into the current national secondary teacher education curricula. To that end, content analysis was used as a tool for data collection. Content analysis is an accepted method of textual investigation (Silverman, 2006). First of all, the entire national curriculum framework prepared for the current secondary teacher education programme, which consists of the descriptions/syllabi of each of the 12 professional courses, was analysed. Of all the 12 professional courses designed for the PGDT programme, the courses entitled “School and Society”, “Action Research” and “Practicum” were taken as samples using a purposive sampling technique.

The three courses were selected as samples due to the fact that they are designed in a modular material form for a distance mode of delivery where basic curricular elements are presented in a detailed and explicit manner that may promote self-learning. The three courses were, therefore, found to be more suitable for conducting the content analysis process than the other courses designed for the PGDT programme since content analysis requires well-developed texts that give room for an in-depth analysis. Further, taking into consideration the dynamic nature of curricula, the entire contents of the sample texts were analysed.

As a research method, content analysis is used differently by different scholars (Krippendorff, 2004). However, in this research, regarding the quantitative content analysis, Sarantakos’ (2005) model that explains content analysis as a systematic, objective and quantitative method was used. Systematic refers to categorising and applying a set of procedures to all the contents to be analysed. Objective means that it is free from personal views, and quantitative means that it is counted in terms of numbers.
In order to pool the results for the quantitative content analysis, a coding sheet, which consists of 12 items, was prepared in the form of a Likert scale with five options (fully agree, agree, no opinion, disagree and fully disagree). The five alternatives were used to ensure relatively better flexibility in the coding of the sample texts. The coding sheet was prepared based on Banks’ (1993, 2001, 2006) four approaches to the integration of ethnic and multicultural contents into teacher education curricula. Each of the four core indicators were systematically repeated three times to check the consistency of the coders’ responses. Accordingly, the first three indicators were framed based on the contributions approach whereas indicators number four, five and six were prepared in line with the addition approach. Indicators number seven, eight and nine were designed based on the transformation approach, whereas the last three indicators were set to address a social action approach (Table 1). Each item in the coding sheet was judged for its validity, whether each of the items was developed based on the respective Banks’ four dimensions as well as the intelligibility of the wording, by senior researchers in the areas of higher education and curriculum studies. The four texts were coded based on the indicators presented in Table 1.

Table 1

<table>
<thead>
<tr>
<th>No</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The cultures of the majority of Ethiopian ethnic groups are incorporated into the objectives, contents, learning activities and evaluations of the secondary education teacher training curricula to supplement the core themes of the mainstream curricula.</td>
</tr>
<tr>
<td>2</td>
<td>Multicultural-oriented concepts are entertained in the current secondary education teacher training curricula without giving much attention to their deeper meanings.</td>
</tr>
<tr>
<td>3</td>
<td>Discrete cultural artifacts, such as the foods, histories, dances, music etc., of ethnic groups (Oromo, Amhara, Tigray, Somali, Sidama and others) are incorporated into the secondary education teacher training curricula to at least make the prospective teachers aware of them.</td>
</tr>
<tr>
<td>4</td>
<td>Concepts that reflect the multi-ethnic and multicultural nature of the Ethiopian society are infused into the secondary education teacher training curricula without changing their fundamental framework.</td>
</tr>
<tr>
<td>5</td>
<td>Words, phrases and/or statements that address the diverse cultures of Ethiopian people’s are incorporated into the objectives, contents, learning activities and evaluations of the current secondary education teacher training curricula to help prospective teachers to see things from different perspectives.</td>
</tr>
</tbody>
</table>

Sequel to Table 1 see on p. 65.
6 Concepts that reflect the Ethiopian ethnic groups’ cultures are added to the secondary education teacher training curricula in the form of units and/or courses without changing them substantially.

7 The purposes, contents, learning activities and assessment methods of the current secondary education teacher training curricula are changed fundamentally so as to enable prospective teachers to view concepts, issues and themes from many ethnic groups’ perspectives.

8 The overall features (purposes, contents, sequences, learning activities, instructional resources and evaluations) of the secondary education teacher training curricula are completely changed to make them responsive to the cultures of the majority of Ethiopian peoples.

9 Contents that extend prospective teachers’ cognitions of the nature, development and complexity of the diverse Ethiopian society are addressed in the teacher education curricula.

10 Contents and/or learning activities that help prospective teachers to become active citizens are addressed in the secondary education teacher training curricula.

11 Contents which aimed at educating prospective teachers to analyse about their social realities thereby develop decision-making skills are accommodated in the teacher education curricula.

12 Balance was maintained in borrowing core elements of curriculum from international perspectives and in incorporating Ethiopian indigenous knowledge into the secondary education teacher training curricula.

When it comes to selection of coders, three with specialisation in curriculum studies and one with specialisation in the English language and literature were selected purposely due to the fact that all of them are teachers’ educators and the relevance of their areas of specialisation to the study under consideration. Further, the person with specialisation in the English language and literature was chosen as he was found to have special training as well as awareness of multicultural education. In addition, the coders were taken from two of the Ethiopian universities with comparatively better experiences in secondary teacher education programme: two from Addis Ababa University and two from Adama Science and Technology University. They were given thorough training in how to code the sample texts. The training focused on establishing a common baseline through understanding how multicultural education is conceptualised in this study. Moreover, the training emphasised understanding the essence of the coding sheet and how to use it in analysing the sample texts through checking off the five-point Likert scale. In order to ensure the validity of the coding process, each of the sample courses was coded by two coders separately. As part of the follow-up process of the coding procedure as well as for cross-checking purposes, I participated as a co-coder for each of the four texts.
The reliability of the coding process was checked using Sarantakos’ (2005) standard, i.e. 80% as satisfactory. Thus, the two respective coders’ level of agreement or the hit or miss between the coders in the respective courses was determined by comparing each of the percentage of concordance to 80%. The assumption was that, if the level of agreement between the two coders was less than 80%, the coding process would be considered as unreliable. If the concordance between the two coders was equal or greater than 80%, it was taken to be reliable. Based on the results, how multi-ethnic and multicultural contents are addressed in the current Ethiopian secondary teacher education curricula is determined.

In addition, qualitative content analysis was employed to compare its results with the research findings obtained through the quantitative content analysis. The qualitative content analysis was made to analyse the degree to which issues of multiethnic and multicultural education are embedded in the latent contents of the sample texts. In other words, this part of the content analysis concentrated on the latent contents which are unobservable, and that should be measured indirectly (Neuendorf, 2002). Furthermore, unlike quantitative content analysis, qualitative content analysis gives the possibility to investigate words and images (Hammersley, 1990). Qualitative content analysis may also help a researcher to explore the meaning and realities beyond the words and images (Alvesson & Skoldberg, 2009). In short, it was against the backdrop of the above discussions that the qualitative content analysis was made in relation to Banks’ four approaches to the integration of ethnic and multicultural contents into teacher education curricula.

In general, in this study, both qualitative and quantitative content analyses were made to obtain valid and reliable research results. This is guided by the notion that any researcher who engages in content analysis is expected to consider both the manifest and the latent contents of the document under consideration. This is also important to triangulate the results of the content analyses.

Results and Discussions

This section deals with the results of the study and the subsequent discussions. As such, results of both the qualitative as well as the quantitative content analyses were presented and discussed. To that effect, in the case of the quantitative content analysis, since the final results of the coding process found to converge mainly to the option ‘fully disagree,’ the five-point scale was reduced to a three-point scale to present the results in a concise manner. To that effect, in the case of the quantitative content analysis, since the final results of the coding process found to converge mainly to the option ‘fully disagree,’ the five-point scale was reduced to a three-point scale to present the results in a concise manner. In so doing, the values of the options ‘fully agree’ and ‘agree’ were combined. Similarly, the values of the alternatives ‘fully disagree’ and ‘disagree’ were summed up. This resulted in having a Likert scale with three columns – agree, no opinion and disagree. So, the upcoming results and discussions were made based on the three-point scale table.
This document encompasses the syllabi of all the 12 professional courses designed for the current Ethiopian secondary teacher education programme. It was developed in connection with the introduction of the PGDT programme in 2009. It consists of, amongst other things, the total number of courses to be offered, their breakdowns and descriptions.

Compared to the secondary teacher education curricula under TESO, in this curriculum framework, certain attempts are made to accommodate multicultural education in Ethiopian secondary teacher education curricula. For instance, for the first time in the history of Ethiopian teacher education, a two-credit course entitled “Teaching in a Multicultural Setting” was included as a fully-fledged course. Although this is argued to be insufficient concerning the importance of multicultural and multi-ethnic education in a diverse nation as Ethiopia, it could be considered as a positive development. Moreover, the course entitled “Inclusive Education” has been included. Because of the inclusive nature of multicultural education, one may expect that issues of multicultural and multi-ethnic education are to be entertained in the course “Inclusive Education”. Nevertheless, the qualitative content analysis reveals that it solely dwells on the issues of special needs education.

Moreover, it is pinpointed in the general framework (Ethiopian Ministry of Education, 2009) that “the process of secondary school teacher preparation has to be guided by such value orientation as inclusiveness, caring, multiculturalism, learner-centered and pragmatism” (p. 11). In addition, it is indicated that the secondary teacher education curricular contents should be related to current societal changes, such as integrating knowledge and competencies concerned with unavoidable socio-cultural realities such as multiculturalism and teaching in minority settings (Ethiopian Ministry of Education, 2009). This shows that there is a tendency of tilting the Ethiopian secondary teacher education programme towards the diverse characteristics of the country. This, on the other hand, calls for introducing the teacher candidates to the multiple ways through which humans acquire knowledge, develop skills and attitudes to effectively cope with the multiplicities prevailing in their society and beyond. As Kolikant and Pollack (2009) state “…education can and should emphasize the multi-perspectivity, controversy, and plurality of human knowledge and thought in order to help students to understand and deal with contradictions in their world” (p. 673).

In general, the results of the qualitative content analysis of the general curriculum framework revealed that core elements of ethnic and multicultural education are, to a large extent, missing from the major parts of the document. In other words, although there are some initial ideas that indicate the importance of incorporating multicultural education into Ethiopian secondary teacher education curricula, the diverse characteristics of the Ethiopian society are, to a great extent, missing in the general curriculum framework. This was ascertained by the results of the quantitative content analysis whereby the two coders’ level of agreement is 83.33%. This means that, out of the 12 indicators applied, the coders came to agree on 10 of the options that showed a complete absence of ethnic and multicultural contents in the national secondary teacher education curriculum framework.

Concerning the importance of teacher education in implementing issues of diversity that are addressed both in the Ethiopian constitution and the education and training policy, one would expect multi-ethnic and multicultural education to be infused into
each of the 12 courses designed for the PGDT programme so that each teachers’ educator may synchronise issues of diversity with the contents he/she teaches. This, in turn, may help the prospective teachers to develop a better understanding of issues of ethnic pluralism and multiculturalism thereby acquainted with strategies to manage such multiplicities during the course of their education and training programme. Many scholars argue that ethnic and cultural diversity needs to be woven into all the components of a teacher education curriculum, rather than being treated only in an isolated course or in fragments scattered across the programme (Banks, 2006; Chan, 2006; Gagliardi, 1995; Gay, 2000). Besides, according to Gay (1997), multicultural assumptions, issues, contents, materials and techniques need to be infused into deliberate, systematic and substantive ways throughout the entire structure of teacher education programmes and curricula.

However, both the qualitative and the quantitative content analyses show that this is not the case in the current Ethiopian national secondary teacher education curriculum framework. Besides, particularly through the qualitative content analysis, it is found that, except for one paragraph that deals with the description of the course “Teaching in a Multicultural Setting”, issues of multi-ethnic and multicultural education are missing in the remaining 11 descriptions of the national secondary teacher education curriculum. Instead of being integrated into each professional syllabus, multicultural education is presented as a separate course with only two credits out of the total of 40 credits allocated to professional courses of the PGDT programme. This might have emanated from lack of in-depth knowledge and skill regarding how to design a general teacher education curriculum framework whereby issues of diversity are infused in each and every professional course. On the other hand, the experts who designed the general curriculum framework may deliberately overlook issues of ethno-cultural diversity thinking that incorporating such issues into the framework may not be welcomed by certain groups of society. The experts may also think that incorporating ethno-cultural perspectives into the framework could be considered as political issues.

School and Society

This module or study material has 139 pages. Its core purposes are to help prospective teachers to understand the overall school environment and the nature of society in which the school is operating analyse forms of societal participation in school affairs and comprehend the role of teachers in fostering school-community relationships. The course may bring the attention of Ethiopian secondary school prospective teachers to the social reconstruction ideology where schools are believed to serve as agents of social change. According to Kenea (2010), the social reconstruction perspectives recognise the power of the formal curricula and teachers to counter the out-of-school influences and the ultimate role of schools to build the future of society.

Fernandez, Ritchie and Barker (2008) contend that “engagement in social practice is the fundamental process by which we learn, and we become who we are” (p. 190). This may be realised if prospective teachers are trained through learning activities which involve cooperative learning, development of interpersonal relationships, appreciation of differences and intercultural grouping of students that create opportunities for them to exercise tolerance and reciprocity.

It could be argued that, for prospective teachers who are expected to work in ethno-culturally diverse nations like Ethiopia, having a clear understanding of how
Representation of the Ethiopian Multicultural Society.. issues such as culture and ethnicity influence students’ learning is extremely important. This, in turn, shows that prospective teacher education and training should highlight issues of diversity. In addition, if a teacher education curriculum is to serve societal interest, one expects it to be designed in a way that addresses the society’s culture, language, history and tradition so that the prospective teachers are acquainted with knowledge, develop skills and attitudes necessary to preserve as well as sustain those important attributes in a fair way as part of teaching in multicultural settings. These overall competences may help the teacher candidates to understand diversity perspectives. This means that, rather than judging other people’s cultural practices against their own, they learn to value the diverse cultural practices as valid and worthy (Souto-Manning & Mitchell, 2010).

The qualitative content analysis revealed however that this is not the case in the course “School and Society”. In other words, whereas the course “School and Society” is suitable for infusing the essence of ethnic and multicultural education into its objectives, contents, learning activities, instructional resources and modes of evaluations in a harmonised manner, issues of ethnic and multicultural education are missing. This was confirmed by the two coders’ level of concordance of 91.67%. This means, out of the 12 indicators, the coders agreed on 11 of them that indicated a complete absence of elements of ethnic and multicultural education. This may emanate from lack of awareness about the importance of integrating issues of diversity into the study material by the writer, and/or the writer might deliberately downplayed these issues thinking that they are sensitive topics.

This also means that if issues of multiethnic and multicultural education are missing in a course which is assumed to be more suitable for integrating them into a teacher education programme, it is less likely that those issues are incorporated into the rest of the teacher education and training courses. In addition, the absence of elements of multi-ethnic and multicultural education in the course entitled “School and Society” may imply that what is being taught under the auspices of the Ethiopian secondary teacher education programme is not reflective of the diversity that characterises the Ethiopian society.

Action Research

This study material has 73 pages in total and consists of two parts. Part one is organised into three units. Unit one deals with the basics of action research, such as its conceptions, importance and characteristics. The second unit dwells on the processes of action research which involve planning, acting, developing and reflecting. The third unit emphasises the preparation and presentation of an action research project report. In all of the three units, pre-reading activities, unit objectives, contents and summaries are provided.

The qualitative content analysis showed that multiethnic and multicultural education are not addressed in any form of Banks’ (1993, 2001, 2006) four approaches of treating ethno-cultural contents in a teacher education curriculum. Here, it could be argued that “Action Research” as a professional course could be a potential subject through which prospective teachers would practically acquire the fundamental knowledge, skills and attitudes necessary for managing issues of diversity by engaging in practical and solution-oriented small-scale research activities individually and/or in teams. In support of this
argument, Souto-Manning and Mitchell (2010) assert that to make classrooms more inclusive and culturally-responsive, action research, especially collaborative action research, could be a critical tool for gathering invisible and multi-faceted knowledge that researchers as outsiders and teachers as insiders cannot solely record and/or obtain. Moreover, Chan (2006) claims that “given the role of experience in shaping perceptions of curriculum, we can expect that teachers’ practices and beliefs about incorporating culture into the curriculum would be shaped by their own experiences of culture in their school curriculum” (p. 172).

However, the results of the qualitative content analysis showed that elements of ethnic and multicultural education are not incorporated into any part of the study material. This argument was confirmed by the result of the quantitative content analysis where the two coders’ level of agreement was 100%, indicating the complete absence of issues of multicultural education. This might result from the course writer’s unawareness about the relevance of addressing issues of diversity that await the prospective teachers after graduation and/or it might be due to resistance. This may also emanate from the Ethiopian Ministry of Education’s lack of awareness or concern about the importance of incorporating basic elements of multicultural education in each professional course as important tool for implementing the objectives stated in the Ethiopian education and training policy and in the general secondary teacher education curriculum framework in relation to issues of diversity.

Practicum

This study material has 108 pages and is grouped into three subsequent sections: practicum I, practicum II and practicum III. According to the course, Ethiopian secondary education prospective teachers are expected to engage in reflection upon what they are learning in the other professional courses in light of the actual teaching practices in the nearby secondary schools. This requires the teacher candidates to observe and practise teaching in the schools throughout the education and training programme. Accordingly, from the very beginning, prospective teachers will go to the nearby partner secondary schools on a regular basis and conduct critical observations, do assignments related to each professional course and gradually practise teaching.

As stated earlier, according to the PGDT programme, Ethiopian secondary teacher education is conducted for one year, although, in actual terms, the training lasts for ten months. This training is divided into three terms of three months’ duration (Ministry of Education, 2009). Each term is assumed to help prospective teachers to maintain the sequence and integration of the courses into the whole secondary teacher preparation programme. According to this arrangement, prospective teachers can take basic courses well ahead of those courses which deal with the specifics of teaching. In addition, those courses that complement each other are offered in the same term. 30% of the courses given in the first two terms are school-based activities. Each prospective teacher taking those courses is required to do school-based assignments by actually experiencing the different aspects of teaching in the schools (Ethiopian Ministry of Education, 2009). This means that, in these two terms, practicum is conducted along with each professional course offered in the two terms. In the third term, the prospective teacher is assumed to work independently with little support from the mentor.
As can be seen from the way the practicum is structured, it could be argued that basic elements of ethnic and multicultural education could be infused into the entire practicum programme so that integration within the course itself as well as across the other professional courses could easily be maintained. Nevertheless, the results of the qualitative content analysis revealed that fundamental elements of multicultural education are missing in the course. This is also supported by the two coders’ concordance of 100%, indicating a complete absence of ethnic and multicultural education contents.

According to Zeichner (1992), prospective teachers’ placement in schools in relation to practicum could involve commitment to the preparation of teachers to serve students of all social and cultural backgrounds. As argued by him, the old model of the practicum was based on a view of teaching as an applied science; the prospective teacher’s role was to apply what had been learned in a teacher education institution to actual teaching in schools. Nevertheless, the new practicum involves recognition that learning to teach is a process that continues throughout a teacher’s professional career and that no matter what we do in our teacher education programmes and no matter how well we do it, at best, we can only prepare prospective teachers to begin teaching. Consequently, teacher educators must help prospective teachers to take responsibility for their own professional development. One could, therefore, claim that Ethiopian secondary education practicum programme is not preparing the prospective teachers for the type of school environment awaiting them.

Conclusions

Multi-ethnic and multicultural education issues are high on the agenda worldwide, especially in the teacher education system of countries characterised by diversity. Nevertheless, although Ethiopia can be characterised as a mosaic consisting of well over 80 ethnic as well as linguistic groups, basic elements of multicultural education, such as ethnicity and culture are, to a large extent, missing in the overall teacher education system of the country. Core elements of multi-ethnic and multicultural education are also missing in the secondary teacher education curriculum framework and the specific courses designed based on the general curriculum framework. Due to this, there is a very limited degree of vertical integration between the national secondary teacher education curriculum framework and the specific secondary teacher training courses regarding the incorporation of basic elements of multi-ethnic and multicultural education into the secondary teacher education curricula. In addition, neither the national curriculum framework nor the specific sample professional courses reflect the Ethiopian ethnic group cultures.

In other words, even though there are certain initial ideas that are useful to gear the Ethiopian secondary teacher education programme towards multiculturalism in the general national curriculum framework, these have not been repeated in the development of the three sample professional courses. On the basis of these findings, one could argue that it is necessary to incorporate basic components of multi-ethnic and multicultural education into the general national curriculum framework and the specific professional courses in an integrated manner so that they could reinforce each other in a positive way in equipping the prospective teachers with the cultural competence necessary for teaching in a multicultural setting. Moreover, while attempting to do justice to all the cultures of the nations and nationalities of Ethiopia, for the sake of manageability, it is important to incorporate the cultures of at least the major ethnic groups, namely Oromo,
Amhara, Somali, Tigraway, Sidama who constitute 34.5%, 26.9%, 6.2%, 6.1% and 4.0% of the total population respectively (Federal Democratic Republic of Ethiopia Population Census Commission, 2008) into the entire secondary teacher education curricula. This would include both the national curriculum framework and the specific professional courses to help the prospective teachers to gain different perspectives.

In so doing, amongst other things, the knowledge, skills and attitudes of the people that involve in the development of the teacher education curricula are expected to be improved with respect to multi-ethnic and multicultural education. To this end, the Ethiopian Ministry of Education is expected to provide courses that focus on how to infuse issues of multiethnic, multicultural and multilingual education into the entire secondary teacher education curricula to the experts who are in charge of developing the curricula. In addition, it is important to make sure that those courses help the experts to bring real attitudinal changes concerning the issues of diversity through challenging their deep-seated preconceived attitudes.

Moreover, it is necessary for the Ethiopian Ministry of Education to develop a clear guideline which indicates how to design teacher education curricula via balancing cultural diversity and national unity, indigenous knowledge and international knowledge, and the likes. Moreover, it is of relevance that the guideline indicates how to effectively apply ethno-culturally sensitive teaching strategies and assessment techniques in a teacher education programme. Furthermore, it is necessary that the Ethiopian Ministry of Education makes sure that the experts who design the secondary teacher education curricula are representatives of, at least, the major ethnic groups outlined above. This representation is important, amongst other things, to get specific cultural contents and inputs which are assumed to be incorporated into the curricula from the various ethno-cultural groups of the country.

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The Finnish Five-String Kantele: Sustainably Designed for Musical Joy

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Abstract
This article discusses the five-string kantele as an example of the Finnish national heritage, a school instrument and an example of sustainable design. A qualitative case study was made by collecting the data from the Finnish students – prospective teachers – and the sixth form pupils, who had designed and carved their own five-string kanteles. The purpose of this research was to find out which aspects of five-string kantele design are considered the most important for sustainable principles and design among these youngsters. As results, the elements and principles of designing the five-string kantele are discussed and its relevance to five sustainable characteristics (creative, ecological, economic, aesthetic and socio-environmental) is presented. The sustainable values of the kantele and the purpose for which it is made are also considered.

Keywords: sustainable design, artifact, five-string kantele, musical instrument design, the Kalevala

Introduction
This paper discusses the five-string kantele as an example of sustainable design. The theoretical background discusses the role of the five-string kantele in the Kalevala and the cultural-ideological information that is conveyed through its use and construction. The principles and values of sustainable design are presented as well as contemporary design and research on the Finnish five-string kantele. The five-string kantele is an example of the Finnish national heritage, a heritage that has become a part of Finland’s living musical culture in kindergartens and schools.

The five-string kantele is widely used in music education of Finnish preschools and primary education. Technical crafts and music education can be integrated by having students construct their own kanteles.

The education of national heritage and cultural history is an important part of Finnish basic education and forms part of the national core curriculum theme of cultural identity. The first part of the article will describe the kantele and its many roles: it is seen as the first invention; it is made for enjoyment and pleasure; it is used to convey information and for peaceful war making (concerning the fight for Sampo, only singing...
and the kantele are present in Pohjola). The music culture of schools and day care centers begins with teachers who create a musically rich living environment where singing, rhymes and kantele playing become part of students’ everyday routines. At schools, the five-string kantele can be constructed by using creative, new design ideas so that music and technical crafts can easily be integrated in a creative design discussion. Finnish folk music and five-string kantele design and playing can also be easily integrated into various other activities like painting, movement, literature and drama.

The second part of this paper is the case study of students’ conceptions of pupils who design and construct their own five-string kanteles, where they discuss the sustainable elements of the five-string kantele. In the Finnish National Core Curriculum (2004), “responsibility for environment, well-being and sustainable future” (p. 39) is a cross-curricular theme from the 1st form to the 9th form. The objective of Finnish basic education is to raise environmentally conscious citizens who are committed to a sustainable way of life. The pupils will learn to promote well-being in their own communities and understand that throughout their choices individuals construct both their own futures and the common sustainable future. The core contents of this theme are, for instance, eco-efficiency of production, design, society and everyday acting. Pupils are studying and discussing consumer behavior, their choices and actions concerning sustainability throughout their basic education years.

The Sustainable Role of the Kantele in the Kalevala

The history of the kantele is learned in schools to better understand its sustainable role in the context of the Finnish national heritage. The origins of this traditional, plucked string instrument can be found in the Middle East, but, as a member of the Baltic psalteries, the kantele is a unique instrument representing Finnish culture. Nowadays there are several types of kanteles; the largest version has 39 strings and a tuning mechanism, and it is used in folk music, classical and popular music (Ruokonen, Kattainen, & Ruismäki, 2012).

The Finnish national heritage of folk music and poems, collected by Elias Lönnrot and published as the Kalevala in 1849, has become the national epic. The five-string kantele was decorated and first played by Väinämöinen, the hero of the Kalevala tale. The role of a kantele and music in the Kalevala is presented by analysing and reflecting on the text of the national epic by focusing on the poems where the five-string kantele is mentioned.

“They Turned, TheyListened to That Sweet Music, to the Kantele’s Eternal Joy”

It has been estimated that approximately 2,500–3,000 years ago, a major new development in the culture of proto-Finnic groups living near the Gulf of Finland occurred. The result of this development, according to Asplund and Mettomäki (2000), was a unique form of song characterised by alliteration and parallelism as well as an absence of stanza structure. The poetic meter of these songs was a special trochaic tetrameter that is now often called Kalevala meter. When sung, the lines actually had four or five stresses and the melodies covered a narrow range, usually consisting of only five notes (Ruokonen et al., 2012).
The archaic song tradition was a vital and living tradition throughout Finland until the 1500s. Some songs were recorded already in the 1600s, but most of the folk poetry collection work was carried out in the 1800s. The Kalevala epic is a collection of poetic song tradition sung in an unusual, archaic trochaic tetrameter, which had been part of the oral tradition of Baltic-Finnish languages for two thousand years. The Kalevala brought the small, unknown country and its people to the attention of other Europeans and strengthened its self-confidence in sustaining the Finnish language and culture. According to Asplund and Mettoman (2000), the Kalevala has been translated into 51 languages in over 150 translations. In this paper, we refer to Keith Bosley’s Oxford world classics translation from 1989. Bosley has, in a marvelous way, penetrated the singer’s way of thinking and expressing thought and feeling in the images, music and rhythm of great poetry.

The oldest layers of folk poetry are represented by mythical poems that tell of creation acts as well as the origins of the world. Lyric songs express human, personal emotions. There are also ritual songs made especially for weddings and bear-killing feasts. The Kalevala meter incantations are verbal magic, which were a part of people’s daily lives and activities. The main character in epic singing is usually a mighty singer, shaman and sorcerer, a leader who makes journeys to the land of dead in order to seek knowledge. The songs’ heroes also have adventures in a distant land beyond the sea where they woo potential brides, make raids and flee the enemy. In the Finnish national epic, Kalevala, Väinämöinen is the main character who sings and plays the kantele. Väinämöinen searches the sea for Aino and catches her (she has been transformed to a fish) on a fishing hook. He loses her again and like most mighty heroes travels through many adventures.

There are two kanteles and two poems of the birth of kantele in the Kalevala and Väinämöinen has a major role in both of them. The first kantele was invented when three mighty Kalevala heroes, Väinämöinen, Ilmarinen and Lemminkäinen, set out to steal the Sampo, which is a pivotal element of the plot of the Finnish epic poem. According to the Kalevala, he who possesses the Sampo receives prosperity and all good things. Ilmarinen, the smith of the Kalevala, had created the Sampo, but it was given to the Pohjola (Northland, a location in Finnish mythology) in ransom for the return of the maiden of Pohjola, who was Mistress of Pohjola’s (Louhi’s) daughter. The tale is like a fisherman’s tall tale. In the course of the journey to Pohjola, the boat of the three heroes runs aground on the shoulders of a giant pike. Väinämöinen kills the pike and fashions a kantele from this jawbone. No one else is able to play the instrument, but mighty Väinämöinen holds all living things spellbound with his playing. Thus, the kantele was a new invention, the first instrument to produce sound in the air. The music Väinämöinen played was so powerful that all creatures in nature wanted to listen to it, “There was none in the forest running on four legs or hopping on foot that did not come to listen marvel at the merriment ... the air’s nature daughters and the air’s lovely lassies marvelled at the merriment, listened to the kantele ... there was no creature not in the water either moving with six fins the best soul of fish that did not come to listen” (The Kalevala, 1849/1989, pp. 539–541).
Sustainable Power of Kantele Music in Peace Making

The Kalevala men want to share the Sampo with Northland (Pohjola), but Louhi, the mistress of Pohjola, refuses and calls her young men together with their swords and weapons to kill Väinämöinen. What did old Väinämöinen do? He had no weapons or swords; he just began to play music with the kantele. This power of music is used instead of weapons, “Steady old Väinämöinen seized his kantele, he sat down to play and began to play prettily; and they all stopped to listen and marvel at the merriment – men in good spirits, wives with smiling lips, fellows with tears in their eyes and boys kneeling on the ground. He wears the folk down and tires the people: all the listeners fall asleep; the watchers sank down; the young slept and the old slept at the sound of Väinämöinen’s music” (The Kalevala, 1849/1989, p. 548).

Väinämöinen puts the people of Pohjola to sleep with his kantele playing. The Sampo is taken to the travelers’ boat, and they row away. Therefore, the war was peacefully over, or so the heroes of Kalevala thought. When the people of Pohjola awaken, Louhi sends obstacles in the path of the sailors to hinder their escape. The seafarers survive, but the first pike bone kantele falls into the sea. Louhi sets off in pursuit and transforms herself into a giant bird of prey. In the ensuing battle, the Sampo is also smashed and falls into the sea, but others wash ashore and bring Finland good fortune and prosperity. In vain, Väinämöinen seeks the kantele, which had fallen into the sea.

Sustainable Value of Joy and Creativity in Kantele Music

Väinämöinen makes a new kantele from weeping birch wood, “Here is a belly for the kantele, a soundboard for eternal joy” (The Kalevala, 1849/1989, pp. 579–580). Nearby there was an oak, and, on its acorn, was a golden whorl and a cuckoo; every time the cuckoo calls and utters five words, gold and silver wells from its mouth on a golden knoll on a silver hill and from there Väinämöinen gets the screws for the kantele. Still, five strings of the kantele are missing and Väinämöinen begs for tresses from the hair of a young maiden, Aino, “Lass, give me some of your tresses, damsel, of your hair for kantele strings voices of eternal joy!” (The Kalevala, 1849/1989, p. 581). The maiden gave some of her tresses and the new instrument was ready. Väinämöinen plays music again and delights the whole creation; this music was characterised as even more beautiful than the sound of the first kantele, “Never have we heard such playing, never heard such strains of music, never since the earth was fashioned, as the songs of this magician, this sweet singer, Väinämöinen!” (The Kalevala, 1849/1989, p. 582). At the end of the Kalevala epic, a poem symbolises the coming of the new Christian era to Finland. Marjatta conceives a child from a whortleberry. Väinämöinen condemns the fatherless child to death, but the child speaks out against the sentence and is christened King of Karelia. Väinämöinen departs in a copper boat with the prediction that he will be needed again someday to make a new Sampo for the people to bring happiness, new light and new songs. He also leaves his kantele and Kalevala songs for Finnish children to sing throughout all times and places. “Then the old Väinämöinen goes full speed ahead in the copper boat, the coppery punt to where mother earth rises and heaven descends and there he stopped with his craft with his boat he paused; but he left the kantele behind the fine music for Finland for the folk eternal joy the great songs for his children” (The Kalevala, 1849/1989, p. 663).
So the role of the kantele in the Kalevala is first as a new invention, a totally new man-made creation, the first instrument ever developed; secondly, the kantele plays an important role as music was a new way to describe emotions so the role of the kantele is to make music for pleasure and joy for all of creation. The kantele had also a peaceful role in a war; it was used instead of weapons. The role of music was also therapeutic and relaxing. The role of music in distributing information is seen throughout the Kalevala. The kantele also had a role as maintainer of creative traditions. That is, the birth of new songs and ways to use the instrument was based on the tradition of folk music singing, playing styles and improvisation. At the end of the Kalevala, Väinämöinen speaks about changing and developing tradition, “Just let the time pass, one day go, another come, and again I’ll be needed... make a new music, convey a new moon, set free a new sun ...” (The Kalevala, 1849/1989, p. 663).

Role of the Five-String Kantele in Finnish Education

The present study concerns the educational design and focuses especially on sustainable design in Finnish culture. Therefore, the role of the kantele in Finnish education as well as design practices and its development in Finnish kantele design is introduced.

The five-string kantele was about to disappear from Finnish education in the early 1950s, but, nowadays, it has an important role in Finnish music culture and education. Several factors influenced this rise in interest in the kantele. Firstly, a new interest in Finnish folk music began in the village of Kaustinen, where the first Folk Music Festival took place in 1968. Secondly, Professor Martti Pokela worked on folk music in the Sibelius Academy and in music teacher education during the 1970s and 1980s; he established the folk music department in the Sibelius Academy in 1983 together with professor Heikki Laitinen (Ruokonen, 2003).

The original playing style of small kanteles from the Savo and Karelia areas has survived until today. In that style, the hands rest against both sides of the instrument. The strings are never damped, except in some cases to produce special sounds, so they can ring as long as possible or until they are played again. That makes the sound lasting longer and creates a hum and rattle – an important element of the musical tissue (Laitinen, 2010b).

Because of the variety of kanteles, there are also many other playing techniques today. The five-string kantele is a great instrument to begin with because of its suitable size, gentle sound and tuning close to the central register of the human voice (d1–a1). Playing a chord is also quite easy, even for small children, so the kantele makes playing fun and interesting.

Playing the five-string kantele began in the kindergartens and schools in the 1980s. The so-called “berry chords” (I=strawberry, V=blueberry, IV=cloudberry), which are, nowadays, commonly used, were invented by kindergarten teacher, Maija Simojoki, who also published the first kantele tutorials together with Ritva Ollaranta. In early music education, the five-string kantele has become one of the most popular instruments. It can be used as an accompaniment instrument, played by the teacher, or played by the children. The kantele can be played even in infant music groups, but it is most commonly used with the children aged six years and older (Ruokonen et al., 2012; Tenhunen, 2010).
According to Ruokonen et al. (2012), the kantele is a part of a journey to the sources of creativity. Improvisation has always had an important role in the kantele tradition. The magical sound of the instrument helps the musician to let the music flow freely. Laitinen (2010a) describes how hundreds of people of all ages, who had never played any instrument, became enchanted by the five-string kantele in the 1980s, when a project on behalf of the kantele was started. The people touched the strings carefully one by one so that new sounds filled the air and suddenly there was an infinite number of melodies and original music. It was impossible for them to stop playing. Laitinen (2010a) acknowledges that there is a complete alternative music pedagogy hidden in the kantele. According to Hill (2005), Finnish contemporary folk musicians have created a new, innovative, passionate, diverse, self-consciously artistic design and form of music.

In the present Finnish National Core Curriculum (2004) for basic education, music and crafts are a part of the arts. Craft is divided into technical and textile crafts. According to Sepp, Ruokonen and Ruismäki (2010), the whole concept of arts as well as arts education has many meanings and connections and is not easy to define perfectly: it encompasses the development of affective, cognitive, technological, psychomotor, social skills as well as specific subject knowledge. According to Autio, Thorstenseinsson and Olafsson (2012), the aim of Finnish craft education is to increase pupils’ self-esteem by developing their skills through enjoyable crafts activities and increasing their understanding of the various manufacturing processes and the use of different materials in craft. Finnish handicraft traditions are also important throughout the whole curriculum (Framework Curriculum guidelines, 2004).

Ruokonen and Muldma (2007) have researched the sustainable and cultural meanings of music in basic education through the 8th form pupils’ thoughts and experiences. Their study indicates that Estonian and Finnish the 8th form pupils see music as an essential value. The kantele is played at schools in both countries, and pupils considered music education to be a part of their culture and cultural education. Music also had important cultural and educational roles for sustainable development in both countries. The meanings of music were connected to the values of recognising diversity and increasing the respect and tolerance for differences. Music also promoted the creativity of pupils in a spirit of freedom and intercultural dialogue (Ruokonen & Muldma, 2007).

**Design and Development of the Finnish Five-String Kantele**

Designing and constructing the five-string kantele is very popular and valued in Finnish instrumental design culture nowadays because of the important role of the kantele in Finnish music culture and education. Many companies, private designers, students pupils construct their own creative versions of a five-string kantele.

According to Hienonen (2007), the success of a new design product is connected to the designer’s ability to feel and give birth to new ideas that provide positive experiences, services and products for people. For instance, the Koistinen Company has had the mission to update the instruments’ old image to a modern look and sound by developing the Wings kantele (Koistinen, 2014a, 2014b). The product graphics collection was designed in two parts accordingly. The ideas for the design are chosen from the Kalevala epic, folk-tales, Karelian embroidery and Finnish nature.
It is easy to produce an electronic version of kantele by adding microphones to it. In schools, acoustic kanteles are primarily used in pre- and primary schools and electronic versions in higher grades.

Nowadays Finnish kanteles are more often seen in concerts and in situations where players are before a large audience, but the traditional Finnish models are usually not heard without amplification. Although there are electronic versions of the kantele and microphones for kanteles on some occasions, they do not serve the musical presentation. On the stage, the kantele needs to be louder than traditional models, and this has been examined by researchers from the Helsinki University of Technology in co-operation with the Leppävirta kantele company. Pölkki, Erkut, Penttinen, Karjalainen and Vesa Välimäki (2003) have developed a new design for the kantele according to what can be done without electrical amplification. They had the idea to add a freely vibrating top plate to an 11-string kantele from the old five-string museum kanteles: some of them have a closed box while others are carved from a single piece of wood so that they have a top with sides along the edges, but no bottom. The bottomless design is clearly the louder of the two, and it has a warmer timbre. Their practical experiments showed that the old bottomless design could be further improved by taking the idea of a “bottomless box” to the direction of a reinforced plate. An experimental bottom, fixed to the top at the center and separated with a small gap at the boundaries sounded louder and was used in their design improvement and research (Pölkki et al., 2003).

Other researchers in the field of kantele design and construction have added other ideas to this discussion. Penttinen’s (2006) future dream of kantele design is to be able to accomplish instrument design in the digital domain. This means building and reshaping an instrument on the computer by listening to how the changes affect the final instrument before a single finger has even touched wood. Kastinen (2000) lifts up the aesthetic features of an artistic experience by stressing that the subjective qualities of sound are not the same as its physical parameters. Loudness, pitch and timbre are all more or less dependent on pressure, frequency, spectrum, duration and envelope (Kastinen, 2000).

Some Principles of Sustainable Design

The concept of sustainability appears in several texts with many different definitions. Broadly, the content of the concept is determined by the different value criteria of the various interest groups around an object or a product. According to McLennan (2004), sustainable design, as the design component in a sustainability philosophy, can be seen as a practice by a growing number of people who understand and accept the sustainability premises, as outlined in the following section. Sustainable design is the philosophy of designing physical objects, the built environment and services to comply with the principles of social, economic and ecological sustainability (McLennan, 2004). Alting, Hauschild and Wenzel (1998) connect sustainability to the economic, social and environmental responsibilities of people in the future in maintaining resources that will continue to serve people’s needs.

Few written research articles exist that discuss the principles of sustainability concerning musical instruments. One has to look at other areas of design products. For instance, design-based, green engineering principles of sustainable design can be used more widely than only in science and technology. The 12 principles of sustainable design move beyond baseline engineering quality and safety specifications to consider environ-
mental, economic and social factors and can be used in creating and describing any design product. The first four green principles are as follows. Firstly, designers need to strive to ensure that all material and energy inputs and outputs are as inherently non-hazardous as possible. Secondly, it is better to prevent waste than to treat or clean up waste after it is formed. Thirdly, separation and purification operations should be designed to minimise energy consumption and materials use. Fourthly, products, processes and systems should be designed to maximise mass, energy, space and time efficiency.

The next principles continue to detail the many aspects of sustainable design. Fifthly, products, processes and systems should be “output pulled” rather than “input pushed” through the use of energy and materials. Sixthly, embedded entropy and complexity must be viewed as an investment when making design choices to recycle, reuse, or beneficially dispose of materials. Seventhly, targeted durability, not immortality, should be a design goal. Eighthly, designs should be tailored to fit needs rather than for unnecessary capacity or capability (for instance, “one size fits all”). The last four principles lead to green and sustainable thinking in designing the products. Ninthly, material diversity in multicomponent products should be minimised to promote disassembly and value retention. Tenthly, the design of products, processes and systems must include integration and interconnectivity with available energy and materials flows. Eleventhly, products, processes and systems should be designed for performance in a commercial “afterlife”, and, finally, material and energy inputs should renew rather than deplete resources (Anastas & Zimmerman, 2003).

Although the five-string kantele was not originally conceived to encompass all of these twelve principles of sustainable design, it can be seen as a design product that incorporates Benyus’ (1997) ideas of biomimicry design. According to Benyus (1997), nature can be seen as a model, and designers can find inspiration for designs in nature; they also use the ecological standard to judge the correctness of their innovations and value what they can learn from nature.

Research Design and Methodology

Creativity and innovations in society require competencies that develop through participation and group work. These processes that develop through collaborative work with knowledge and solving problems is called knowledge creation (Bereiter, 2002; Hakkarainen, Palonen, Paavola, & Lehtinen 2004). According to Seitamaa-Hakkarainen (2011), design learning provides students important opportunities to work with design task in authentic and meaningful collaborative learning contexts where they can share and develop their new creative ideas of design. Because the design activity happened in collaborative learning settings, the group interview was a natural choice for data gathering in this case study. According to Stake (2006), a case study attempts to understand particular nuances about a case, which, in this study, involves the kantele designing experiences of the pupils and prospective teachers.

The aim of this qualitative case study was to determine which sustainable features Finnish young people can find in the five-string kantele as a design product. The aim was to discuss the sustainable features in the design of the five-string-kantele through group interviews of five prospective teachers and five 6th form pupils who had experiences of carving and designing five-string kanteles for themselves. They were asked to consider which elements and principles of the design of the five-string kantele have made it so
Inkeri Ruokonen, Anu Sepp, Venla Moilanen, Ossi Autio and Heikki Ruismäki

good and sustainable that it has been a part of Finnish culture for so long. The group interviews were made at the University of Helsinki, Department of Teacher Education and with five 6th form pupils from a Finnish comprehensive school in the Helsinki metropolitan area. The group interviews were made after their kantele design project when their kanteles were ready for playing. The questions asked both groups were the following: Which aspects of five-string kantele design do you consider the most important for sustainable principles and design; What is your opinion of the elements and principles of designing the five-string kantele and What can you tell about the design process of your own kantele? Finnish school children are used to discuss about the sustainability because of the cross curricular theme “Responsibility for environment, well-being and sustainable future” in the Finnish National Core Curriculum 2004. According to Cohen, Manion and Morrison (2011), group interviews are useful choice when a group of people have been working together for some time or a common purpose. In this case, both arguments were true, and, when discussing sustainability and design, it was important to share the experiences and ideas that were presented during the collaborative work.

In this research, we were interested in identifying the sustainable design elements of the five-string kantele. Group interviews began by looking at and playing five-string kantele with a brief discussion of some general features existing in this instrument and by discussing how interviewees describe the term sustainable design. In both groups of interviewees, students and pupils had constructed their own designs of a five-string kantele. These new models were compared with the traditional ones and with each other by discussing which features they wanted to maintain in their own kantele design and which variations they made and why. During the group discussion, they introduced the type of five-string kanteles they had designed, and they named the five most important features of sustainability for five-string kanteles in general. The actual group interview focused on the subjective experiences of the participants and their varied and common opinions about the design process and sustainable design. The group interviews were recorded, and the transcribed form of interviews were listened to and read several times to provide a context for the specific units of meanings which were identified and qualitatively analysed by finding different aspects of sustainability. The group interviews were qualitatively analysed and classified to five themes found from the basic data.

Research Findings

As a result, the features of sustainable design of five-string kanteles are presented as these ten young Finnish prospective teachers and pupils describe them. According to these interviews and the views of Finnish young people, the sustainable features of five-string kantele design were classified in five dimensions.

At first, the creative values of the five-string kantele were discussed. The five-string kantele was seen as a musical instrument that is optimally easy to play and improvise so it increased the willingness of the player to invent melodies and playing styles and improvise. This was seen as an important sustainable value of creating joy and increasing creativity in the mind. The five-string kantele allowed for an individual’s own musical design. The visual and shapely creativeness was also used in constructing and decorating their models of the kantele. One student mentioned that, “I looked at the old model of the kantele in the National Museum and used it in my model, but I wanted to decorate it somehow in a tattoo style.” (6th form pupil)
The ecological aspects were discussed as a feature of sustainable design. Finland is famous for its forests, and the kantele is made from wood – a natural material that is very familiar to Finns. Wood, usually black alder, is easy to carve and use again if needed. One prospective teacher suggested, “The five-string kantele has a sustainable future in Finland; we should teach more wood-carving in our schools.” In this feature, nature could be seen as an essential element of design.

Also, economic values were discussed as an element of sustainability. The five-string kantele is an inexpensive instrument of natural material and it is even less expensive if people make it themselves. The instrument is also easy to make at school and fits well in a curriculum of technical crafts. One student noted, “For me this was the best part of my craft studies. I could plan the form of my piccolo five-string kantele, and I only had to pay for five metal strings and some metal parts (ponsi and varras) of my kantele, so I saved a lot of money. I could also have a personal bird design on my kantele.” Thus, the natural design and material of the kantele shows that it can be ecologically designed and that process enhances creativity.

An aspect of sustainability found in these discussions was a social aspect in a craft class where wood was carved and the visual ideas of design were shared. When the instruments were ready, the musical joy of playing the kanteles and singing together was shared. One pupil described this enthusiasm, “The atmosphere was high when we first tuned our kanteles and started to play and realised that these are real instruments we have designed and made.” (6th form pupil)

Another sustainable aspect discussed was aesthetic or musical. The interviewees mentioned the sound of the kantele as one of the features of sustainable design. They valued the quiet sound of the kantele and, especially according to the prospective teachers’ opinions, this was a real sustainable value in a world, which one teacher described as full of “loud, global sound pollution enfolding us everywhere”. This was a very interesting opinion to consider when the kantele companies are now developing and researching new design forms to produce a louder kantele. The aesthetic features of the visual design and its effect on sound production were also mentioned. The individual beauty of design was also seen as a sustainable value. The old Kalevala spirit of kantele was also seen as an aspect of sustainability. The kantele is the only instrument with such a long history in Finnish culture and this was seen as a very sustainable feature, as expressed by one prospective teacher, “The spirit and beauty of Kalevala style singing is touching contemporary singers. Many singers and players also compose new music from the old tradition.”

Figure 1 outlines the main aspects of sustainable design that can be seen in the modern use of the kantele.
Discussion and conclusions

According to this study, the five-string kantele can be used as a tool of learning Finnish national heritage and cultural history as well as an instrument in music education and a design artefact in crafts education. These characteristics can be used to promote different forms of sustainable education. The examination of the Kalevala shows that, in Finland, the five-string kantele, firstly, had a role as an invention; secondly, as an instrument to provide enjoyment and pleasure and, thirdly, as a means of distributing information and, finally, as a means of promoting a peaceful lifestyle. The elements and principles of the design of the five-string kantele show that this sustainable design object consists of visual, musical, creative, aesthetic compositional elements. The five-string kantele is an old invention, and, somehow, by looking at it and its new forms, we can see that nature is a Finnish mentor. The kantele introduces people to an era-based musical tradition, and the instrument can also be designed in many new ways, so it shows people what can be learned from nature and cultural heritage, how it can be used in creative ways in Finnish culture and education now and in the future.

Design learning and participation in the artistic integrative activities create capabilities for students to be part of surrounding society and think about its sustainable design. Integration crafts and music education for sustainable education provides a possibility for collaborative learning. Sustainability is discussed, adapted and developed in a concrete way in an integrative process in which students become creative problem-solvers and designers of their own model. The sustainable aspects of kantele are found in its cultural spirit and old Kalevala tradition, which has to be learned and transformed. Moreover, five-string kantele is pedagogically very practical and easy to use in new creative ways at school. The Finnish National Core Curriculum for Basic Education as
well as the Curriculum of Teacher Education provides a lot of possibilities to apply integrated curriculum to implement education for sustainability, particularly via educational design learning projects.

References


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Teaching Methods Influencing the Sustainability of the Teaching Process in Technology Education in General Education Schools

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Abstract
The sustainability of technology education is related to a traditional understanding of craft and the methods used to teach it; however, the methods used in the teaching process have been influenced by the innovative changes accompanying the development of technology. In respect to social and economic development, it is important to prepare young people, both boys as well as girls, with comprehensive knowledge and a basic education in technology for the benefit of their future life. Teachers’ assessment of craft and technology education, from two different periods of time, are compared in light of two different national curricula in order to explain possible changes in teachers’ conceptions related to the teaching methods of technology and examines teachers’ opinions on the methods of technology education. This research attempts to find answers to the questions: What are teachers’ attitudes towards teaching methods at the two different periods of time? What changes occurred in the teaching methods of the syllabi in light of the curricula adoptions in 2004 and in 2011? The research is based on questionnaire surveys administered across Estonia in 2004 and 2011. Findings indicate that during the two periods in question the teaching methods used by the teachers of technology education in Estonian schools shifted from the traditional approach to teaching towards a more constructivist approach. The researcher concludes that the teaching methods applied in technology education must keep current. Teaching would greatly benefit from the introduction of more activating teaching methods, particularly those connected with applying technology.

Keywords: technology education, teaching, teaching methods, sustainability

Introduction
Every day we experience a rapid development and expansion of technology and innovation. Society increasingly needs people who are able to cope with using, managing and planning different fields of technology. Also the idea of the sustainability of education supports the thoughts and actions that innovative and motivated people instinctively direct towards sustainability. Technology education is a part of general education and can play an important role in promoting sustainable production and consumption.
(Pavlova, 2006). One prerequisite for guaranteeing such sustainability is adopting innovated teaching methods into the subject lessons.

In 2010, the schools in Estonia adopted the National curriculum for basic schools (Põhikooli riiklik õppekava [National curriculum for basic schools], 2011), which, in respect to technology education, grants learners a larger number of options than before, including co-learning possibilities for boys and girls as well as project work.

The learner is an active participant in the teaching and learning process, who, according to his/her abilities participates in setting the goals for his/her learning, learns independently and with peers, learns to assess peers as well as himself/herself, to analyse and manage his/her learning. Acquiring new knowledge is based on learner’s previous knowledge, and, on the basis of the new information, the learner constructs his/her knowledge. The acquired knowledge is applied in new situations or when the learner solves problems, makes choices, discusses about the correctness of statements, arguments his/her viewpoints and in further studies (Põhikooli riiklik õppekava [National curriculum for basic schools], 2011, Chapter 3).

The curriculum is based on the social-constructivist approach where the learner is not a passive receiver of knowledge but is an active participant in learning. Learners interact with the world around them and construct their own knowledge models based on their experiences; these include models of how the physical and the social worlds operate (Owen-Jackson & Steeg, 2007). The teacher plays a key role in making sure that all the learning activities operate as smoothly as possible and are effective in fostering the intended learning outcomes (Kyriacou, 2012). Whereas direct instruction tends to be teacher-centred, indirect instruction is more learner-centred (Kellough & Kellough, 2011). The ideas of pupils emerging through their talk are scaffolded or framed by the teacher putting in a ‘step’ or as questions at appropriate junctures (Burton, 2009). Learner-centred curricula, referring to learning through practical application or doing based on the momentary interests of children, is a collective term which refers to the rejection of teacher-directed learning (Marsh, 1997). Parikka, Rasinen and Ojala (2011) posit that it is important to look for viewpoints and methods which can be implemented in everyday school life to motivate pupils for ethical-moral studies. Teaching methods easily implemented in a classroom include modelling (showing pupils how to do or think about a difficult task), scaffolding (providing maximum support at the outset which is gradually withdrawn), coaching (assisting pupils while they are solving a problem), articulation (getting pupils to express their ideas), reflection (getting pupils to reflect on their activities) and collaboration (working with other pupils), exploration (working on non-routine problems) (Muijs & Reynolds, 2005).

Watkins, Carnell and Lodge (2007) point out that effective learning can occur when the teacher is invisible, when people are willing to be vulnerable, when learners take an active role in their learning experiences and after a failed attempt. Indirect instruction does not need a teacher to give learners knowledge but happens when classroom management brings about a positive atmosphere where learners want to learn (Watkins, Carnell & Lodge, 2007). Teachers should encourage pupils to construct meaning by structuring learning activities around big ideas and explorations as well as giving them sufficient time to explore concepts thoroughly to connect new knowledge to what pupils already know (Muijs & Reynolds, 2005). Today, the approach in technology education that
focused on practical craft skills, an apprentice-based ‘show, copy and practice’ teaching model, has shifted to the background (Banks, 2009). Parikka and Kantola (2001) point out changes in the trends of learners’ technical education: the teacher no longer mediates the information to the learner but rather consistently develops different aspects in the learner’s thinking and practical activity, along with experimentation and exploration.

“Modular technology education” and “technological problem solving”, entailing an approach in which learners design and build solutions to problems posed by the teacher, are now more widespread than the project-from-plans method (Sanders, 2001). This new conceptualisation of technology education emphasises new activating approaches in teaching towards a solution of technical problems (work of the pupils in teams, system of module teaching, use of the Internet etc.), in support of education towards independent and creative work (Novakova, 2006). Parikka and Rasinen (2009) expressively bring forth the educational essence of today’s technology education.

Learning is viewed as ... active mental activity that is led by intrinsic models and adopted study goals related to various questions and competent achievements that have previously developed in the memory. Reproducing and assessing knowledge and skills stored in the memory is an important part of the learning activity. The learner’s ability to assess, observe and manage his or her own progress is considered to be vital. When teaching technology, it is important to see the problems and to work out solutions for them. Thereat, the central focus is on supporting learner’s development towards self-regulation (p. 39).

Technology education should enable pupils to develop their technological ability through opportunities to take part in activities of an extended nature, which offer an advantage of knowledge, understanding and skills from many areas curriculum (Layton, 1993). The fields of technology and technology education place great emphasis on problem solving and application as teachers strive to promote technological literacy (Koch & Sanders, 2011).

The approach to teaching methods is highly dependent on teachers’ readiness and abilities to apply innovative methods. In the choice of teaching method, a teacher needs to have in mind many important aspects. Meriläinen (2006) notes that, when considering suitable teaching methods, one must remember that the chosen methods should always be relevant from the point of view of educational objectives, the content taught, the readiness and abilities of the teachers as well as the learners, in addition to the point at which the learners are located on the continuum of learning and development. According to the analysis of technology education in the curricula of five European Union countries (Austria, Estonia, Finland, France and Germany), Rasinen, Virtanen and Miyakawa (2009) point out that:

The pedagogical means and methods are very similar in all five countries. Hands-on activities are emphasized in all curricula. (...) Such learning methods as observation, exploration, experimenting, discovery, analysis, problem solving, design, manufacture and innovation are expressed. (...) Also both individual work and co-operative learning methods are encouraged (p.71).

Many researchers (Doherty & Canavan, 2006; Jones & Compton, 2009; Mita, Matsuda, Iwaki, & Furuta, 2006) stress that the new content of technological studies – together with its emphasis on the integration of technologies, coupled with an approach towards supporting learning that give emphasis to project work, resource-based learning
and using technology in a problem solving context – all combine to mark the distinctiveness of this course from anything that has proceeded.

Experts accentuate self-directed and independent discovery or investigation; furthermore, they relate evaluation of their significance and meaning as well as team-working methods (Parikka, 1998). Järvinen, Karsikas and Hintikka (2007) bring out ideas about teaching technology:

*If a child is able to identify a problem and proves to be successful in solving it in a way that the solution meets personal needs, it results in a very positive experience. (...) The authors wish to encourage teachers who are not already doing so to try an open-ended approach to technology teaching. (...) When the final outcome of children’s problem solving processes is unknown to them, boredom and disinterest is replaced with thrilling anticipation* (p. 50).

The methodological challenges, concerning learning by doing and similar approaches, are not without significance either. Parikka (1998) accentuates the importance of planning and problem-solving skills needed in daily life as well as of learning skills, both independent and those involving joint responsibility. Parikka and Ojala (2008) emphasise that learners have opportunities to develop their creativity and design skills, make choices, take risks, cope with uncertainties and constraints, learn to commit themselves to the chosen aims, take responsibilities and experience success as the result of their own entrepreneurial activity.

The aim of the current research is to probe the question: *What are teachers’ attitudes towards teaching methods at the two different points of time – 2004 and in 2011?*

**Methodology**

The research compares and analyses the changes in the teaching methods of technical subjects in Estonia and seeks to explain which teaching methods guarantee the sustainability of modern technology education and the development of learners’ personality.

**Sample**

Initially, in the autumn of 2004, 482 questionnaire surveys were sent out to the teachers of craft and technology education in the general education schools of the country; 157 were returned. At the beginning of 2011, the author sent out 417 questionnaire surveys to the technology teachers in general education schools; 109 were returned. The 2004 data collection is referenced as Phase 1, and the 2011 data collection is referenced as Phase 2. Most of the respondents were men. In Phase 1, 149 of the respondents were men, and 8 – were women. In Phase 2, 103 of the respondents were men, and 6 – were women. Across the years, the gender distribution of the teachers of technical subjects has remained similar in that the greatest proportion is male.

**Instrument**

Assessing the teaching methods, the author asked the teachers of technical subjects to formulate their opinions based on the usefulness of teaching and on its importance in everyday life as well as to reflect on what is vital in view of the future. The questionnaire
Teaching Methods Influencing the Sustainability of the Teaching Process...

is based on a survey used by Rasinen (2000), which was translated into Estonian. The questionnaire contained four different blocks of themes: objectives, contents, methods and material-technical situation. In this paper, only teachers’ opinions on different teaching methods will be examined and analysed. Altogether 36 substantial questions on the teaching methods of technology education were posed to the teachers. A six-point Likert scale was employed (0 = cannot answer; 1 don’t know; 1 = has not been useful; 2 = has been useful or important only to a little amount; 3 = to a certain amount useful or important; 4 = rather useful and important; 5 = very useful and important). The value “0” was not taken into account when analysing the results.

Method

Analysing the results and comparing the aggregates, a $t$-test was administered to determine the significant probabilities of average differences between Phase 1 and Phase 2, using the average values to illustrate the results on the graph (Figure 1). Further, in order to determine the mutual relations between the primary characteristics and to determine latent variables (hidden characteristics), a factor analysis was applied to identify characteristics with common elements and, based on these, to form the factors that describe a broader common aspect (Niglas, 2013). The statistical data processing software SPSS 18.0 was utilised to process the data; values of the factor loads were obtained by a rotated factor matrix (Varimax method). Factor analysis enables one to express data through a linear network of interconnected characteristics which best expresses the data’s preliminary mutual relations, or, to put it another way, the correlation between the measured characteristics is reduced to the correlation between the measured characteristics and the common factors as well as possible (Tooding, 2007). Based on the obtained factors, it is possible to give a broader and more general description of the changes in the teaching methods between Phase 1 and Phase 2 as well as to point out changes in teachers’ assessment of teaching methods at the different points of time.

Based on the conceptual and interpretative aspect of the teaching methods of technology education (Tooding, 2007) and keeping in mind the statistical parameters, the eight-factor model proved to be the most suitable, which was formed on the basis of 36 basic characteristics, originally given as the survey questions. Thus, the 36 characteristics are replaced with eight factors, which give a more equable and trustworthy picture of general views and assessment, than if the specific basic characteristics are analysed separately. The names of the factors most expressively reflect the qualities within the primary characteristics. These descriptors rest on the teaching methods of technology education as interrelated with practical tasks and pertinent activities.

Research Findings

Comparing the questions of a survey concerning the methods of teaching in Phase 1 and Phase 2 using a $t$-test, it became evident that only in the case of statement Experimenting, the averages of the answers in the two studies had statistically significant differences, $p = .034 < .05$. In 2011, the statement related to experimenting had the biggest positive increase compared to other questions concerning teaching methods. Phase 1: $M = 3.85$, $SD = .948$ and Phase 2: $M = 4.10$, $SD = .935$. Figure 1 shows the averages of all questions in the decreasing order of general averages at the different points of time.
Figure 1. Comparison of the order of the methods based on questionnaires administered in Phase 1 and Phase 2
Based primarily on the constructive aspect, while at the same time keeping in mind the statistical parameters, the eight-factor model, formed on the basis of 36 primary characteristics, proved to be the most optimal. Based on the analysis of the results of teachers’ questionnaires in Phase 1, it appears that eight factors explain 63% of the whole variability of the basic characteristics; in Phase 2, eight factors explain 64% of the whole variability. This is high and sufficient enough for the model with the eight factors to be regarded as good.

Analysing the obtained factors and their primary characteristics in Phase 1 and Phase 2, it became evident that a series of factors emerged which could have the same name in the both research phases: Learner-centred activity; Practical activity; Educational outing; Teacher-centred activity and Production activity. However, the primary characteristics of all the factors with the same name are not completely the same. Furthermore, three factors in the two studies could not be identified with the same name as a set of pairs. In order to describe the factors, Table 1 and Table 2 for Phases 1 and 2 respectively, present an overview of percentages on a specific factor as received from the teachers based on its usefulness or importance, according to the provided assessment scale.

Table 1
Distribution of the Factors of Teaching Methods in Phase 1 in Percentages

<table>
<thead>
<tr>
<th>Factors</th>
<th>Is not useful or important</th>
<th>Useful or important to a small extent</th>
<th>Useful or important to some extent</th>
<th>Rather useful or important</th>
<th>Very useful or important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner-centred activity</td>
<td>20.6</td>
<td>17.4</td>
<td>20.0</td>
<td>21.9</td>
<td>20.0</td>
</tr>
<tr>
<td>Research and solving problems</td>
<td>19.9</td>
<td>17.9</td>
<td>25.0</td>
<td>18.6</td>
<td>18.6</td>
</tr>
<tr>
<td>Practical activity</td>
<td>24.2</td>
<td>17.8</td>
<td>26.1</td>
<td>16.6</td>
<td>15.3</td>
</tr>
<tr>
<td>Instructions and homework</td>
<td>15.5</td>
<td>20.6</td>
<td>18.1</td>
<td>21.9</td>
<td>23.9</td>
</tr>
<tr>
<td>Educational outing</td>
<td>16.8</td>
<td>22.6</td>
<td>23.2</td>
<td>23.2</td>
<td>14.2</td>
</tr>
<tr>
<td>Teacher-centred activity</td>
<td>17.8</td>
<td>15.9</td>
<td>34.4</td>
<td>15.3</td>
<td>16.6</td>
</tr>
<tr>
<td>Cooperation</td>
<td>17.2</td>
<td>25.5</td>
<td>21.0</td>
<td>17.2</td>
<td>19.1</td>
</tr>
<tr>
<td>Production activity</td>
<td>14.9</td>
<td>17.5</td>
<td>23.4</td>
<td>24.7</td>
<td>19.5</td>
</tr>
</tbody>
</table>

Table 2
Distribution of the Factors of Teaching Methods in Phase 2 in Percentages

<table>
<thead>
<tr>
<th>Factors</th>
<th>Is not useful or important</th>
<th>Useful or important to a small extent</th>
<th>Useful or important to some extent</th>
<th>Rather useful or important</th>
<th>Very useful or important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner-centred activity</td>
<td>19.3</td>
<td>22.0</td>
<td>20.2</td>
<td>19.3</td>
<td>19.3</td>
</tr>
<tr>
<td>Cooperation and solving problems</td>
<td>17.4</td>
<td>22.0</td>
<td>21.1</td>
<td>22.9</td>
<td>16.5</td>
</tr>
<tr>
<td>Teacher-centred activity</td>
<td>20.2</td>
<td>29.4</td>
<td>12.8</td>
<td>21.1</td>
<td>16.5</td>
</tr>
<tr>
<td>Educational outing</td>
<td>22.9</td>
<td>11.0</td>
<td>31.2</td>
<td>16.5</td>
<td>18.3</td>
</tr>
<tr>
<td>Outdoor learning and homework</td>
<td>16.5</td>
<td>22.9</td>
<td>17.4</td>
<td>24.8</td>
<td>18.3</td>
</tr>
<tr>
<td>Practical activity</td>
<td>14.7</td>
<td>20.2</td>
<td>37.6</td>
<td>14.7</td>
<td>12.8</td>
</tr>
<tr>
<td>Supervising</td>
<td>4.7</td>
<td>32.1</td>
<td>0.0</td>
<td>63.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Production activity</td>
<td>15.5</td>
<td>34.0</td>
<td>0.0</td>
<td>39.2</td>
<td>11.3</td>
</tr>
</tbody>
</table>
Common Factors in Phase 1 and Phase 2

The common factors in Phase 1 and Phase 2 are Learner-centred activity; Practical activity; Teacher-centred activity; Educational outing and Production activity.

The factor Learner-centred activity has obtained high assessment from teachers in the results of both studies, the aspect of usefulness and importance of about 80% (Table 1 and Table 2). The primary characteristics of the factor describe the teaching methods closely related to the factor – distance working or completing assignments via the Internet, using online materials, working on the computer etc. In Phase 1, the first six primary characteristics have strong factor loading, correspondingly between .632 and .745. In Phase 2, the first five primary characteristics have strong factor loading, correspondingly between .615 and .758, which are proof of teachers’ high confidence in the factor. In Phase 2, the factor Practical activity has received higher assessment compared to Phase 1. In Phase 2, 85.3% of the teachers see this factor as useful or important, in Phase 1 being 75.8%. The factor Practical activity contains activities necessary for learners to carry out practical activities, including practising techniques. The first three primary characteristics of Phase 1 mostly describe the examples of practical activities, independent work in a workshop, working by the aid of manuals and instructions provided by the teacher, the corresponding factor scales being .608; .665; .689. Two primary characteristics of Phase 2 describe the factor, which are different from the primary characteristics of the previous Phase, so frontal work, producing identical working objects at a time and illustrating, the corresponding factor scales being .772 and .506., which are proof of teachers’ high confidence in the factor. The factor Teacher-centred activity received high assessment from teachers in the results of both Phase 1 and II, the aspect of usefulness and importance in Phase 1 being over 82%, and, in Phase 2 – as 77 % (Table 1 and 2 respectively). The primary characteristics of the factor describe activities common to teachers: explaining, instruction in work process, working by the aid of manuals and instructions provided by the teacher, using textbooks and teaching aids etc. In Phase 1, the first two primary characteristics have strong factor loading,.734 and .732 correspondingly. In Phase 2, all three primary characteristics have strong factor loading, .673; .694, and .701 correspondingly, which are proof of teachers’ high confidence in the factor. The factor Educational outing received high assessment from teachers in the results of Phase 1, the aspect of usefulness and importance being 83 %; in Phase 2, the teacher assessment are lower, over 77% (Table 1 and 2 respectively). The primary characteristics of the factor are educational trips to enterprises, discussions, cooperation with partner enterprises. The factor loading of the primary characteristics of the factor in Phase 2 are higher (.633; .729; .742) compared to the factor scale of Phase 1 (.520; .544; .587; .706). The factor Production activity has obtained high assessment from teachers in the results of both research phases, the aspect of usefulness and importance of about 85% (Table 1 and 2 respectively). The factor is characterised by production-related activity. In Phase 1, the factor has high connection with primary characteristics: serial production, frontal work, corresponding factor scales being .751 and .647. In Phase 2, only one of the aforementioned primary characteristics has been brought out, the factor scale of which is .726 and is a proof of teachers’ high confidence in the factor.
Unique Factors in Phase 1

As a result of factor analysis, three unique factors—Research and solving problems; Instructions and homework and Cooperation—were formed in Phase 1. More than 80% of the teachers regarded Research and solving problems as useful or important in school work, which includes statements related to research, experimenting and analysing as well as solving problems (Table 1). The factor has a strong correlation with the first three primary characteristics: treating and solving problematic situations (.737), examining and experiencing (.678), analysing (.600), which are proof of teachers’ high confidence in the factor. More than 84% of the teachers regarded the factor Instructions and homework as useful or important in school work (Table 1). The factor contains activities in the field of technical activities which learners can carry out at home and in their free time: worksheets or workbooks and homework. The factor loading of the two primary characteristics are .769 and .590 respectively. More than 82% of the teachers regarded the factor Cooperation as useful or important in school work (Table 1). The factor has a strong correlation with the primary characteristics of group work (.795).

Unique Factors in Phase 2

As a result of factor analysis, three unique factors were formed in Phase 1: Cooperation and solving problems; Outdoor learning and homework; Supervising. The factor Cooperation and solving problems includes tasks where learners cooperate: Treating and solving problematic situations (.783), discussions (.727), analysing (.700), project and team work (.677), group work (.609) and experimenting (.510). More than 82% of the teachers regarded the factor as useful or important in school work. The factor has a strong correlation with six presented primary characteristics, which is proof of teachers’ high confidence in the factor. The factor Outdoor learning and homework describes learners’ activities performed outside the school: learning in the nature (.600) and homework (.588). The correlations are rather modest. The biggest percentage, more than 95% of the teacher regarded the factor Supervising as useful or important in school work (Table 2). The factor contains only one primary characteristic—instruction in work process—and has high factor score (0.805), which is proof of teachers’ high confidence in the factor.

Discussion and Conclusions

On the level of teaching methods, teachers’ assessment of craft and technology education (Phase 1) and technology education (Phase 2) are rather similar than different, answering the research question: What changes have occurred in teachers’ assessment of the methods of teaching at the two points of time—2004 and 2011? Statistically significant difference can only be seen in assessment of the statement Experimenting, where the results of Phase 2 express more positive attitudes. In Phase 2, the bigger interest in the statement Experimenting most probably reflects the change in stress in the new syllabus of technology education, according to which a greater stress is on experimenting with practical tasks, experiencing and experimenting. On the basis of the results of the factor analysis in the both research phases, teachers’ assessment of factors are equally high. As a result, the factors characterising the teaching methods,
bearing the same names were formed: Learner-centred activity; Practical activity; Educational outing; Teacher-centred activity and Production activity. In Phase 2, the factor Outdoor learning and homework was formed, the factor loading of which was low. However, the factor Supervising in Phase 2 received a high factor loading, which shows teachers’ strong attitude towards supervising as a method of teaching. The teaching methods, compared on the basis of the two syllabi, highlighted as the main differences the opinion of teachers, according to which in the first phase during 2004, the factor Teacher-centred activity is singled out, the factor which Banks (2009) calls an apprentice-based ‘show, copy and practice’ teaching model; whereas, in the second phase during 2011, the factor received considerably lower assessment. This researcher posits that, year after year, teachers’ explanations and instructions have an increasingly less impact on the learning process; there should be an increase in learners’ thinking and experimenting and finding solutions. Thus, over the years, teachers’ opinion on the factor’s usefulness has considerably changed.

The factor Production activity faced the same situation. Based on the results of the first phase, it could be elicited that too much stress is laid on the factor Production activity, where more attention should be paid to promoting learners’ creativity and applying more active teaching methods in technology education. Whereas, in the later phase, the number of respondents supporting the factor was considerably lower.

The factor Learner-centred activity had similar results in both of the phases. It is necessary that learners start practising independent learning gradually from the very beginning, for this ensures that further independent learning is easier to acquire. Teachers hold the opinion that a considerable importance in completing learning tasks is on individual work and on doing it via the Internet, using computers in the teaching and learning process. Also, Parikka and Rasinen (2009) stress the need for adopting a similar teaching method. However, it should be monitored in class that learners have independent tasks fitting for their ability level and age.

Also, the factors Research and solving problems and Cooperation and solving problems received similar teacher assessment at the different times. High assessment were given to solving problems, research, analysing and discussing. In technology education lessons, learners often have to think and solve various tasks to which they initially do not have an answer. They find solutions through experimenting and testing, and experiencing. Many researchers (Jones & Compton, 2009; Parikka, 1998; Rasinen et al., 2009) point out this important approach in technology education.

Based on the results of Phase 1, the factor Practical activity received rather modest assessment from the teachers. In Phase 2, the factor received high assessment. This leads us to believe that teachers mostly engage learners in the form of practical activities, but have not succeeded in spotlighting this fact very well in their responses. This factor could be regarded as a traditional form of practical work, because in many of the Estonian schools teaching is mostly based on this factor.

The results of the factor Educational outing received higher assessment from the teachers in Phase 2. This factor shows that, in addition to school lessons, teachers value the need to introduce company workplaces to their learners and, if possible, to cooperate with the companies, to introduce production to learners via videos and later discuss what was seen. In introducing new production techniques and machines as well as modern production processes, an important role is played by educational outings to visit company sites and by mutual cooperation, if possible.
The relative importance of the factor *Cooperation* in school work must increase, because it is through various project-based activities that learners learn to do the same work they will come into contact with in their future work life, and, thus, it is important for them to develop their project-based activity. That children’s understanding of technology can be achieved by enabling them to work in the same spirit as real technologists do. This approach brings authenticity to the experience (Järvinen, Karsikas, & Hintikka, 2007).

On the basis of this research, it is possible to conclude that the teaching methods applied in technology education must keep current. Teaching would greatly benefit from the introduction of more activating teaching methods, especially those which are connected with applying technology: web-based materials, using mobile applications etc. Teachers continually consider practical activity and supervising the work process as important parts of technology education lessons. However, more attention should be paid to learners’ independent work and cooperation, which received slightly lesser assessment. Using different and innovative teaching methods in technology education enhances the development of learners’ personality and creates opportunities for the sustainable development of the teaching.

*It is important that knowledge which one has is applied or put into practise in an innovative, “creatively new” way. Innovation process is associated with brainstorming, problem solving, innovativeness, inventiveness, design, modelling, evaluation, experimental approaches and also creativity, aesthetical and ethical aspects. The aim of the activity is that awareness raising, learning and design processes are integrated to enable application and create innovative solutions. In technology education learning by doing method has a central role in innovative problem solving processes* (Rasinen et al., 2009, p. 78).

More use should be made of innovative teaching methods, which enable the use of technology in a more diverse way. This would increase learners’ interest in the topics being taught and help them learn in cooperation. Accordingly, iTecEC has been created, which aims at promoting the development and application of information technology at school (Sillaots, 2012).

There are several methods that could be studied and piloted as a part of teaching technology education. For example, in case of design-based learning approaches, the experts point out that this approach helps to prepare learners for professional practices by bridging the gap between education and engineering preparation for industry settings (Gómez Puente, van Eijk, & Jochems, 2012). It is suggested that teaching should have more place of values and beliefs as an important aspect that can be overlooked in curriculum development and implementation, as can environmental issues (Jones, 2009). Also, researchers are seeking for new ways of applying such methods as problem solving, designing, modelling and systems thinking (Banks, 2009).

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Educative Experience of the Use of Concept Mapping in Science and Environmental Teacher Training Programmes

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University of Cordoba, Spain

Abstract

Environmental education in the 21st century requires well-instructed teachers with teaching and communication abilities. This paper presents an educational experience developed in several biology and environmental teacher training courses and focused on the treatment of environmental education as a transversal educational topic. For that aim, text analysis techniques, concept mapping and informatics tools have been used to represent individual and collaborative knowledge about environmental topics. 69 students participated in the research. Data about the educational activities developed by the participants have been collected. Furthermore, students have expressed their opinions on the formative process by means of an opinion survey. The outcomes of this study reveal that future teachers and environmental educators consider that concept mapping is a valuable tool to represent their knowledge about environmental education, to encourage reflexive and collaborative learning, to improve teaching communicative abilities and to use effectively ICT in the classroom.

Keywords: teacher training, environmental education, concept mapping, collaborative work, CmapTools

Introduction

The damage to nature caused by human beings has increased noticeably during the last century. Some examples of the environmental degradation are the global climate change, the desertification, the thinning of the ozone layer or the loss of biodiversity. Different countries and international organisations have presented different proposals and initiatives, including environment protection and regeneration programmes or policies to encourage the development of sustainable technologies and the prevention and treatment of contaminants. However, global responses to environmental problems cannot come only from politic interventions and scientific and technologic advances. Concurrently, all inhabitants must get involved (Fien, 1995; Stapp, 1971).

In that sense, since teachers are considered major agents of change (Ilisko, 2007), education has been stated fundamental to promote sustainable development. Indeed, environmental education must be considered the basis for rebuilding the relations between...
people, society and the environment (Hicks & Holden, 1995; United Nations [UN], 1992). Consequently, it is necessary to incorporate respect for nature in educational programmes so that society becomes aware of the environmental problems and interacts with nature in a sustainable way (Gedžūne & Gedžūne, 2011; Wellie, 2002).

According to that, countries need qualified educators capable of designing and implementing educational programmes, and planning and organising resources to promote sustainability from an interdisciplinary point of view. In this way, in all the subjects and at all educational levels, environmental topics, such as the respect for nature and sustainability, can be treated by means of different educational activities, such as reading texts, problem solving and concept maps (Espinosa, 2008; Guruceaga & Gonzalez, 2004). For that purpose and taking into account the importance of emotional and motivational aspects for the teacher professional development (Hargreaves, 1998), it is necessary to reinforce or introduce new specific educative and motivational strategies in teacher training programmes so that teachers of all the educative levels become aware of the importance of environmental education as an instrument to promote respect for nature (Fien, 1995; Gil Pérez, Vilches, Edwards, Praia, Marqués, & Oliveira, 2003).

In this context, an innovative project called RAET (Reflective Approach to Environmental Educators’ Training) has been functioning since 2008 in several science and environmental teacher training programmes of the University of Córdoba (Spain) to develop technological, methodological and communicative competences of future teachers (Korthagen, Loughran, & Russell, 2006) and to promote collaborative, reflexive and meaningful learning with concept maps (Preszler, 2004), related to environmental education topics (Murga-Menoyo, Bautista, & Novo, 2011).

In this paper, the results of this project are presented. Particularly, the use of concept mapping as a classroom activity in science and environmental teacher training programmes is analysed to check whether it is a useful educational tool to make users reflect on their own knowledge, to identify learning shortcomings and to construct a more meaningful knowledge of nature on which an environmentally responsible behaviour can be based (Andrews, Tressier, & Mintzes, 2008; Beyerbach, 1988; Buntting, Coll, & Campbell, 2006).

**Concept Mapping and Information Technologies Tools in Teacher Training Programmes**

Concept mapping is a knowledge representation model that promotes the construction of a mental image of the information, making easier the visual identification of the most important concepts, the relationships among them and their hierarchical organisation (Novak & Gowin, 1984). This graphic representation of concepts provides students and teachers a suitable tool to organise, summarise and communicate their knowledge about any topic, showing information in a schematic and organised way. Consequently, students can use concept mapping as a learning strategy for any subject since it promotes individual or collaborative, reflexive and meaningful learning (Buntting et al., 2006). Additionally, teachers can use concept mapping as teaching resources to show the structure of a topic or to analyse the relationships among the concepts related to the topic (Novak & Cañas, 2006). In that way, concept mapping may complement teachers’ explanations and improve students’ comprehension about it.
The educative use of concept mapping is essentially based on the meaningful learning theory (Ausubel, 2000; Ausubel, Novak, & Hainesian, 1978) and constructivist learning philosophy (Anderson & Demetrius, 1993; Novak & Cañas, 2006). It is also based on the study of the relationships among science, technology, society and environment – STSE relations (González, 2008). According to constructivism, students’ new knowledge is based on prior knowledge, since the latest can be considered as a cognitive scheme that may be enriched and restructured while new knowledge is gradually acquired and integrated in the memory (Novak & Cañas, 2004). Thus, concept maps not only are very useful to represent students’ knowledge and its evolution during the formative process, but also to identify their learning difficulties (Jones, Carter, & Rua, 2000). Furthermore, concept mapping motivates students (Schaal, 2010) as it is suitable for developing reflexive and collaborative learning (Edwards & Fraser, 1983) and can be used both as teaching or assessing tools (Buehl & Fives, 2011). For all these reasons, concept mapping is a valuable teaching methodology that provides a measure of conceptual understanding (Andrews et al., 2008; Buehl & Fives, 2011; Miller et al., 2009; Miranda-Correia, Silva, & Romano-Junior, 2010; Moreira, 1985; Novak & Gowin, 1984; Proctor & Bernstein, 2013; Stuart, 1985).

Indeed, concept mapping has been used for decades in scientific education (Stewart, 1980; Stuart, 1985) and in teachers’ and environmental educators’ education and training programmes (Andrews et al., 2008; Guruceaga & González, 2004; Novak, 1978). Specifically, in the field of environmental education, Balgopal and Wallace (2009) used concept maps to identify students’ misconceptions and explore changes in knowledge about ecological concepts when applying an educational methodology, focused not only on concepts, but also on the connections between cognitive and affective domains. Additionally, a methodology based on the use of concept mapping and a Likert-scale inventory was developed to work on topics related to conservation and preservation of animal species, finding out that students with a greater knowledge of animal species are more aware of its conservation and protection (Barney, Mintzes, & Yen, 2005). Finally, Vanheur and Pace (2008) describes a new teaching methodology based on the use of concept maps, together with Vee Heuristics, to promote, among 6 and 7 years old children, meaningful learning about nature and, in the long run, the environmentally responsible behaviour based on this knowledge.

As far as teacher training is concerned, Mosothwane (2002) proved that teachers with a solid understanding of the main concepts of their areas are more effective teachers. Accordingly, concept mapping is a quite helpful strategy in teacher training programmes since, as mentioned before, it promotes reflexive and meaningful learning (Beyerbach, 1988). In this line of work, Zak and Munson (2008) investigated pre-service teachers’ conceptual understanding of basic ecological concepts using concept maps. Also, meta-conceptual teaching activities, such as concept mapping, have been proved to help pre-service teachers to change alternative misconceptions related to flowering plants (Nejla, Meryem, & Mehmet, 2011). Finally, in the last decades, the use of concept maps for teacher training has experienced a considerable increase due to specific software based on information and communication technologies (ICT). According to MacKinnon and Aylward (2009), ICT provide promising chances to create new teaching and learning frameworks that enrich the educational context in which students and teachers are enrolled. They show the advantages of using of ICT in teacher training programmes, describing experiences in which electronic portfolios, collaborative concept mapping
Educative Experience of the Use of Concept Mapping...

and educational digital forums are used (Tergan, 2005). In addition, ICT can be used to improve information search processes, develop new communicative technologies, design any kind of didactic resources, implement simulation and modelling tools or develop collaborative and intuitive learning environments (Ojeda, Gutiérrez, & Perales, 2009).

Specifically, ICT have an important role in the field of environmental education, since they can open access to information and knowledge about sustainability and, consequently, promote public awareness of the need for sustainable development (Ospina, 2012). In that line, for instance, considering that promoting active citizens learning must be based on the principles of the ExConTra learning paradigm (experiencing, constructing, transforming), a web-based learning environment, including several ICT tools (concept maps, spreadsheets, presentations, paint tools, word processing and Venn diagrams), has been developed to introduce primary school learners to the issue of climate change from a cross-thematic and interdisciplinary curricular approach (Makrakis, Gkotzos, & Larios, 2012).

Combining both tools (concept mapping and ICT), CmapTools is open software developed by the Florida Institute for Human & Machine Cognition (IHMC) that can be used to design and use these maps in the educative processes (Cañas, 2004; Cañas, Hill, & Lott, 2003; Daley, Cañas, & Stark, 2007; Martínez, Perez, Suero, & Pardo, 2013). This software lets the user build, save and modify concept maps easily and attach to them any kind of digital resource (Novak & Cañas, 2006). In that way, the design of concept maps with informatics tools and, particularly, with CmapTools, helps future teachers to use ICT in the classroom effectively, improves teaching communicative abilities, encourages educational innovation and increases future educators’ motivation (Pontes, 2012). For all these reasons, numerous educational activities based on the design of concept maps with CmapTools have been developed in environmental education (Echarri & Puig, 2009; Guruceaga & González, 2004; Vanheer & Pace, 2008). Thus, it can be interesting for future educators to learn concept mapping techniques and informatics tools for its design, such as CmapTools (González, 2008).

RAEET Project: Educational Proposal and Design of the Research

As mentioned before, different studies have proved the potential of ICT as educational tools (Ojeda et al., 2009) and the use of concept maps as individual and collaborative learning strategies to motivate students (Schaal, 2010). Thus, the software CmapTools, which combines both elements, can improve the motivation of environmental educators (Murga-Menoyo et al., 2011). In this context, the RAEET project has been carried out to develop a new methodology proposal for environmental teacher training programmes.

The aims of this study are:

- to develop a methodology proposal for the treatment of environmental education, as a transversal and interdisciplinary topic, based on the analysis of texts and concept mapping to promote reflexive and collaborative learning;
- to use informatics resources, such as CmapTools, for the elaboration of concept maps related to environmental education and for the acquisition of communicative abilities, promoting the effective use of ICT in teacher training programmes;
- to design a survey to analyse future teachers’ motivations and opinions on the activities, resources and methodology used in this formative proposal.
Educational Proposal and Data Collection

The data analysed in this paper have been collected in the study course entitled “Knowledge Representation by Concept Mapping” of the master’s degree study programmes “Environmental Education” and “Biology Teachers’ Training” at the University of Cordoba in Spain. In this study course, the didactic treatment of transversal topics related to environmental education (climate change, renewable energies, sustainable development, environmental education and so on) is tackled by the analysis of text about these topics and concept mapping as educational activities to promote the reflexive and collaborative approach in teacher training programmes. Furthermore, by knowledge representation, it is expected that future teachers acquire general teaching skills, such as the effective use of ICT and communicative abilities in the classroom (Pontes, 2012).

Firstly, in order to get used to this knowledge representation technique (Novak & Cañas, 2006), students make, with pen and paper, individual concept maps based on the comprehensive reading of a document related to environmental education. After that, in order to encourage team work abilities, students are put into two or three people groups to discuss their individual concept maps and re-elaborate a collaborative one (Pontes & Varo, 2013). Secondly, students learn to use CmapTools and construct with it individual and collaborative digital concept maps related to environmental education. These collaborative concept maps could be done either in the classroom or online thanks to the collaborative work tool that the software provides (Novak & Cañas, 2006; Daley, et al., 2007). Additionally, students elaborate multimedia presentations with their concept maps and they present them in the classroom to promote the debate and the acquisition of teaching communicative abilities.

The final mark of the study course is based on the average marks of the individual and collaborative concept maps elaborated with CmapTools. To assess these concept maps, according to previous studies (Murga-Menoyo et al., 2011; Proctor & Bernstein, 2013; Stuart, 1985), an evaluation pattern has been designed by the teachers taking part in the innovative experience (Table 1).

<table>
<thead>
<tr>
<th>Quality</th>
<th>Evaluation Criteria</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>(I) Low</td>
<td>The concept map shows incorrect concepts or a lack of important concepts and has technical (hierarchy, visual impact) or semantic (link sentences) faults</td>
<td>0–4,9</td>
</tr>
<tr>
<td>(II) Suitable</td>
<td>The concept map includes most of the main concepts and semantic relationships but has technical (hierarchy, visual impact) or semantic (link sentences, nodes with different concepts) faults.</td>
<td>5–7,5</td>
</tr>
<tr>
<td>(III) High</td>
<td>The concept map includes the main concepts of the topic and the link sentences are correct. The hierarchy is appropriate and it has a good visual impact.</td>
<td>7,6–10</td>
</tr>
</tbody>
</table>

At the end of the workshop, students filled out an open questionnaire to collect their opinions on the development of the educational experience (Appendix 1). This survey is an important element to promote reflexive learning (Pontes, 2012) and sheds light on the research topic. Since the survey is composed of open questions, a qualitative analysis of the answers has been done. Specifically, the most frequent answers have
been classified into different categories and counted by means of their relative frequency. Moreover, the most representative opinions have been identified, and interesting conclusions have been drawn.

Thus, there are two types of data collected: individual/collaborative concept maps based on comprehensive reading of texts related to environmental topics and opinion surveys filled out by the research participants. The first set of data provides the participants’ knowledge and the influence of collaborative work on it. From the surveys, it is possible to highlight the participants’ opinions on the elaboration of individual concept maps, the influence of collaborative work, the use of CmapTools, the possible application of concept mapping in environmental education and the educational value of the innovative experience developed.

Participants

Since 2009, 69 people have participated in this educational innovation project developed in the study course entitled “Knowledge Representation by Concept Mapping” of the master’s degree study programmes “Environmental Education” (25 participants) and “Biology Teachers’ Training” (44 participants). The mean age of the group was 26.3 years, and the majority of the participants were biology, environmental sciences or veterinary sciences graduates. Most of the participants had some skill in word processing software and had knowledge of educational online platforms. Only 3 participants (4.4 %) knew how to use software for the elaboration of concept maps.

Results

Individual and Collaborative Knowledge Representations

The analysis of the individual (Pontes, 2012) and collaborative (Pontes & Varo, 2013) concept maps elaborated by the participants show a positive influence of the team work on the concept map design. Table 2 shows the results of the T-Student analysis obtained when comparing the average of the marks given by the teachers to the individual (ICM) and collaborative (CCM) concept maps, according to the assessment criteria described in Table 1. Additionally, other important didactic aspects of this activity include the social interactions developed in the classroom and the increased students’ motivation and interest in participating actively when working in groups (Preszler, 2004; Schaal, 2010). Thus, the elaboration of collaborative concept maps with computer resources promotes general competence in communication, which is very important in current educational settings (Chiu, Huang, & Chang, 2000; MacKinnon & Aylward, 2009).

Table 2
Comparative Analysis of the Average Marks of the Individual (ICM) and Collaborative (CCM) Concept Maps

<table>
<thead>
<tr>
<th>Master</th>
<th>ICM</th>
<th>CCM</th>
<th>T-Student (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master of Environmental Education (n=25)</td>
<td>5.84</td>
<td>7.73</td>
<td>13,952 (p&lt;0.01)</td>
</tr>
<tr>
<td>Master of Biology Teacher Training (n=44)</td>
<td>5.67</td>
<td>7.59</td>
<td>14,173 (p&lt;0.01)</td>
</tr>
<tr>
<td>Total (n=69)</td>
<td>5.73</td>
<td>7.64</td>
<td>14,105 (p&lt;0.01)</td>
</tr>
</tbody>
</table>
Finally, in order to promote the use of concept mapping as a technique to represent the knowledge acquired in teacher training programmes, future educators are encouraged to use concept maps in their final project to obtain a master’s degree. As an example of this interesting activity, Figure 1 shows the concept map used by one of the students to schematise an educational unit related to the water cycle. This example shows that future teachers use properly concept mapping to represent complex knowledge of scientific and educational topics. Furthermore, according to the instructors, students using concept mapping display good communicative abilities, which are important for their future profession.

Opinions and Motivations of the Use of Concept Mapping in Environmental Teacher Training

The use of individual concept maps in teacher training programmes. The first question of the survey was as follows: How do you evaluate the use of concept maps as a tool to represent the knowledge in teachers’ initial formation? The learners were also asked to discuss the advantages and disadvantages of elaborating individual maps.

The answers to the first question have been classified into the categories.

(A) Evaluation of the elaboration of individual concept maps as a technique to represent the ideas extracted from a text related to environmental education:
   A1. Good (61.0%)
   A2. Suitable (18.8%)
   A3. Bad (10.1%)
   A4. No answer (10.1%)

(B) Reasons for the evaluation:
   B1. They indicated some advantages or educational interest points (68.2%)
   B2. They indicated some disadvantages (13.0%)
   B3. They indicated neither advantages nor disadvantages (18.8%)

Accordingly, bringing together the results of A1 and A2, about 80% of the participants favourably evaluated the use of concept mapping as a strategy to individually represent the knowledge acquired from a text related to environmental education. Importantly, 72% of the students stated that they were motivated while learning the technique and found the activity quite interesting. Furthermore, most of the participants considered that, although concept mapping requires reflection and an intellectual effort, it helped them to better understand the topic they were representing. Some of them also thought that the design of concept maps promotes self-learning. Several individuals pointed out that patience and repeated practice are necessary to reach a good result. Few students had experienced doubts or confusion while learning this technique, stating that concept selection represented a greater difficulty. Finally, some students declared that the design of the first individual map was not easy, and different drafts had to be elaborated before producing the final satisfactory map.

Use of CmapTools for concept mapping. The second question of the survey was as follows: What do you think about the use of CmapTools for concept map elaboration? The learners were also asked to discuss the advantages and disadvantages of this tool.

The answers to the second question have been classified into the categories.
(A) Evaluation of CmapTools as a tool to design digital concept maps:
   A1. Good (76.8 %)
   A2. Suitable (14.5 %)
   A3. Bad (2.9 %)
   A4. No answer (5.8 %)

(B) Reasons for the evaluation:
   B1. They indicated some advantages (66.7 %)
   B2. They indicated some disadvantages (11.6 %)
   B3. They indicated neither advantages nor disadvantages are indicated (21.7 %)

Thus, about 90% of the participants gave a favourable evaluation of CmapTools to elaborate digital concept maps. Among the reasons for this evaluation, the students pointed out that, despite the doubts, CmapTools is easy to learn. In addition, they considered that this software is very suitable for teacher training programmes. Among the advantages, they underlined that, with CmapTools, concept maps can be saved in order to be extended or reorganised later, the software lets the user attach digital resources, such as documents, figures or even videos. It was also pointed out that, thanks to the colours and geometrical shapes included in the software, the maps created with it encourage communication in the classroom. Most of them (68%) conclude that “learning CmapTools to design concept maps is fun and motivating”.

Elaboration of collaborative concept maps. The following questions of the survey were related to the elaboration of collaborative concept maps: How do you evaluate the elaboration of concept maps in groups? Do you think this activity encourages the learning process?

The answers to the third question have been classified into the categories.

(A) Evaluation of collaborative concept maps:
   A1. Good (65.2 %)
   A2. Suitable (20.3 %)
   A3. Bad (5.8 %)
   A4. No answer (8.7 %)

(B) Influence of the collaborative concept mapping in teacher training:
   B1. Positive and they give reasons in favour (40.6 %)
   B2. Positive but they do not give reasons in favour (34.8 %)
   B3. Not important (10.1 %)
   B4. Answer not justified (14.5 %)

Combining the results of the categories A1 and A2, it is possible to state that 85% of the participants evaluated favourably the elaboration of collaborative concept maps to promote the exchange of ideas in a collaborative team atmosphere. Specifically, they state that, “It is an interesting and fun activity”. Many of the participants considered that, thanks to interaction in the group, the topic is better understood and that individual concept maps can be improved, although sometimes it is difficult to agree on the concept selection and hierarchy. A lot of students also stated that these activities encourage social interaction.

Global evaluation of the educational experience and the possible applications of concept mapping in environmental education. Finally, the learners were asked to express their opinion on the experience and point out the roles that concept mapping can have in environmental education and teacher training.
The answers to the last question have been classified into the categories.

(A) Global evaluation of the educational experience:
   A1. Positive and they provide the reasons in favour (36.2 %)
   A2. Positive, but they do not provide the reasons in favour (31.9 %)
   A3. Negative and they provide the reasons against (5.8 %)
   A4. Negative, but they do not provide the reasons against (7.2 %)
   A5. No answer (18.9 %)

(B) Educational applications of concept mapping in environmental education:
   B1. Point out more than three applications (53.6 %)
   B2. Point out less than three applications (26.1 %)
   B3. No application/no answer (20.3 %)

Accordingly, 68% of the participants positively evaluated the educational activities proposed, including the activities developed and the resources used, considering it a motivating, fun and interesting activity. Many of them considered the experience interesting and innovative, and they agree that the treatment of topics related to environmental education by means of the analysis of texts and the elaboration of individual and collaborative concept maps is very motivating.

Additionally, most of the future educators thought that CmapTools had contributed to the development of teaching competences (in a technological, methodological and communicative sense) that would be suitable in their future professional career as biology teachers or environmental educators.

In general, more than 50% of the students thought that concept mapping could be very useful in environmental education because it helps teachers to organise the contents of the subject. Moreover, students can use them as a study technique to organise their thoughts. Some of them also pointed out that knowledge representation activities promote autonomous learning and encourages reflection on their own knowledge.

Discussion and Conclusions

In this paper, an experience developed since 2009 within the framework of an innovative educational project at the University of Cordoba is described. The project seeks to promote a reflexive and collaborative educational strategy in the master’s degree programmes: “Biology Teachers’ Training” and “Environmental Education”. To do this, different kinds of teaching activities are implemented: the analysis of texts related to environmental education, the elaboration of individual and collaborative concept maps and the use of CmapTools to elaborate digital maps and design multimedia expositions with concept maps (Andrews et al., 2008; Balgopal & Wallace, 2009; Guruceaga & González, 2004; Zak & Munson, 2008).

Thus, one of the aims of this experience was to teach future environmental educators how to use concept mapping as an individual learning strategy that promotes the formation of more expressive teachers since it facilitates their reflection on their own knowledge (Nejla et al., 2011; Reitano & Green, 2012). Additionally, the proposed methodology promotes teamwork (Preszler, 2004), and it is a useful way of applying ICT tools effectively in environmental education (Ojeda et al., 2009) and in teacher training programmes in general (Makrakis et al., 2012). Furthermore, the proposed methodology fosters communication in the classroom, the acquisition of teaching competences and future educators’ motivation towards their self-development and professional progress.
Educative Experience of the Use of Concept Mapping...

(Hargreaves, 1998; Korthagen et al., 2006; MacKinnon & Aylward, 2009; Murga-Menoyo et al., 2011; Preszler, 2004; Schaal, 2010).

In this experience, the learning outcomes have been analysed by evaluating the proposed activities and the concept maps created by the students. In addition, by means of a survey, the students’ opinions on the experience have been gathered to improve the design of the experience (Bunting et al., 2006; Murga-Menoyo et al., 2011).

It is possible to conclude that future teachers have learned to design concept maps, and they think that concept maps are useful tools to graphically represent the contents of an environmental education topic and to present these contents in any kind of academic exposition. In addition, it is possible to state that future teachers learn very quickly how to use CmapTools in order to construct concept maps, how to attach digital educational resources and how to use these concept maps to improve classroom communication. Furthermore, it has been observed that the elaboration of collaborative concept maps in the classroom or online, thanks to the synchronous collaboration feature of CmapTools (Novak & Cañas, 2006), promotes social interaction among students and the development of the ability to work in groups, confirming the results of previous studies in the field of teacher training (Preszler, 2004; Schaal, 2010). In that sense, the opinions on the participants are quite positive, and they highlight that this tool promotes methodological change and, mainly, the motivation of the users (Chiu et al., 2000; MacKinnon & Aylward, 2009).

It is important to point out that this paper focuses on describing the educational experience based on concept mapping and the analysis of the future teachers’ opinions on the methodology and educational activities proposed. However, the project’s aims are wider, and the use of concept mapping is being promoted as a technique to represent the knowledge in teacher training programmes. Thus, future teachers are encouraged to use concept maps to sum up an educational unit (Figure 1). The analysis of the experience points out that students that use concept mapping develop communicative abilities.

It is also possible to conclude that the results obtained in this study, related to the students’ opinions on the use of concept mapping in teacher training programmes, confirm previous research outcomes (MacKinnon & Aylward, 2009; Murga-Menoyo et al., 2011). However, it is important to point out that this experience is the first phase of a wider innovative project. In the future stages, a new opinion survey, based on a Likert scale, will be carried out. Additionally, since environmental education is a transversal topic that may be tackled in all areas of the educational system (Espinosa, 2008), the use of concept mapping and the analysis of texts related to environmental challenges, such as pollution or climate change, will be proposed in other teacher training programmes in order to promote favourable behaviours towards sustainable development among future teachers (Gil Pérez et al., 2003; Fien, 1995). Thus, by means of this project, a transversal and interdisciplinary treatment of environmental education will be promoted in different teacher training programmes. In that way, due to the great influence of teachers and teaching as agents of change in society, this educational experience developed in teacher training programmes is expected to contribute to the attainment of the environmental education objectives and to promote the sustainable development (Fien, 1995; Ilisko, 2007; Gedžūne & Gedžūne, 2011).
Figure 1. Example of a concept map “Water Cycle” developed by a student of a master’s degree programme “Environmental Education” for the final project.
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Re-examining the Importance of Indigenous Perspectives in the Western Environmental Education for Sustainability: “From Tribal to Mainstream Education”

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Abstract
This paper highlights the importance of integrating indigenous perspectives on environmental sustainability into mainstream education as a way of bridging the gap in the understanding of indigenous knowledge systems into Western science explanations of sustainable development (SD) in education, at the same time ensuring traditional ecological knowledge (TEK) continuity for future generations as well as taking a steady stand in the global debates on SD. The first part of the paper will attempt to explore the issue of SD through Western and indigenous perspectives and will emphasise on the model of strong sustainability (in theory). Secondly, the importance of TEK will be examined and justified through case studies on Aboriginal peoples of British Colombia and Roviana people of Solomon Islands in achieving goals of sustainability. Thirdly, challenges for TEK will be investigated and some possibilities of protecting the rapid disappearance of indigenous knowledge will be dealt with. Lastly, a pedagogical approach to sustainability will be provided that postulates the relevance of indigenous pedagogy to formal and informal education, attempting to integrate Tilbury’s (1995) characteristics of environmental education for sustainability.

Keywords: sustainable development, indigenous perspectives, Western science, traditional ecological knowledge, environmental education for sustainability

Introduction
Modernity is a form of ‘social organisation’ that dominates most societies of the world today. It originates from the 17th century Europe with an evolution embracing the interrelatedness of the economic, political, cultural and social orientations (Huckle, 1996). The rise of capitalism led to the rise in demand for land which resulted in the breaking up of social institution that supported cooperative and sustainable land use. Land became a product for sale and a source of private wealth. The rise of capitalism initiated nation states and governments to create and protect property rights for capital accumulation. The centralised and bureaucratic forms of governments used their demo-
cratic powers to salvage environmental protection operations however, the unequal power distribution favoured business interests to get the maximum value out of the environment.

As Huckle (1996) points out sustaining capital accumulation and the living standards of majority of the elites often poses constraints for sustainable development (SD). Modernity is a product of revolutionary change as a result it has broken down the traditional world views that were concerned with the interconnectedness of all living and non-living things, generating respect for nature that is contained in traditional and local wisdom which serves to the sustainability of the environment (Huckle, 1996). The disorganised capitalism led to the fragmentation of the equilibrium state of nature and cultural traditions of society. The results show that the last 500 years of mechanistic and scientific world view has promoted domination and manipulation of nature which has led to severe environmental, social and economic crisis.

Post-modernity rests on the foundations of insecurity and uncertainties due to mass consumption which challenges species and natural resources survival. However, Huckle (1996) argued that a constructive postmodernism can solve the problems of modernity by coming in terms with the limits of positivism and technocracy through exploring other kinds of knowledge. “A constructive post-modernism can put society back in touch with nature and cultural tradition and so end the alienation induced by the rise of modernity” (Huckle, 1996, p. 9). The problems of modernity and a realisation for sustainability make it vital to recognise indigenous knowledge and cultural perspectives to help to solve ecological problems. The objective of this paper is to highlight the role of indigenous knowledge systems in the fight towards ecological sustainability, outlining its strengths for education and for sustainable practices at global level.

What does SD Mean?

Origins of SD

The principle of SD under the Western world view is built on the ideological separation of people and nature underlying free-market democracy. Under free market economy, development reflects the idea of promoting well-being. Also, sustainability is a recognition that the goals of economic growth are in tension with nature. The Western ideology of SD has been universalised through international legal principles which are problematic, as such an ideology has serious implications to nature and therefore a need to recruit valid explanations from different societies of the world so that the problem could be analysed through different societal lenses.

The debate on SD is about reconciling economic development with environmental conservation (World Commission on Environment and Development [WCED], 1997). Given the important role of culture in defining, evaluating and managing economic-environment interactions, the cultural dimension is notably absent from the paradigm of SD. This is because the Western views of SD are guided by modernisation theory based on the principles of neoclassical economic – views of rationality, individualism, materialism and social hierarchy (Daly & Cobb, 1989). The west should leave the thought of superiority of their own ideas on SD, based on the history of the past and move forward in welcoming alternative perspectives from indigenous societies in finding a way forward.
Western Perspective

SD as a term first emerged from the World Conservation Strategy 1980 and was later reinforced by the World Commission on Environment and Development 1987 also known as the Brundtland Report (Fien & Tilbury, 2002). According to Fien & Tilbury (2002), “world conservation strategy primarily aimed at protecting essential ecological processes, life-support systems and genetic diversity through the sustainable utilization of natural resources” (p. 2). However the strategy linked poverty, development and environment, focusing on the rural people of developing countries who turn to over-utilise natural resources in order to solve the problem of starvation and poverty (Fien & Tilbury, 2002).

This report the problems rooted in social, political and economic aspects heightening environmental crisis. Through the influence of Brundtland Report and Agenda 21, SD got its footing in the international debate on environmental degradation, which helped to create policies at the local, national and international levels, programmes and strategies to mitigate the effects on the environment of development. Therefore SD is defined by the World Commission on Environment and Development (1987) as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (p. 15).

The development of the concept of SD originates from a Western paradigm where its interpretation and implementation reflects Western culture and values. Although it claims at solving global environmental problems of all societies, its solutions are defined through the Western eyes (McGregor, 2004). The term “sustainable development” is used interchangeably with the term “sustainability” in the literature, however, “propo-nents of both concepts are faced with the challenge of encouraging a shift in societal world-views in order to achieve the goals they promote” (McGregor, 2004, p. 73), threatened by increasing depletion of the world’s natural resources and the degradation of the biosphere. According to McGregor (2004), SD from a Western perspective does not challenge the power imbalances between the Western and indigenous world in a meaningful way due to the ways the policies are implemented, which results in a loss of empowerment of indigenous nation. Indigenous nations TEK is not recognised as an integral part of achieving sustainability on its own but used within the framework of dominant Western agenda (McGregor, 2004).

The modern economic concept of SD undermines the ways of survival of indigenous people through generations of living with the environment; this is a result of the inherent tension between environment and economic aspects which adopts economic aspects for the survival of westernised nations, despite knowing its severe implications on the rest of the world. Advocating SD from a Western perspective as a way to integrate societies is problematic since indigenous people feel insecure with their traditional ecological knowledge to be applied within the framework of Western ideals thinking that it could be misleading. This goes back to the colonial history of the native societies, where colonial policies were aimed at benefiting the developed and natives were deprived of their indigenous land. However, this perspective of indigenous knowledge and its application is identified as a possible solution for achieving the goals of sustainable future (Tilbury, 1995).
Indigenous Perspectives

Western and indigenous perspectives are similar along the lines that both recognise the need to change from the current pathway of progress which is unsustainable. However, there are fundamental differences between the two world views. Indigenous world view is linked to the romanticised explanations of how people are connected with all creation. It is based on the stories of creation which explains key understanding of their place in the world. It provides the foundational teachings and lessons on how humans are related to the rest of the world. Therefore McGregor (2004) states that indigenous views of survival are based on giving not taking; thereby building a personal sacred relationship with creation and the way of living is based on protecting and enhancing this relationship with all creation.

McGregor (2004) explains that indigenous people regard creation as a gift and “to be sustainable means taking responsibilities and being spiritually connected to all of creation at all times” (p. 77). This responsibility is carried by both people and animals; therefore all elements of creation play a significant part towards the natural equilibrium of the environment. McGregor (2004) further elaborates that “sustaining, maintaining and enhancing relations with all creation is of utmost importance from an indigenous point of view” (p. 77). It is worth noting that an essential rule that emerges from creation stories is that “no one can interfere with the ability of the elements or beings of creation to perform their duties” (McGregor, 2004, p. 77) as this threatens sustainability. Based on the above explanations of indigenous perspectives (McGregor, 2004), it is evident that SD under this world view is based on the survival of all the elements of the world, through their prolonged relationship and indispensable affiliation towards the maintenance of all creation.

To have a better understanding of the indigenous world view, it is essential to investigate the indigenous knowledge systems which can be traced back through the colonial history of the colonised. The ethnographical basis of indigenous knowledge reflects compromised efforts, strengths and perseverance in day to day survival and generations of experimental living with nature. Indigenous history is of oppression and their survival is dependent on tradition and beliefs in ancestors and prayers. The rich knowledge systems of particular indigenous groups have provided active resistance methods and a process of reclaiming their traditions overtime, and as McGregor (2004) reveals “resisting and reclaiming form an integral part of the concept of sustainable development” (p. 77), which relates closely to the cultural component of sustainability.

This strong sustainability model ensures that SD should emphasise on a continuing and holistic approach to integrating economic, environmental and social/cultural elements (Figure 1). It attempts to resolve the conflict between economic prosperity, environmental equality and social equity (Econation, 2010). The strong sustainability model ensures that the environment is a self-contained system and society and the economy are the dependent subsets of the environment (Sustainable Aotearoa New Zealand Incorporated [SANZ], 2009). Strong sustainability controls human activities and reiterates societal ethics and values which aim at the rejuvenation of ecosystems’ resources thereby providing wise consumer choices and controlling market operations (economy) based on producing environmental friendly goods and services. In this way, society controls the economy and the environment controls the society, therefore assuming that what is good for the environment should be good for society and the economy. The strong sustainability model illustrates the working relationship of people with other elements of the world, which is the central idea of TEK.
Keeping strong sustainability in mind the next part of the paper looks at TEK and how it is developed and maintained through generations of living with the environment for a number of indigenous groups. It is important to point out at this stage that traditional knowledge is not consistent or the same across different indigenous groups. Some studies show that traditional knowledge has been unsuccessful in maintaining their sustainable procedure and practices in the current times (Howard & Widdowson, 1996), however, I feel that there are some grounds for its justification and successful application in some societies.

**TEK**

TEK is a body of knowledge and beliefs transmitted through oral tradition and first hand observation. It includes a system of classification, a set of empirical observations about the local environment and a system of self-management that governs resource use (Emery, 1997). Ecological aspects are closely tied to social and spiritual aspects of the knowledge system. The quantity and quality of TEK varies among community members, depending on gender, age, social status, intellectual capability and profession (hunter, spiritual leader, healer etc.). With its roots firmly in the past, TEK is both cumulative and dynamic, building upon the experience of earlier generations and adapting the new technological and socio-economic changes of the present (Emery, 1997).

TEK is a ‘way of life’ of a group of people where a special attention is given to the actual living of life of indigenous people in a particular time period. According to Battiste and Henderson (2000), TEK is localised and social. It focuses on building a web of relationships between different elements of the world within a particular locality, therefore this knowledge is original and is based on specific models of species interactions in a small geographical setting which provides better explanations for the physical changes of the environment in that area than compared to Western science explanations which is mostly based on global generalisations.

Traditional ecological knowledge is a dynamic but stable knowledge system which keeps on renewing from generation to generation through individual observations, comparing current experiences with past generation experiences, thus conducting experiments and testing through day-day interaction with the environment, which is done to test for the reliability of their knowledge and sharing findings with others (Battiste & Henderson, 2000). This shows that this knowledge system is re-examined by each generations, at an individual and community level, to test for its current validity, which reflects empirical self-consciousness of individuals. Now, it becomes important to examine and justify the successful application of traditional ecological knowledge in some societies through Aboriginal people of British Colombia and Roviana people of Solomon Islands.
Case Study 1

Turner, Ignace and Ignace (2000) discuss TEK and wisdom of aboriginal peoples of British Columbia by looking at the traditional practices of *shuswap*, *Interior Salish* and *Kwakwaka’wakw* and *Nuu-chah-Nulth* groups, and it is noted that aboriginal practices are based on a “dialectic relationship between those practices and its people’s belief systems” (p. 1276). For instance, these groups’ plant resources are managed at three levels: *population* – placing emphasis on the number of a plant species while harvesting it; *habitats* – using fire to create and maintain successful stages favourable in the productivity of a complex plant species and *landscapes* – a variety of strategies are used which includes, “seasonal rounds, conventions over resource ownership, culturally mediated prescriptions for humans, relationship between plants and animals, determine landscape development” (Turner et al. 2000, p.1277). The techniques used to preserve plant resources in these communities is based on the virtue that plant species are ‘perennial’, therefore plant harvest depends upon what it will be used for, therefore, according to Turner et al. (2000), “unless an entire tree is required for construction or canoe making, individual plants are not generally destroyed” (p. 1277). On other circumstances where parts of a plant has to be used, harvesting only takes place from those plants that have the ability to regenerate (Turner et al., 2000).

Turner et al. (2000) also points out how some trees are harvested in large quantities, but the productivity of population is maintained through the use of various strategies. For example, the inner bark of Western red-cedar and yellow cedar is harvested in big quantities for basketry, mats and clothing, without using more than one third of the tree’s circumference (outer birch bark is used), and the tree continues to regenerate and live. These barks are used in a range of products from handmade goods to edible tissues and medicine. This is a result of successful pruning and branching of plants as, for the root vegetable harvest, the whole corm is removed to increase propagation. In these communities, the emphasis is placed on selective harvest of plants keeping a well maintained forest cover, pruning and burning of selected fields for long-term yields. When harvesting seafood high significance is placed on the ecological indicators for population health. For example, the number and size of different fish species found can be used as an indicator of biodiversity. People of these communities have a direct authority system by leaders who manage and control resource use based on survey and observations as they decide when to announce harvest for their people.

Case Study 2

Another example of TEK practice is through fishers’ knowledge in Western Solomon Islands. According to Lauer and Aswani (2009), practices of Roviana fishers are examined through an on-going marine conservation project. Under this study, the Roviana ecological knowledge of fishers challenge the current models based on the cognitive aspects of knowing. This project shows how local knowledge could be applied with a scientific approach to develop hybrid methodologies, where fishing practices, socioeconomics and demography are all integrated into geographical information systems. Roviana knowledge was used in the production of habitats and benthic maps, identifying common fishing sites for spawning and the locals identified the fish species in the area. The project showed how through ethnoscience local people “explore, understand, conceptualize and categorize local ecologies” (Lauer & Aswani, 2009, p. 319).
According to Lauer and Aswani (2009), Roviana fishers’ engagement, interaction and close attention from their canoes to the undersea environment is important in “interpreting the patterns, textures of features and substrates underneath them to determine their position and navigate the seascape in finding fishing grounds” (p. 325); hence this interaction helped them in enhancing their visual skills. The Roviana fishers are capable of interpreting air photos and satellite images which they acquired through accumulation of knowledge based on years of fishing and navigating experiences. This study highlights that the epistemology and ethnoscience of Roviana understanding was consistent with that of the practise approach, and it integrated a quantitative framework to test its suitability with the Western scientific knowledge. The findings of Lauer and Aswani (2009) suggest that a local practice-based approach is systematic and informative in understanding of knowledge than cognitive models and calls for more research in developing approaches and methods for knowing and understanding indigenous knowledge, through variety of methodologies and a multiple theoretical framework.

Challenges for TEK

According to McGregor (2004), there is an environmental science dilemma, where traditional knowledge, in spite of its successful application in some societies, corresponds poorly with the Western explanations of the phenomena, because traditional knowledge is not intellectually developed through institutionalised practices. As a result, environmental scientists find it non-systematic, non-quantitative, which is mostly metaphorically based and lacking cognitive aspects of explanations. Since indigenous knowledge is tested in narrow geographical settings, Western science is not convinced if it could be successfully applied in the global context. Breidlid (2009) adds that indigenous knowledge systems provide romanticised explanations of the world which could be inadequate and misleading in situations of rapid change. There is a call for a critical exploration of the traditional knowledge system towards its validity for achieving SD at a global level.

McGregor (2004) argue that cultural disruption in native communities, which is a result of colonisation, has led to the degrading of local knowledge systems. Therefore a need to revitalise native communities to maintain and develop the existing knowledge and regain the lost ones. It is also evident that the dialogue regarding the importance of using TEK is currently performed in English, which could cause severe complications in its translation from a native language into English thereby compromising on its understanding for non-indigenous people from the Western world. McGregor (2004) recognises that there is a power imbalance between the two groups which means indigenous people, who hold the knowledge are vulnerable to exploitation and the existing structure of environmental bodies for SD, provides limited provisions for the safety and continuity of indigenous knowledge.

Possibilities of Global Acceptance

It becomes crucial to integrate indigenous knowledge systems into Western science so that a better understanding is achieved when dealing with the problems of unsustainability for all societies of the world. As outlined by McGregor (2004), indigenous people must control their own information, but, since their knowledge base is dynamic, vital and evolving, there is a tendency for this knowledge to be lost, because written records
are not kept. Moreover, the process is oral. McGregor also points out that indigenous people must not support ‘salvage’ operations towards the recovery of lost knowledge, but they must ensure that the information gained reflects the relics of the past. As we know that traditional knowledge is holistic, indigenous people must ensure that they do not compartmentalise it to the topic state for scientific exploration as it has to be understood as a whole through day to day living experiences with the environment.

There is a need for transformative action through environmental education for sustainability (EEfS) in schools and non-governmental organisations’ (NGOs’). Also, environmental campaigns must ensure the respect for indigenous world views and enhance ways in which it could be further tested for reliability of the knowledge to be used at a global level through community participation in projects, especially designed using indigenous methods and knowledge.

There is a need for transformative action through EEfS in schools and NGOs. Also, environmental campaigns must ensure the respect for indigenous world views and enhance ways in which it could be further tested for reliability of the knowledge to be used at a global level through community participation in projects, especially designed using indigenous methods and knowledge. Battiste and Henderson (2000) identified the need for convention laws, protecting indigenous knowledge and heritage through an appropriate agency at an international level, which should be given equal acceptance with Western legal regimes.

Since the challenges and possibilities are recognised for traditional ecological knowledge, now it becomes necessary to come up with some relevant pedagogy to enhance the successful application of this knowledge in society through formal and informal education. The pedagogical approach in the successful application of TEK is the final part of this paper, therefore I aim to integrate the characteristics of EEfS in its explanation.

The Pedagogical Approach

We need a pedagogical strategy that is based on scientific knowledge and social experience among other factors, that establishes organised collective action towards clear ends ... only in this way will individual action become meaningful and contribute to overcoming the current state of things (Gonzalez-Gaudiano & Meira-Cartea, 2010, p. 36).

EEfS must promote a holistic view of education through the transformation of the education system from reductionist approaches of teaching to a more child-centred tradition or place-based education rooted in inquiry learning. Pedagogies should encourage ethical relativism where students’ should be given a chance to compare strengths and weaknesses of different value systems and look at alternative ethical positions to nurture environmental ethics (Sterling, 1993). EEfS should begin with the existing knowledge of the child, where the pedagogy employed should assist in the ability to recognise the problem and to develop a sense of responsibility for a need to participate in the process of change, in other words, it should focus on the child’s readiness to learn, emphasising on ‘relevance’ – a central principle of EEfS where students are involved solving in world problems.

Students should be taught appropriate skills and knowledge to undertake responsibilities as citizens and as members of the community, where they critically evaluate
information based on their traditional knowledge and school science. This makes the learner acquainted with a variety of appropriate skills for action, which portrays environmental action by Tilbury (1995). Another way of enhancing traditional ecological knowledge is information sharing through community environmental awareness programs. This practice could keep youths involved in practising their cultural ways and using TEK enables them to understand changes to the knowledge systems and the environment (Fuhker, 2002).

EEfS must also ensure that programmes are based on responsibility towards our biosphere rather than focusing on past mistakes, where students find their own ways to protect and improve the environment (Fuhker, 2002). In this way, the whole picture surrounding the problem is being investigated demonstrating a holistic approach to learning. EEfS must ensure that “there is no separation between teaching and learning as everyone does both” (Fuhker, 2002, p. 51) by sharing their traditional and Western experiences in groups. Developing this holistic approach to learning through “personal environmental ethics, valuing social responsibility, concern for others and harmony with nature” (Tilbury, 1995, p. 210) reflects value education.

Fuhker (2002) explains that the participants of EEfS programmes must become resources for their own learning, and their effort to provide answers for each other should provoke the learning process at a deeper level, which further allows the participants to investigate issues that interest them. Therefore each individual plays a role in creating his/her own education. This approach to education offers issue-based learning and critical education, where it develops an action-oriented approach and politically literate individuals with critical skills for understanding complex issues and finding suitable solutions (Tilbury, 1995).

Traditional knowledge can be integrated into the mainstream curriculum across the curriculum content and taught through various subject topics that require students to undertake projects on local topics; thereby teachers’ can focus on testing the relevance of this knowledge to the current curriculum outcomes, such as making connections to prior learning and experience. The use of an indigenous pedagogy should ensure that formal and informal education incorporates the learning of community approaches in successfully transforming all the areas of the civil society. Their application should reflect education about/in/for the environment using the head, heart and hands, demonstrating a three-fold approach to the EE (Tilbury, 2005). Tribal and village leaders should also encourage students and youths to form activists’ groups to represent current actions and projects, taken to preserve indigenous knowledge, at national and global environmental conferences to enlighten people as to the reliability of the knowledge system. This shows the future dimensions for EEfS that could possibly promote empowerment and action by desiring a “greener economic, social and political society” (Tilbury, 1995, p. 207).

Final Comment

This paper takes a stand on integrating indigenous perspectives into Western EEfS in mainstream education. It explains the concept of SD through the Western and indigenous perspectives to provide a framework for discussion. Therefore, in this paper, I have attempted to justify the importance of traditional ecological knowledge and its useful application in some societies through Aboriginal peoples of British Colombia and Roviana
people of Solomon Islands which provides a basis for its validity in the literature on sustainability. The use of strong sustainability model is re-emphasised, which reflects the sustainable practices and is used to explain TEK of indigenous societies that places much emphasis on the environment. In this paper, I have also highlighted some possible challenges for TEK as having an independent stand on promoting sustainability and have provided some scenarios for its positive implementation in achieving global ecological sustainability. Lastly, I have provided a pedagogical approach where practices have been identified that could promote indigenous perspectives into formal and informal education, by integrating characteristics of EEfS into learning. The outcome of this paper suggests that, based on the case studies on some societies, the validity of indigenous knowledge systems still prevails, but more research is required in order to test for its application at a global level with Western scientific techniques.

References


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