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UNDERSTANDING OF SUSTAINABILITY AND EDUCATION FOR SUSTAINABLE DEVELOPMENT AMONG STUDENTS TEACHERS OF BIOLOGY
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RAZUMEVANJE KONCEPTA TRAJNOSTNEGA RAZVOJA IN VZGOJE
IN IZOBRAŽEVANJA ZA TRAJNOSTNI RAZVOJ MED BODOČIMI
UČITELJI BIOLOGIJE
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I owe special thanks to The University College for Agrarian and Environmental Pedagogy in Vienna for warm welcome and great working experience on Erasmus+ project.
Tell me - and I forget.
Teach me - and I remember.
Involve me and I learn.
Benjamin Franklin
ABSTRACT

Sustainable development (SD) is one of the global and central aims of today’s politics. Different agendas have been developed to promote sustainability and make it a political goal worldwide. As stated in Agenda 21, education has to play an essential role in achieving a sustainable society.

The research was focused on understanding and knowledge about SD and education for sustainable development (ESD) by Slovenian and Austrian biology teacher students, and comparing the results between the two countries. Another aim of our research was to determine pre-service teachers pedagogical content knowledge (PCK).

The research was carried out at the University of Ljubljana, Faculty of Education, Department of Biology, Chemistry and Home Economic and at the University of Vienna, Centre for Teacher Education.

60 Slovenian pre-service biology teachers and 60 Austrian pre-service biology teachers were interviewed for our study. Pre-service biology teachers answered a set of closed, Likert-type and open survey-questions that were analysed both, qualitatively and quantitatively. The questionnaire was in Slovenian and German language. The closed and Likert questions were analysed statistically. We were using the following methods: T-test (Independent Samples) and A chi-square test. Open questions were analysed qualitatively with the process of coding. We used deductive and inductive coding methods.

Pre-service biology teachers from Slovenia and Austria have a good understanding of the environmental approach of sustainability, but lack interconnections between the environmental, economic and social concerns related to SD. They describe and connect ESD with environmental education and environmental awareness. The most frequent sources of knowledge for Slovenian pre-service teachers were the second subject of study (chemistry or home economics). The most frequently mentioned source of knowledge for Austrian pre-service teachers were biology study and other sources, such as mass media or personal information channel. Pre-service teachers from both countries had strong positive attitudes about implementing ESD in their future classes. The difference between pre-service teachers in the two countries was not statistically significant regarding knowledge of, and attitudes to ESD. Students from both countries know the pedagogical principles of ESD, such as active learning and transformative education.

Results of the research contribute to evaluation and development of curriculum for middle and high school biology teachers.

KEY WORDS: Pre-service biology teachers, sustainable development, education for sustainable development, pedagogical content knowledge, knowledge, attitudes
POVZETEK


Rezultate raziskave bi lahko uporabili pri evaluaciji in snovanju novih učnih načrtov za študente biologije z vezavami.

KLJUČNE BESED: izobraževanje učiteljev biologije, izobraževanje za trajnostni razvoj, znanje za poučevanje (PCB), znanje, stališča.
# CONTENTS

1 INTRODUCTION ........................................................................................................................................... 1

1.1 UVOD .................................................................................................................................................... 2

2 THEORETICAL PART .................................................................................................................................. 3

2.1 Sustainable development ......................................................................................................................... 3

2.1.1 Three pillars of sustainability ............................................................................................................ 4

2.1.2 Models of sustainability ...................................................................................................................... 4

2.2 Education for sustainable development ................................................................................................... 7

2.2.1 Pedagogical approach in ESD ........................................................................................................... 8

2.2.2 Competences in ESD ......................................................................................................................... 10

2.2.3 Education for Sustainable Development in Biology Education ................................................. 10

2.2.4 Critical view on sustainability ........................................................................................................... 11

2.3 Pedagogical content knowledge ........................................................................................................... 13

2.3.1 Pedagogical content knowledge in biology ...................................................................................... 14

2.4 Education system in Slovenia .............................................................................................................. 15

2.4.1 Primary and Secondary Education .................................................................................................. 15

2.5 Education system in Austria ................................................................................................................ 16

2.5.1 Primary and Secondary Education .................................................................................................. 16

2.5.2 Differences between Education system in Slovenia and Austria ................................................. 16

2.5.3 The role of biology in curriculum ................................................................................................... 17

2.6 Teacher training .................................................................................................................................. 18

3 METHODOLOGY ...................................................................................................................................... 19

3.1 Research problem ................................................................................................................................. 19

3.2 Hypotheses ............................................................................................................................................ 19

3.3 Sample and Settings .............................................................................................................................. 20

3.3.1 Age of students ................................................................................................................................. 20

3.3.2 Previous education ............................................................................................................................ 21

3.3.3 Second subject of study .................................................................................................................... 21

3.3.4 Year of study .................................................................................................................................... 22

3.4 Method ............................................................................................................................................... 23

3.4.1 Questionnaire ................................................................................................................................... 23

3.4.2 Data analysis .................................................................................................................................... 23

4 RESULTS ................................................................................................................................................... 25
4.1 Analysis of 15 associations about the term “sustainability” ........................................... 25
4.2 Analysis description/definition of Sustainable Development ........................................ 30
4.3 Analysis of students’ understanding of Education for Sustainable Development ............ 34
4.4 Analysis the contexts of school subjects where students would place Education for Sustainable Development ......................................................................................................................... 38
4.5 Analysis students’ sources of knowledge about sustainability and Education for Sustainable Development .......................................................................................................................... 41
   4.5.1 Analysis students’ sources of knowledge about Brundtland’s definition of Sustainable Development .......................................................................................................................... 42
   4.5.2 Analysis students’ sources of knowledge about Education for Sustainable Development ............................................................................................................................... 43
4.6 Analysis of students’ attitudes to implementing Education for Sustainable Development in biology class .......................................................................................................................... 46
4.7 Analysis of students’ previous knowledge about sustainability and Education for Sustainable Development ....................................................................................................................... 48
4.8 Analysis of suitable topics and contents for teaching biology in order to implement Education for Sustainable Development .......................................................................................... 51
4.9 Analysis of teaching approaches to implement Education for Sustainable Development in biology lessons ..................................................................................................................... 54
4.10 Students opinion about Education for sustainable development in society in general and in biology lessons ................................................................................................................. 57
5 DISCUSSION ........................................................................................................................... 59
6 CONCLUSION ......................................................................................................................... 63
   6.1 ZAKLJUČEK ......................................................................................................................... 64
7 REFERENCES .......................................................................................................................... 65
8 APPENDICES .......................................................................................................................... 70
   8.1 Appendix 1 - Questionnaire in German language ................................................................. 70
   8.2 Appendix 2 - Questionnaire in Slovenian language .............................................................. 74
   8.3 Appendix 3 – Results of T-test and Chi-square test ............................................................. 78
LIST OF FIGURES

Figure 1: Weak sustainability model/Triple bottom line (TBL) model of sustainability (United Nations World Summit, 2005) ................................................................................................................. 5
Figure 2: Strong sustainability model (Ekins et al., 2003) .......................................................... 6
Figure 3: Pedagogical content knowledge. ..................................................................................... 14
Figure 4: Age of students .................................................................................................................. 20
Figure 5: Previous education ........................................................................................................... 21
Figure 6: Second subject of study ................................................................................................. 22
Figure 7: Year of study .................................................................................................................... 22
Figure 8: Slovenian (SI) and Austrian (A) students’ associations about the term "sustainability" in main categories ................................................................................................................................................................................................. 29
Figure 9: Slovenian (SI) and Austrian (A) students understanding of SD .................................... 33
Figure 10: Slovenian (SI) and Austrian (A) students’ understanding of ESD .............................. 37
Figure 11: Category where students placed ESD ......................................................................... 39
Figure 12: Preferred allocation of ESD among the school subject .................................................... 40
Figure 13: Slovenian (SI) students’ source of knowledge about "sustainability" and ESD ......... 44
Figure 14: Austrian (A) students’ source of knowledge about "sustainability" and ESD .......... 45
Figure 15: Slovenian (SI) and Austrian (A) students’ attitude to implementation ESD in secondary school ................................................................................................................................................................................. 47
Figure 16: Slovenian (SI) and Austrian (A) student’s description of previous pupils’ knowledge about sustainability and ESD ................................................................................................................................................................................................. 50
Figure 17: Potential topics from the biology curriculum for ESD in biology lessons ............... 53
Figure 18: Suitable approaches to implement ESD in biology lesson ........................................ 56
Figure 19: Students opinion about ESD in society in general ....................................................... 57
Figure 20: Students opinion about Education for sustainable development in biology lessons. ................................................................................................................................................................................................. 58
LIST OF TABLES

Table 1: Integration of sustainability within higher education implies shifts (Sterling, 2004, p. 58) ........................................................................................................................................................................ 9
Table 2: Slovenian (SI) and Austrian (A) students’ associations about the term "sustainability" ........................................................................................................................................................................ 26
Table 3: Different categories with included answers about the term of SD........................................................................................................................................................................ 31
Table 4: Students’ understanding of ESD ........................................................................................................................................................................ 35
Table 5: School subject where students placed ESD ........................................................................................................................................................................ 39
Table 6: Slovenian (SI) and Austrian (A) student’s description of previous pupils’ knowledge about sustainability and ESD ........................................................................................................................................................................ 49
Table 7: Potential topics from the biology curriculum for ESD in biology lesson ........................................................................................................................................................................ 52
Table 8: Teaching approaches mentioned by students ........................................................................................................................................................................ 55
LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Austrian</td>
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<tr>
<td>AHS</td>
<td>Allgemein Bildende Höhere Schule</td>
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<tr>
<td>BHS</td>
<td>Berufsbildende höhere Schule</td>
</tr>
<tr>
<td>BnE</td>
<td>Bildung für Nachhaltige Entwicklung</td>
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<tr>
<td>CoRe</td>
<td>Content representation</td>
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<tr>
<td>ECTS</td>
<td>European credit transfer and accumulation system</td>
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<td>EE</td>
<td>Environmental education</td>
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<td>ESD</td>
<td>Education for sustainable development</td>
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<td>EU</td>
<td>Europe Union</td>
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<td>GAP</td>
<td>Global Action Plan</td>
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<td>NMS</td>
<td>Neu Mittelschule</td>
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<td>PCK</td>
<td>Pedagogical content knowledge</td>
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<tr>
<td>PaP-eRs</td>
<td>Professional-experience repertoires</td>
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<td>SI</td>
<td>Slovenian</td>
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<tr>
<td>SD</td>
<td>Sustainable development</td>
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<td>SDGs</td>
<td>Sustainable development goals</td>
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<td>SMK</td>
<td>Subject matter knowledge</td>
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<tr>
<td>SuS</td>
<td>Schüler und Schülerinnen</td>
</tr>
<tr>
<td>TBL</td>
<td>Triple bottom line</td>
</tr>
<tr>
<td>TR</td>
<td>Trajnostni razvoj</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>UNECE</td>
<td>United Nations Economic Commission for Europe</td>
</tr>
<tr>
<td>VITR</td>
<td>Vzgoja in izobraževanje za trajnostni razvoj</td>
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<tr>
<td>WCED</td>
<td>World Commission on Environment and Development</td>
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1 INTRODUCTION

One of the most important goals of humanity in the 21st century is to construct a sustainable society. Education is one key to achieve sustainability. The term sustainable development (SD) was first published in the late eighties. Most known is Brundtland's definition of SD: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Conference on Environment and Development, 1987, p 43). Education for sustainable development (ESD) is one of the main aims of the national, European as well as international school policy (UNESCO, 2005). For the (future) teachers is essential to raising awareness about sustainable development and education for sustainable development (Marentič Požarnik, 2014; Sterling, 2004).

As far as we know, no previous research has investigated the understanding of sustainability and ESD among student teachers of biology in Slovenia and Austria. Skribe Dimec (2013) report that in national tests, ESD is more often mentioned in biology tests than in other school subjects. Other Slovenian researchers already studied understanding of SD in kindergartens (Lepičnik Vodopivec and Tominec, 2011) and among future primary school teachers (Skribe Dimec, 2013). Students’ views on the acceptability of their teachers’ value-related statements about sustainability and climate change were studied by Torkar (2013). Austrian researchers report about competences for ESD in teacher education (Rauch and Steiner, 2013). Pfaffenwimmer and Rauch (2014) studied networking for innovation in ESD in Austria. In international studies, we could find more studies among student teachers and their understanding of sustainability and ESD. Summers, Corney and Childs (2004) analysed subject matter knowledge of science teacher trainees regarding SD in the field of geography. Burmeister and Eilks (2013) described an understanding of sustainability and ESD among German student teachers and trainee teachers of chemistry. Jerne, Palmberg and Yli Panula (2016) researched teaching methods in biology education and sustainability education, used to promote sustainability. Researchers recognised positive attitudes towards concepts of SD and ESD, but also their lack of knowledge.

The theoretical part of this thesis includes an overview of the different theories about SD and ESD. The following chapters introduce pedagogical content knowledge (PCK) and education systems in Slovenia and Austria. In Methods section, we provide a description of research methods. In our research, a questionnaire developed by Burmeister and Eilks in 2013 was used. The questionnaire was initially prepared for chemistry teachers. In our thesis, it is modified for pre-service biology teachers.

This work aims to identify understanding and knowledge about SD and ESD by Slovenian and Austrian students and compare the results between countries. The research also looks into future biology teachers’ PCK.

The main contribution of this work provides an understanding of students’ attitudes and knowledge about SD and ESD among pre-service teachers of biology in Slovenia and Austria. Results of the research could be used to evaluate and develop a curriculum for middle and high school biology teachers.
1.1 UVOD


Skupne ugotovitve avtorjev so, da je tema pozdana tako med učitelji kot učenci/dijaki, vendar premalo zastopana v šolskem kurikulumu in predvsem (pre)ozko obravnavana. Predlagajo sistemske in izvedbene spremembe na področju VITR.


Glavni cilj raziskave je bil ugotoviti, kakšno je razumevanje in znanje bodočih učiteljev biologije iz Univerze v Ljubljani in na Dunaju o TR in VITR, ter primerjati rezultate med skupinama študentov. Rezultati raziskave nam bodo tudi pokazali, kakšno znanje za poučevanje imajo bodoči učitelji biologije. Raziskava bo pripomogla k razumevanju stališč in znanju študentov, ki se izobražujejo za bodoče učitelje biologije na Univerzi v Ljubljani in Dunaju. Rezultate raziskave bi lahko uporabili pri evalvaciji in načrtovanju novih učnih načrtov za študente biologije z vezavami.
2 THEORETICAL PART

2.1 Sustainable development

SD is one of the most well-known and complex concepts in the 21st century. In literature, we could find many different definitions. The most commonly accepted definition is found in the document Our Common Future: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Conference on Environment and Development, 1987, p 43). It is known as Brundtland's definition of SD. This concept has received the most attention since the United Nations Conference on Environment and Development, held in Rio de Janeiro in 1992. The key document of the Rio agreement is Agenda 21, a major action plan for SD in the 21st century (Palmer and Neal, 1994). Nowadays, SD is the theoretical basis and an increasingly important norm for human development worldwide (UNESCO, 2009).

SD can be traced back to the emerging environmental movement of the 1960s (Palmer and Neal, 1994). One of the main events to raise awareness and start thinking about the environment was the publication of Rachel Carson’s Silent Spring in 1962. The environmental movement was concerned that human activity was having severe and negative impacts on the planet (such as nuclear power, environmental damage of war, waste problems etc.) and that the patterns of growth and development would be unsustainable if they continued unchecked (Palmer and Neal, 1994). This provided scientific evidence of the global impact of humans on their environment. The report called “The Limits to Growth” was one of the key aspects that highlighted this movement (Meadows et al., 1972).

Nevertheless, this report did not define what the goal of public policy should be. The theoretical framework for the paradigm of SD was created between 1972 and 1992 through a series of international conferences and initiatives (Drexhage and Murphy, 2010). The “World Conservation Strategy” and “Our Common Future” (well known as the Brundtland Report) presented the term “sustainable development”. The concept of SD was born. SD is a difficult concept to describe; therefore, different organisations provide different definitions of SD. In the next paragraph, the most commonly used are introduced.

The Forum for the Future organisation describes SD as:” a dynamic process, which enables all people to realise their potential and improve their quality of life in ways, which simultaneously protect and enhance the Earth’s life support systems” (Forum for the future, 2011). The human rights community says that “sustainability is attainable through and supported by peace, justice, and democracy (McKeown, 2002).” In educational policy, UNESCO describes SD as: “international resource development that is socially desirable, economically viable, culturally appropriate and ecologically sustainable” (UNESCO, 2005, Annex II, p. 3). The similar definition was given by Education for Sustainable Development Toolkit 2.0. highlights that “sustainable development is often thought to have three components: environment, society, and economy. The well-being of these three areas is intertwined, not separate” (McKeown, 2002). O’Riordan (2004) defines SD “as a constant process of transformation of a society and an economy towards acting as trustees for future generations of the planet that maintain and nurture life and habitability”.

From many different definitions of SD, a general common idea can be recognised. One of the well-known is an increasingly widespread concern about the damage to environments, arising from the trends and variations in peoples’ life chances and lifestyles, their relationships with others and with the world around them, and understanding of those issues (Corney and Reid,
2007). As mentioned by different authors (Corney and Reid, 2007; UNESCO, 2005), learning is the focus of efforts to foster sustainability.

2.1.1 Three pillars of sustainability

The term SD is widely used among educators, economists, politicians and others. Different interest groups often interpret it in different ways. In literature, we could find a growing consensus that SD must be conceptualized in a way that concern three dimensions (pillars): environmental, economic and social (Summers et al., 2004).

The environmental dimension refers to nature and includes all living things, natural resources and life-supporting systems. The economic dimension comprises of jobs and income, and the goal is appropriate development. The social dimension involves people living together. The main aim is peace, equality and human rights. In addition to these three dimensions, some authors also mention a fourth dimension, the political dimension. It has to do with politics, policy and decision-making as a goal of democracy (Fien, Maclean, Park and Work, 2009). Other authors said that the fourth dimension is a cultural dimension. A cultural dimension represents culture itself (such as heritage, creativity, cultural industries, crafts and cultural tourism), as well as, public policy, which include education, economy, science, communication, environment, social cohesion and international cooperation (UNESCO, 2010).

2.1.2 Models of sustainability

The relationship between social, economic and environmental systems is usually shown in two ways, depending on the disciplinary perspectives, and the philosophical and ethical interpretation (egocentrism (biocentrism) versus anthropocentrism). These two different paradigms represent strong and weak sustainability (Hediger, 2000; Neumayer, 1990; Pearce and Turner; 1990). The difference between weak and strong sustainability started to come out in the seventies (Neumayer, 1990). Weak and strong sustainability give the economic and environmental components different weight and meaning.

Weak sustainability means that natural capital and other types of capitals (economic and social) are perfectly substitutable. Weak sustainability represents strong connection between social, ecological and economic system. The economic system has much more influence on decision-making than social and ecological ones. Some authors see an economic system as the main centre of weak sustainability (Stachan, 2009). The issues are the total value of the aggregate stock of capital, which should be at least maintained or, ideally, increased for future generations (Dietz and Neumayer, 2007; Ekins et al., 2003). The key idea of strong sustainability is the sustainability of natural capital, whereas other types of capitals (economics, social) are perfectly substitutable. The leading sustainability issue of strong sustainability is conserving the irreplaceable “stocks” of critical natural capital, for the sake of future generation (Ekins et al., 2003). Ecological system in strong sustainability is a frame for all other systems (ecological and social one) (Strachan, 2009).

The triple bottom line (Venn diagram) model of sustainability is widely used. It is known as a weak sustainability model which describes the environment as only one “resource base” for human beings. The diagram shows three interlocking circles with environmental (conservation), economic (growth), and social (equity) dimensions. Markets are seen to guide development in the best possible (most sustainable) way (Dietz et al., 2007). In this model, SD is achieved, when all three pillars act together. Two basic critiques of this model are brought to mind. The first one is the idea that the “pillars” are independent constructs. Some
authors said that humans are biological entities, and therefore, social pillars are also environmental and thus cannot be independent. It is impossible to separate human development from environmental development (e.g. by destroying ecosystems for agriculture, we potentially destroy access to natural resources like wood, food, and medicines) (Costanza et al., 1997). The second critique is that the model does not include a time dimension, a core component of Brundtland's definition of SD (WCED, 1987).

Figure 1: Weak sustainability model/Triple bottom line (TBL) model of sustainability (United Nations World Summit, 2005)

The emphasis of strong sustainability is put on the paradigm of the present non-substitutability, in which there are natural systems, that cannot be eroded or destroyed without compromising the interests of future generations (Fiorino, 2011). The utilisation of natural resources is necessary, but economic growth should not be of intrinsic value. Human society cannot exist without the environment, which provides the necessities of life: air, water, food, energy and raw materials. The human economy depends on people and social interaction. The core concept of strong sustainability is that the benefits of nature are irreplaceable and that the entire economy is reliant on society, which in turn is entirely dependent on the environment. This emphasises the interdependencies between our society, our economy and the natural environment (Dedeurwaerdere, 2014; Ekins et al., 2003).
Development is sustainable only when the environmental system represents the frame and inside of this frame is placed social and economic systems. System thinking is essential for understanding real sustainability and engaging the learners with the complexity of the world (Stachan, 2009).

Figure 2: Strong sustainability model (Ekins et al., 2003).
2.2 Education for sustainable development

Many different terms are known under the umbrella of sustainability education, such as Earth education, development education, environmental education, education for the environment, education for sustainability, education for a sustainable future or education for sustainability (Sterling, 2004). The relationship between concepts of environmental education (EE) and ESD is complicated (Fien et al., 1993; Huckle, 1993; Sauvé, 2002). The primary goal is to move towards the achievement of the sustainable development goals and to use both EE and ESD curriculum to support these processes (UNESCO, 2009).

From many different research results, it can be seen that education is the most important thing to develop in order to achieve sustainability. Education has at least four functions, which are often in conflict with educational policy, theory and practice (Sterling, 2004):

- The socialisation function: to replicate society and culture and promote citizenship.
- The vocational function: to train people for employment.
- The liberal function: to develop an individual and his/her potential.
- The transformative function: to encourage change towards a better society.

The term ESD has a strong connection with the paradigm of change, which asserts both humanistic and ecological values. It provides learning, training and practical experience, in both formal and non-formal educational settings. ESD paradigm includes vision, image, design and action (Sterling, 2004). First, it is essential to know the difference between education for sustainability, education about sustainability and education as sustainability. Education for sustainable development is a tool to achieve sustainability (McKeown, 2002). Education about sustainable development means an awareness lesson or theoretical discussion about sustainability. Education as sustainability promotes active collaboration with various stakeholders throughout society, organising processes, as well as, learning among science and society (Barth and Michelsen, 2013; Sterling, 2004). The categorisation of educational responses regarding sustainability start: from accommodation (education about sustainability) though reformation (education for sustainability) to transformation (education as sustainability) (Sterling, 2004).

One of the main aims of ESDIs to make the world liveable for future generations, giving people knowledge and skills for lifelong learning; and help them find new solutions to their environmental, economic and social issues (McKeown, 2002).

ESD was first mentioned in Chapter 36 of Agenda 21, where four main aims of the work of ESD were described: improve basic education, reorient existing education to address sustainable development, and develop public understanding, awareness, and training (Agenda 21, Chapter 36). One of the broad definitions by UNESCO is “ESD empowers learners to make informed decisions and responsible actions for environmental integrity, economic viability and just society, for present and future generations, while respecting cultural diversity” (Agenda 21, Chapter 36, p.320). Education is one of the most important things to improve the quality of life on the level of a person or nation. Implementation of ESD in national curricula could build awareness about sustainability. Well-educated citizens, who are part of our community, make decisions about social, economic, and environmental well-being more critically.
Global citizenship needs eight key characteristics (de Hann, 2000):

- Looking at the problems in a global context
- Working cooperatively and responsibly
- Accepting cultural differences
- Thinking in a critical and systemic way
- Solving conflicts non-violently
- Changing lifestyle to protect the environment
- Defending human rights
- Participating in politics

The United Nations has declared 2005 to 2014 the Decade of ESD (UNESCO, 2005). ESD was included in all educational levels, from kindergartens to the universities. ESD is more than knowledge-based education about environment, economy and society. The most important issues besides knowledge are skills, perspectives and values. These issues must be part of a formal curriculum. The follow-up program of Decade of Education for Sustainable Development is the Global Action Programme (GAP). The main GAP aims are to integrate sustainable development into education and to integrate education into sustainable development (UNESCO, 2009). Based on the declaration Decade of Education for Sustainable Development (2005-2014), most of the countries have released a national document about ESD. In Slovenia, it is named “Slovenian strategy for ESD” and was published in 2007 (Smernice VITR, 2007). In Austria, the document about ESD is named “Austrian strategy for ESD” (Österreichische Strategie zur Bildung für nachhaltige Entwicklung, 2008). ESD is in both curricula (Slovenian and Austrian) as an additional element. It is still not an integral part of formal education and there are no special chapters about SD in school textbooks.

ESD is education for change. “You cannot learn without changing, or change without learning” (Kosko, 1994; p. 205). Mainstream education is slow to change. It is easier to affect “movement of mind” at the micro level. At the macro level of the institution/organisation, it should be transformative, and that is why system change is challenging. Usually, we identify four learning stages (Sterling, 2004):

- No change (no learning, ignorance)
- Accommodation (adaptation and maintenance)
- Reformation (critically reflective adaptation)
- Transformation (creative re-visioning)

Many writers call this “transformative” change in society “strong sustainability” (Kosko, 1994; Sterling, 2004).

### 2.2.1 Pedagogical approach in ESD

ESD has a holistic and transformational learning approach. It is a lifelong learning process. An essential aim of ESD is to inspire learners to act and live sustainably, to become global citizens who have active roles in society and to think and act both locally and globally (UNESCO, 2005). It is not just about the transmission of information, knowledge and values anymore, but is interactive learner-centred and action orientated. Schools should have an active role in the community (Uzzell, 1999). It is crucial to inspiring learners of different ages and educational settings to start changing themselves, through a bottom-up participatory process (UNESCO, 2005). One of the aims of ESD is to move from transmissive (or
didactical) teaching methodology towards more participative and transformative methodologies.

Table 1: Integration of sustainability within higher education implies shifts (Sterling, 2004, p. 58)

<table>
<thead>
<tr>
<th>From</th>
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<tbody>
<tr>
<td>Transmissive learning</td>
<td>Learning through discovery</td>
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<tr>
<td>Teacher-centred approach</td>
<td>Learner-centred approach</td>
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<tr>
<td>Individual learning</td>
<td>Collaborative learning</td>
</tr>
<tr>
<td>Learning dominated by theory</td>
<td>Praxis-oriented learning linking theory and experience</td>
</tr>
<tr>
<td>Focus on accumulating knowledge and a</td>
<td>Focus on self-regulative learning and a ‘real issues’ orientation</td>
</tr>
<tr>
<td>content orientation</td>
<td></td>
</tr>
<tr>
<td>Emphasis on cognitive objectives</td>
<td>Cognitive, affective and skills-related objectives</td>
</tr>
<tr>
<td>Institutional, staff-based teaching/learning</td>
<td>Learning with staff but also with and from outsiders</td>
</tr>
</tbody>
</table>

Methodological approaches and values are often associated with learning and teaching in relation to sustainability (Sterling 2008):

- critical thinking;
- systemic thinking;
- interdisciplinary and transdisciplinary;
- experiential learning and real-life issues;
- reconnecting to sense of place and real-world inquiry;
- empowerment of the learner;
- teacher as mentor, exemplar and facilitator;
- multiple teaching styles;
- developing dialogue;
- space for emergence;
- learning for action;
- reflection on learning (reflexivity);
- transformative learning;
- collaborative learning and co-inquiry;
- action competence;
- campus as curriculum and use of campus as a learning resource.

Such methodological values and approaches can be manifested through many methods, as suggested below. Taking ESD further is often a matter of extending pedagogic diversity by one, two or more chosen methods on the board (Sterling, 2004):

- role plays;
- group discussions and dialogue;
- stimulus activities (e.g. use of photos, videos, newspapers);
- debates;
- keeping diary;
- critical incidents (posing critical events and asking what students would do);
- case studies;
- reflexive accounts;
- personal development planning (PDP);
- critical reading and writing;
- problem-based learning;
- fieldwork;
- modelling good practice;
- futures visioning;
- worldview and values research;
- action research.

### 2.2.2 Competences in ESD

Different organisations provide different competencies for ESD. Most widely used are UNECE Competences for lifelong learning defined by the United Nations Economic Commission for Europe:

- The use of systemic, critical and creative thinking and reflection in both local and global contexts, as these are prerequisites for action for SD.
- Appropriate knowledge of SD and awareness of the impact of decisions that do not support SD.
- Insight into global, regional, national and local environmental problems, including their economic, ecological and social implications.
- Awareness of the ethical dimension of SD, including issues of equity, intra and intergenerational solidarity and responsibility (UNECE, 2005).

### 2.2.3 Education for Sustainable Development in Biology Education

We can find many models of how to include ESD into general teaching and biology education. All these models have a multi-level process. Models include societal issues (local, regional, global levels), inter- and multidisciplinary approach as well as changes in pedagogy. ESD teaching is a combination of different views: socially relevant topics, biology in combination with chemistry and/or physics and the three pillars of sustainability: social, economic and ecological. The aim of teaching follows a skill orientated paradigm (Padem, 2000). Topics in the context of a sustainable future are biodiversity, climate change, the sustainable use of natural resources, health, cultural heritage, multiculturalism and global welfare (UNESCO, 2005). One of the main critical issues for teachers is to discuss with students the effects of their’ behaviour and sustainable practice in the local environment. Other important goals are to learn negotiation, problem-solving and decision-making skills through discussions about ecological, social, economic, and ethical principles concerning local and global responsibility in their own life. Through memorable, experiential, and active processes, students learn to discuss their value and to critically select and evaluate sources of information (Maina, 2004; McMillan et al., 2002).

Biological field-based activities, for instance, fieldwork and field trips, provide students with authentic and interactive experiences and experiential learning opportunities, which increase
students’ interest to their learning (McMillan et al., 2002). Students’ engagement in field-based activities plays has an important role in learning biological issues (Wood, 2009). In fieldwork students, get a chance to observe nature and the environment, and use scientific inquiries to test ideas and concepts, which they have learned in the classroom. Fieldwork had a positive effect on students’ knowledge, attitude, behaviour and promoting sustainability (Hart and Nolan, 1999). It is essential to present biology as action-oriented science education, where students are engaged in socio-political actions and start making a change (McMillan et al., 2002; Wood, 2009).

2.2.4 Critical view on sustainability

Problems of sustainability are complex social problems because of their uncertainty, contradictions in scientific knowledge, and the lack of conventional norms and values. This results in differing opinions about sustainability among social institutions and groups. Consequently, ESD is a social learning process.

Humanity depends on the environment and economy that exists within a society. In western societies, the main thinking and behaviour are that humans are separate from and dominant over nature. (Bonnett, 1999; Giddings, Hopwood and O’Brien, 2002; Selby, 2017).

The reality is that humanity is dependent on the environment, with society existing within, and dependent on, the environment, and the economy that exists within society. Humans live within the environment (Giddings et al., 2002) and depend on it for survival and well-being; we cannot ignore the environment. The reality is that humanity is dependent on the environment, with society existing within, and dependent on, the environment, and the economy exists within society. Within the environment and depend on it for survival and well-being; we cannot ignore the environment (Giddings et al., 2002).

De-natured nature (environment is one of three pillars of sustainability) involved learns to lose contact with nature. Kingsnorth (2012) explained that global campaigns, which promote caring for the abstract “environment”, did not work. The most important goal is to talk about “the specific environment” and not about an environment on the global scale. The environment is presented as an environment where people live and have experiences with it. Selby (2017) suggested vernacular learning. This is based on rooted learning and intrinsic values. Some suggested activities that we can use in the education field (Selby, 2017):

- Keeping weather logs, making comparisons year by year;
- Harvesting and prepare wild food;
- Joining localised chains of food production as growers prepare an end-user;
- Creating a school butterfly and bee gardens linked to maintaining a log of insect appearances;
- Frequent and detailed observation of the fauna and flora in an uncultivated square meter of land
- Searching out and observing wildlife in the urban context;
- Re-naturalizing and re-wilding urban parks etc.

Another critical view of Selby’s critics about ESD is to include multi-sensory learning. This was also mentioned in the world-changing book about an understanding of the environment – Silence Spring (Carson and Darling, 1962): “I sincerely believe that for the child, and for the parents seeking to guide him, it is not half so important to know as to feel” (p. 55).
The aim of ESD and other educational approaches, such as outdoor education, bioregional education, place-based education, is to see human beings as just one part of the nature and human culture as an outgrowth of interactions between our species and a particular world (Selby, 2017).
2.3 Pedagogical content knowledge

Pedagogical content knowledge was and still is a very important issue in research in teaching and teacher education, mostly in the natural sciences (Loughran, Berry and Mulhall, 2012). In the late eighties, Shulman defined pedagogical content knowledge as teachers’ interactions between content knowledge (CK) and transformation of the subject-matter knowledge in the context of facilitating student learning. PCK has several key elements:

- Knowledge of representations of subject matter (CK).
- Understanding of students’ conceptions of the subject, the learning and teaching implications that were associated with the specific subject matter.
- General pedagogical knowledge (teaching strategies).

Knowledgebase for teaching includes elements such as curriculum knowledge, knowledge of educational contexts and knowledge of purposes of education (Shulman, 1987).

Teachers need subject matter knowledge (SMK) on one side and pedagogical content knowledge on the other. PCK for science teaching has five components (Shulman, 1987):

- Orientation toward science teaching;
- Knowledge and beliefs about the science curriculum;
- Knowledge and beliefs about students understanding of specific science topic;
- Knowledge and beliefs about assessment in science and
- Knowledge and beliefs about instructional strategies for teaching science.

Cochran, DeRuiter and King (1993) further developed Shulman's original model of teachers’ knowledge. The developed model has integrated four main components. The first is subject matter knowledge. The second is pedagogical knowledge. The third is teachers' knowledge of students' abilities, learning strategies, ages, development levels, attitudes, motivations, and prior knowledge. The fourth is teachers' understanding of the social, political, cultural and physical environments in which students learn. All of this four components have critical roles to pedagogical content knowledge. Researches showed that PCK is increased by teaching experiences and their reflection (Loughran et al. 2012; Kennedy, 1990). Loughran et al. (2012) described new planning approaches about teaching specific topics. They are presented as “Content Representation” (CoRe) and “Professional-Experience Repertoires” (PaP-eRs). “Content Representation” is described as a framework of thinking deeply about science content knowledge in teaching. Professional-Experience Repertoires represent the knowledge about teaching routines and explain how the CoRes are enacted. CoRe and PaP-eRs are put together in Resource Folio and represented in pedagogical content knowledge.

PCK is highly subject-specific. It is the teacher’ understanding of how students learn and understand the specific subject matter. Magnuson, Kajck and Borko (1999) described PCK as the transformation of several types of knowledge for teaching (part of this is also subject matter knowledge). It presents a unique field of teacher knowledge.
2.3.1 Pedagogical content knowledge in biology

Teachers’ pedagogical knowledge and teachers’ subject matter knowledge are essential to good science teaching and student understanding (Hattie and Yates, 2014). PCK is a form of knowledge that makes science teachers rather than science researchers (scientists) (Gudmundsdottir, 1987). Teachers and scientists have different subject matters that are not necessarily the same in quality or quantity. The difference is in the organisation and usage of knowledge. Science teachers have organised knowledge of science from a teaching perspective. They use it as a base for training students to understand different concepts. Scientists’ knowledge is organised from the research perspective and is used as a base for developing new ideas and concepts (Hattie and Yates, 2014).

Hauslein, Good and Cummins (1992) have documented this idea in biology. By comparing the organisation of subject matter knowledge among groups of experienced science teachers, experienced research scientists, novice science teachers, subject area science majors, and preservice science teachers, Hualien et al. (1992) found out that science majors and preservice teachers both showed similar, loosely organised subject matter knowledge. The subject matter knowledge of the experienced teachers and the research scientists were much more in-depth and more complex. Compared to the researchers (who showed a flexible subject matter structure), the teachers showed a more fixed structure, such as it is presented in a state curriculum.
2.4 Education system in Slovenia

Pre-school education is aimed at children aged 1 to 6 and is not compulsory. It is up to parents to decide whether to enroll their child or not. Public and private kindergartens provide it. The programmes are carried out by pre-school teachers and pre-school teacher assistants (Tastanovska, 2017).

2.4.1 Primary and Secondary Education

Primary and lower secondary education is organised in a single-structure nine-year primary school, attended by pupils aged 6 to 15 years. It is provided by public and private schools (less than 1% of pupils attend private schools), as well as educational institutions for special education. The school programme is divided into three educational cycles; each cycle has three grades. In the first educational cycle pupils are taught by primary school teachers. In first grade, there is also a second teacher (pre-school teacher or primary school teacher) present during half of the lessons. In the second educational cycle, a primary school teacher primarily provides the instruction and subject teachers provide instruction of individual subjects, like Science, Society etc. In the third cycle, subject teachers deliver all lessons. Instruction in specific subjects (such as Slovenian language, maths and foreign languages) may be provided in smaller groups.

After finishing compulsory primary education, at the age 14-15, students continue in two to five years in upper secondary education. The upper secondary education is divided into general (gymnasium), vocational and technical education (Krek and Metljak, 2011; Tastanovska, 2017).

- General education has different four years programmes, with a final examination at the end (matura).
- The second option is a vocational and technical education with different levels of difficulty. Short upper secondary vocational (2 years) and upper secondary vocational education programmes (3 years). In the end, students shall pass the school – leaving exam.
- Four years programme is upper secondary technical education programmes, vocational-technical education programmes (2 additional years after completing a vocational programme) and the vocational course (1 year) in all of which students shall pass the vocational matura (final examination) to complete the education programme successfully.

After vocational matura grants candidates have the right to enrol into professional higher education study programmes, short-cycle higher vocational study programmes and some of the first cycle academic studies. Passing the final exam (general matura) gives students possibilities of enrolling in first cycle academic and professional study (Krek and Metljak, 2011; Tastanovska, 2017).
2.5 Education system in Austria

Pre-school education is not part of the school system. Children aged from three and over can attend a nursery school (kindergarten). The final year of kindergarten, before entering to school at the age of 6, is compulsory in a half-day form (Austrian Federal Ministry of Education, 2016).

2.5.1 Primary and Secondary Education

In Austria, compulsory education starts at the age of 6 and finishes at the age of 15. Primary education (Volksschule) lasts four years. The first differentiation is at the end of primary education. Pupils have a choice between two types of school that last for four years. These are the new secondary school (Neue Mittelschule - NMS) and the lower cycle of secondary academic school (Allgemein Bildende Höhere Schule or AHS - Unterstufe).

Pupils may later change from the Academic secondary school lower level (AHS) to the New secondary school (NMS) and vice versa. A NMS must accept all pupils, whereas AHS has the right to reject applicants. The condition for entry at an AHS is successful completion of the 4th grade of primary school (very good or good grade in the following subjects: German, reading, writing and mathematics) or positive evaluation of the primary school committee. The main aim of an AHS is to impart a broad and extended general education.

After the end of the 8th class at age 15, pupils continue their education in upper high school level. It is not compulsory.

- Vocational school lasts precisely as long as the apprenticeship (2 to 4 years). Students must find a company that will appoint them as an apprentice and attend Vocational School at the same time. The final apprenticeship examination entitles the individual exercise.
- Vocational secondary school (BMS) – technical colleges from age 14 to 18 provide professional qualifications and general education. BMS last for 3 or 4 years and end with the final examination. After that, it possible to enter working life or prepare oneself on an advanced course to complete a course of study at a vocational higher school.
- Vocational higher school (BHS) is for students from age 14 to 19 years. BHS provides higher vocational education and solid general education. It lasts for five years and at the end of school a diploma examination. This examination entitles the holder to study at the first cycle academic studies.
- After NMS or the lower level of AHS, pupils can continue their school education in the upper level of AHS. The AHS provides an excellent general education. It lasts four years and ends with the Austrian school-leaving examination (Matura). After the final exam in AHS students can enter the first cycle academic studies (Education is Austria 2016/2017, 2016; Weiß and Tritscher-Archan, 2011).

2.5.2 Differences between Education system in Slovenia and Austria

Nine year of education is mandatory in both countries. The differences between Austrian and Slovenian education system are the organisational models of compulsory education: primary and lower secondary education. In Slovenia, it is a single structure of education. That means the general education is universal for all pupils from six until fifteen. Austria has differentiated lower secondary education. At the end of the primary school, at the age 10, pupils continue in two different types of lower secondary education. Nonetheless, the lower
secondary school is compulsory in both countries (Education is Austria 2016/2017, 2016; Krek and Metljak, 2011; Weiß and Tritscher-Archan, 2011).

2.5.3 The role of biology in curriculum

In Slovenian curriculum, biology topics are part of interdisciplinary subjects such as: Environmental Studies (Grade 1-3), Science and Technology (Grade 4-5) and Science (Grade 6-7). After 7th Grade, Science is divided into Biology, Chemistry, and Physics. Biology is a separate subject in the last two years of compulsory education. In high school, it is a compulsory subject in the first three years in general high schools, while the fourth year is elective. In vocational schools, the subject diversity is much higher, and the role of biology depends on the type of school (Šorgo, 2010). In Austrian primary schools (Volksschule), Grade 1-4 Biology is part of the Science curriculum. In lower and higher secondary school the subject is called Biology and Environmental Education. It is a compulsory subject in lower secondary school (NMS and AHS) and higher level of secondary school. In other levels of high schools, it depends on the school orientation. Some vocational schools have different names, such as Ecology, Environmental education (Austrian Federal Ministry for Education, 2016).
2.6 Teacher training

In this chapter is a description of a teacher training programme for pre-service biology teachers at the University of Ljubljana and at the University of Vienna.

Slovenian student teachers of biology study at the University of Ljubljana in Faculty of Education, Department of Biology, Chemistry and Home Economics. The duration of the Bachelor program is eight semesters (240 ETCS). The study program has three parts: common pedagogical subjects and two elective subjects (biology is in combination with chemistry or home economics). The program does not have modules. The study process is organised in cooperation with two other Faculties in the University of Ljubljana: The Biotechnical Faculty and the Faculty of Chemistry and Chemical Technology. The following master studies of the subject Teacher Education is a one-year program with 60 ECTS. The program is divided into three modules: general modules (required and elective), professional modules and free elective modules. After a successfully finished master’s degree, a biology teacher can teach in lower secondary school and higher secondary school, where biology is not a subject in the final examination. Biology teachers, who want to teach in upper secondary school, do their Master studies at the Biotechnical Faculty. This study lasts for four semesters (120 ETCS credits) (Predstavitveni zbornik Dvopredmetni učitelj, 2017).

At the University of Vienna, biology student teachers study in the Teacher Education programme for secondary school teachers. Students choose two teaching subjects (or one teaching subject and one specialisation, e.g. integrative and inclusive pedagogy). General educational fundamentals and studies on teaching are included. The biology subject is called Biology and Environmental Education. Students can select between 28 different subjects. Therefore, a great variety of combinations can occur. Bachelor’s programme is the same as in Slovenia; 8 semesters with 240 ECTS credits. Master’s programme is four semesters and 120 ECTS credits. After finishing the Bachelor’s degree, teachers can already start teaching in lower secondary school and after finishing a Master’s degree a teacher can teach in all levels of secondary schools (Allgemeines Curriculum für das Bachelorstudium, 2016).

One of the differences between study programs in the University of Ljubljana and Vienna is an entrance examination for the Bachelor program at the University of Vienna due to the very high number of students. The criteria to enroll at the University of Ljubljana, Faculty of Education are the results from a general examination in upper secondary school or any other secondary school as well as any achievements and grades obtained in secondary school programmes. (Allgemeines Curriculum für das Bachelorstudium, 2016; Predstavitveni zbornik Dvopredmetni učitelj, 2017).
3 METHODOLOGY

3.1 Research problem

Understanding SD and ESD are nowadays one of the critical competencies for future biology teachers. From the curricula for biology in Slovenian lower secondary school (8th and 9th grade), we figured out that SD is mentioned in the 9th grade in context of Biology and society and Human impact on the environment (Učni načrt za biologijo, 2011). From the curricula for biology in Austrian lower secondary school (1th – 4th grade), we figured out that SD is mentioned in 1st grade in context of Human and Society and in 3rd grade in context Animals and plants (Biologie und Umweltkunde, 2018).

There is a growing body of literature about the EE and ESD and the relationship between the concepts (Jickling and Wals, 2008; Johnson 2011; Kopnina, 2012). Both concepts were developed from observation of the environment and an anthropocentric view (Kopnina, 2012).

This work aims to identify an understanding and knowledge about SD and ESD by Slovenian and Austrian students and to compare the results between countries. The research will enable us to get an insight into pre-service teacher’s PCK: how students will implement SD in their future biology teaching, which learning methods will be used, what is the pupil's prior knowledge about SD and which topics will be suitable for teaching SD?

3.2 Hypotheses

Hypotheses used to guide this thesis research were:

H1: Pre-service teachers of biology understand SD quite well.
H2: Pre-service teachers of biology understand ESD quite well.
H3: Pre-service teachers of biology know the concept of SD and ESD from biology studies.
H4: Pre-service teachers of biology could imagine teaching SD in their biology lessons.
H5: The difference between pre-service teachers of biology in the two countries is not statistically significant in the knowledge of sustainability.
H6: The difference between pre-service teachers in the two countries is not statistically significant regarding knowledge and attitudes of ESD.
3.3 Sample and Settings

The study collected data from pre-service teachers from the University of Ljubljana and the University of Vienna. The first sample were students from the University of Ljubljana, Faculty of Education, Department of Biology, Chemistry and Home Economic. The number of participating students was 60. The second sample was taken from the pre-service teachers from the University of Vienna, Centre for Teacher Education. The number of students was the same, 60. The sample was limited to this count because at the University of Ljubljana, the cohort does not exceed this number.

The study was conducted in May and June 2018. To fill in the questionnaire, it took the students from 15 to 20 minutes. It was anonymous. First, the instructions and the goal of the research were presented. The questionnaire was translated to Slovenian language for Slovenian students and German language for Austrian students. The sample was non-randomly chosen. From the University of Ljubljana, Faculty of Education, more than 80% were future biology teachers from 3rd and 4th year Bachelor study and Master study were also reached. At the University of Vienna, Centre for Teacher Education, the same number of future biology teachers represented less than 40% of future biology teachers from 3rd and 4th year of Bachelor study and the outdated Diploma study (this is the program before the Bologna architecture was implemented).

3.3.1 Age of students

In the research cohort, 58% of Slovenian students and 65% of Austrian students were younger than 25 years. 42% of Slovenian students and 28% of Austrian students were in the category from 25 – 30 years old. 7% of Austrian students were older than 30 years. The latter age group did not appear in Slovenia.

Figure 4: Age of students
3.3.2 Previous education

7% of Slovenian students and 3% of Austrian students finished Vocational high school. 40% of Slovenian students and 87% of Austrian students were in Gymnasium (academic high school). 53% of Slovenian students and 13% of Austrian students had already finished their Bachelor studies.

![Previous education](image)

**Figure 5: Previous education**

3.3.3 Second subject of study

Student teachers of biology from Slovenia and Austria showed very different second subjects of study (Figure 6). The main reason is different study programs at the University in Ljubljana and at the University in Vienna. In the Faculty of Education at the University of Ljubljana, students select Home Economics or Chemistry as secondary subject. 52% students selected Home Economics and 48% students Chemistry as the second subject of study.

At the University of Vienna, the program for Secondary biology teachers is called Biology and Environmental Education. Students can choose subject Biology and Environmental Education in combination with 28 different subjects. In our study we observed the most popular combination was biology - geography, biology with psychology and philosophy (15% of students per each combination), followed by the combination biology - German language with 13% of students. 10% selected Home Economic, 8% selected Spanish, 7% selected English, Sport or Maths, 5% selected French or Chemistry as the second subject. Other subjects, with less than 5% of students in our cohort (less than 3 students per subject) were: Latin, Hungarian language, Politics and History, Physics, and Italian language.
3.3.4 Year of study

In this research, 47% of the Slovenian students were in their Bachelors studies (28% in the third year of study – 6th Semester and 18% in the fourth year of study – 8th semester). 92% of the Austrian students were in their Bachelors studies (28% in the third year of study – 5th or 6th semester and 45% of students in the fourth year of study – 7th or 8th semester). 54% of Slovenian students and 8% of Austrian students were Master students. At the University of Vienna, the Master studies started in Academic year 2017/2018 as a new Study program for Secondary teachers to substitute the old Diploma studies. There were not many students in this program. In the Faculty of Education in Ljubljana, students can take an additional year after the official completion of the Master study program for writing master thesis; and 17% of students from our research were in their additional year.
3.4 Method

Our research was based on descriptive and causal non-experimental research methods. In this research, qualitative and quantitative methods were used. A questionnaire was used to collect data.

3.4.1 Questionnaire

The study is based on the questionnaire, which Burmeister and Eilks developed and used in their research in 2013 (Appendix 1 and 2). The questionnaire was developed for chemistry teachers. In our research, it was modified for biology teachers. The questionnaire includes open, closed and Likert-scale items.

In the first part, pre-service teachers wrote the general information: age, place of studies, formal level of education and the second subject of study.

In the second part, students answered to four open questions. In the first question, students wrote 15 associations on the term “sustainability”. In the next two questions, students had to describe/define SD and ESD. The last question in the set was about school subject where students would place ESD.

The third part of the questionnaire focused on modern theories of sustainability: where did participants hear about the modern theories (in universities, in media, etc.) and where did participants hear about ESD.

The last part of the questionnaire focused on participants’ PCK concerning sustainability issues and ESD. It starts with the Likert-type question, which asks if participants think that ESD should be included in lower secondary school subjects and if they could imagine teaching sustainability in their biology lessons. The next one was an open question on how to implement ESD in biology lesson in secondary education and what was pupils’ prior knowledge about sustainable development. The last two questions were closed questions. Students should rate the importance of ESD in society in general and in biology lesson on a scale of 0 to 10 (0 = not important at all, 10 = extremely important).

3.4.2 Data analysis

All data from the questionnaire were digitised and translated from Slovenian and German language to English.

Firstly, the closed and Likert questions were analysed with the Excel program and statistical program IBM SPSS Statistic, version 24. Data obtained from the questionnaire was processed on the level of descriptive and interfering statistic, using the following statistic methods:

- T-test (Independent Samples) was used to whether Slovenian and Austrian students have different average values.
- A chi-square test was used to determine whether there was a significant difference between Slovenian and Austrian students’ sources of knowledge.

Secondly, open questions were analysed qualitatively in the process of coding. Coding is the interpretive process by which data is broken down analytically (Corbin and Strauss, 2008). In qualitative analysis, we used the deductive and inductive coding methods.

Data (associations/words/sentences) with the same meaning were coded together. In our research, data that appeared less than three times per question was not coded. This presented
in 2% of all answers. The frequency of the codes in each category was calculated. The codes to the open questions were separated into different categories, depending on the similar meaning. The first written were the most common codes, and then less and less often mentioned.

First and second question (association with the term “sustainability” and understanding of SD) were operated using the categories suggested in Burmeister and Eilks (2013). It was a deductive coding method. For the first and second questions, some categorisations were redefined and added, based on data material and theoretical frame. For other open questions, categorisations were created based on the data materials and literature review (inductive coding method). Categories were developed in cooperation with the supervisor and co-supervisor.
4 RESULTS

In this Chapter, all the results from the questionnaire are presented and examined in detail. Questionnaire in Slovenian and German languages are in Appendix 1 and 2.

4.1 Analysis of 15 associations about the term “sustainability”

First, students were asked to write 15 associations with the term “sustainability”. Their answers were coded into seven categories (Table 2, Figure 8). Categories were developed based on the results of previous research (Burmeister and Eilk, 2013) and literature review (De Haan, 2006; McKeown, 2002; Paden, 2000; Sterling, 2004; 2006; UNESCO, 2005). Only a small number of participants did not answer the question (two students from Slovenia and no students from Austria).

First category was named Ecological context. Key words mentioned by participants were: recycling, environmental conservation, environment, nature, nature conservation and renewable energy sources. Some answers were mentioned only in one group of students. Only Slovenian students mentioned green chemistry. Only Austrian students mentioned ecological footprint, vegan and vegetarian, environmentally friendly, environmental organization, wildlife conservation, rainforest protection. In this category were 51% of Slovenian students’ answers and 55% of Austrian students’ answers.

Second category was Economical context. Key words mentioned by participants were: consumption, bio production, economy and saving. Only Austrian students mentioned local products, seasonal products, agriculture and GMOs. In this category were 12% of Slovenian students’ answers and 15% of Austrian students’ answers.

The third category was Social contexts: Key words mentioned by participants were: future generation, health and values. Only Slovenian students mentioned association: European Union, convention. Only Austrian students mentioned global thinking and first world vs. third world. In this category were 9% of Slovenian students’ answers and 11% of Austrian students’ answers.

The fourth category was Time issues. Key words mentioned by participants were: future and time. All answers were mentioned in both groups of the students. In this category were 9% of Slovenian students’ answers and 7% of Austrian students’ answers.

The fifth category was Education issues. Key words mentioned by participants were: education and education for sustainable development. Only Slovenian students mentioned association such as: home economics, chemistry and competences. In this category were 7% of Slovenian students’ answers and 6% of Austrian students’ answers.

The sixth category was Definition of SD. In this category were mentioned only two associations. The first was SD; the second was paraphrasing Bruntland definition of SD. In this category were 6% of Slovenian students’ answers and 4% of Austrian students’ answers.

The seventh category was Others. In this category were 2% of Slovenian students’ answers and 1% of Austrian students’ answers.
Table 2: Slovenian (SI) and Austrian (A) students’ associations about the term "sustainability"

<table>
<thead>
<tr>
<th>NO</th>
<th>Category</th>
<th>Number of answers (f SI/A/T)</th>
<th>Answers included in the category and their frequency (f SI/A/T)</th>
</tr>
</thead>
</table>
| 1  | Ecological context     | (f 277/311/588) (f % 51/55/53) | More than 30 mentions per associations
recycling (37/38/75), environmental conservation (34/35/69), environment (35/29/64), nature (16/24/40),
nature conservation (21/15/37), renewable energy sources (22/12/34)

30 – 15 mentions per associations
waste management (15/7/22), pollution (12/8/20), ecolabel (3/12/15), ecological footprint (0/15/15),
water conservation (9/6/15)

15 – 10 mentions per associations
biology (2/12/14), extinction specious (6/8/14), energy conservation (5/8/13), ecology (5/6/11),
biodiversity (6/4/10), global warming (2/8/10)

10 – 5 mentions per associations
animals (7/2/9), fossil energy (5/4/9), plastic pollution (2/7/9), reuse (5/4/9), environmental problems
(3/5/8), public transport (5/3/8), vegan and vegetarian (0/8/8), water pollution (3/5/8), ecological
awareness (5/2/7), climate changing (2/5/7), plants (5/2/7), food self-supply (2/4/6), Earth (5/1/6)

5 – 3 mentions per associations
CO2 emissions (2/3/5), environmentally friendly (0/4/4), environmental organizations (0/4/4), green
chemistry (4/0/4), rainforest protection (0/4/4), wildlife conservation (0/4/4)
| 2 | **Economical context** (f 63/86/149) (f % 12/15/13) | 30 – 15 mentions per associations consumption (9/8/17)  
15 – 10 mentions per associations bio production (7/8/15), economy (5/8/13), saving (8/3/11)  
10 – 5 mentions per associations local products (0/9/9), money (8/1/9), transport (4/5/9), seasonal products (0/8/8), bio products (5/2/7), energy consumption (4/3/7), globalization (2/5/7), corruption (1/5/6), Fair trade (2/4/6), industry (5/1/6), technology (2/4/6)  
5 – 3 mentions per associations agriculture (0/5/5), traffic (1/3/4), GMOs (0/4/4) |
| 3 | **Social context** (f 67/60/127) (f % 13/11/12) | More than 30 mentions per associations future generations (17/18/35)  
30 – 15 mentions per associations health (10/7/17), values (6/11/16)  
10 – 5 mentions per associations society (3/4/7), human (4/2/6), politics (2/4/6), quality of life (6/0/6), Europe Union (2/3/5), responsibility (3/2/5), global thinking (0/5/5)  
5 – 3 mentions per associations convention (4/0/4), care (3/1/4), awareness (3/1/4), adaptability (4/0/4), first world vs. third world (0/3/3) |
| 4 | **Time issues** (f 49/44/93) (f % 9/8/8) | More than 30 mentions per associations future (20/26/46)  
30 – 15 mentions per associations time (7/13/20) |
|   |   | 15 – 10 mentions per associations  
duration (7/5/12), long-lasting (11/0/11)  
5 – 3 mentions per associations  
time limited (4/0/4)  
30 – 15 mentions per associations  
education (15/9/24)  
15 – 10 mentions per associations  
education for sustainable development (3/8/11)  
10 – 5 mentions per associations  
science (2/7/9), knowledge (3/4/7), learning (2/4/6), teaching (3/2/5)  
5 – 3 mentions per associations  
chemistry (4/0/4), home economics (3/0/3), competences (3/0/3)  
30 – 15 mentions per associations  
development that meets the needs of the present and future generations (paraphrasing Brundtland’s definition) (17/12/29), sustainable development (18/10/28)  
5 – 3 mentions per associations  
balance (4/1/5), information (4/0/4), goal (1/3/4), solution (4/0/4)  
(2/0) |
|---|---|---|---|
|   | **Education issues** | (f 38/34/72)  
(f % 7/6/7) | (f 35/22/57)  
(f % 6/4/5) |
|   | **Definition of sustainable development** | (f 13/4/17)  
(f % 2/1/2) | (f 2/0/2)  
(f % 3/0/3) |
|   | **Others** | (f 542/561/1104)  
(f % 49/51/100) | (f 542/561/1104)  
(f % 49/51/100) |
Figure 8: Slovenian (SI) and Austrian (A) students’ associations about the term "sustainability" in main categories
4.2 Analysis description/definition of Sustainable Development

Next, students were asked to describe/define the term SD. Their answers were coded into seven categories (Table 3, Figure 9). Categories used were the same as in the research of Burmeister and Eilks (2013). Categories varied in range from zero knowledge to advanced knowledge. Only a small number of participants did not answer the question (two students from Slovenia and five students from Austria).

First category was named No understanding. In this category were a very small number of students (0% of Slovenian and 5 % of Austrian students).

Second category was Confusion of the concepts. Students mentioned several possible definitions, combined explanations from the educational issues with ideas fitting to the three pillars model of sustainability or gave a semantic explanation of the sustainable world (Burmeister and Eilks, 2012). In this category were 16% of Slovenian students´ answers and 13% of Austrian students´ answers.

The third category was Abstract understanding. Students explained Sustainability and SD as something, permanent and long-lasting (Burmeister and Eilks, 2012). In this category were 17% of Slovenian students´ answers and 15% of Austrian students´ answers.

The fourth category was Educational issue. Students explained sustainability as sustainable learning (Burmeister and Eilks, 2012). In this category were 5% of Slovenian students´ answers and no Austrian students´ answers.

The fifth category was Single right idea. The answers presented one of the three pillars of modern sustainability concepts (ecological, economic, and societal sustainability) or they referred to the idea of inter-generational equitability (Burmeister and Eilks, 2012). In this category were 38% of Slovenian students´ answers and 36% of Austrian students´ answers.

The sixth category was Basically right idea. It described students combining aspects of at least two dimensions from the three-pillars-concept of sustainability - or the idea of inter-generational justice - in a correct way (Burmeister and Eilks, 2012). In this category were 21% of Slovenian students´ answers and 29% of Austrian students´ answers.

The seventh category was Good understanding. It described elaborated understanding of sustainability (Burmeister and Eilks, 2012). Students regarded all three dimensions of a world- and society-oriented understanding of sustainability in a meaningful way. In this category were 3% of Slovenian students´ answers and 2% of Austrian students´ answers.
Table 3: Different categories with included answers about the term of SD

<table>
<thead>
<tr>
<th>NO</th>
<th>Category</th>
<th>Number of answers (f SI/A/T)</th>
<th>Typical answers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(f % SI/A/T)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>No understanding</td>
<td>(f 0/3/3)</td>
<td>“I do not know.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 0/5/3)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Confusion of the concepts</td>
<td>(f 9/7/16)</td>
<td>“Development with positive attitude to the future.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 16/13/14)</td>
<td>“Development that is good for everyone.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Related to agriculture; extensive farming. In meadows, small number, no intensive fertilization, etc...”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“I think about which materials I use for what. I consider whether there are alternatives that are best for nature.”</td>
</tr>
<tr>
<td>2</td>
<td>Abstract understanding</td>
<td>(f 10/8/18)</td>
<td>“Something last for long time.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 15/17/16)</td>
<td>“Something permanent.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Process that enables a sustainable lifestyle.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“The process when something changes positively for nature or humanity.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“The development of a more sustainable world, greater awareness of one's own decisions.”</td>
</tr>
<tr>
<td>3</td>
<td>Educational issue</td>
<td>(f 3/0/3)</td>
<td>“Ecology in 9th grade”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 5/0/3)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Single right idea</td>
<td>(f 23/20/43)</td>
<td>“Environmental conservation.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 38/36/39)</td>
<td>“Doing things, that are good for present and future generation.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Saving and not exhausting renewable resources.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“To use resources in such a way that they do not run out -&gt; to develop technology in this field.”</td>
</tr>
</tbody>
</table>
“Development towards more environmental awareness.”

“Respecting our environment. Not harming nature.”

“Conscious handling of food, eating regional products, no plastic dishes, no aluminium foil.”

“The development over time (over generations, etc.) that goes in the direction of sustainability/pursues sustainable goals.

“Keeping the ecological footprint as small as possible, living in an environmentally conscious way.”

5 Basically right idea  
(f 13/16/29)  
(f % 21/29/26)  

“Development on the way of less consumption, that future generation have enough resources.”

“Development that is not only aimed at maximum profit, but also at preserving the environment and resources.”

“The way of living which include conservation of the nature and take care for all life organisms. This message could be spread also to future generations.”

“Rethinking the resources used (energy, transport), rethinking agriculture (nature conservation through fewer chemical sprays, reducing water pollution, etc.)”

“Sustainability should not impair natural cycles. Raw materials etc. should be returned to the cycle. Nature must not be irreversibly damaged/changed. Use of nature without destruction.”

“Sustainability refers to the impact of our activities (e.g. travel, shopping, etc.) on the environment in a broad sense, e.g. how my behaviour subsequently has a global impact.”

“To make decisions on action in such a way that they are forward-looking and resource conserving.”

“To use resources carefully and respectfully. To use the environment (plants, animals,
forests) in such a way that a life is also possible for the future generation.”
“Sustainability describes an action, change or adaptation that has long-term development or a long-life span.”

“Raw materials and given environmental conditions are to be integrated into an ecological cycle and thus embedded into a cycle of reuse or use which does not represent a disadvantage for nature, man or the environment for now and the future.”

“Development in way that is good for society and nature now and for future generation”

“Principle in which the long-term focus is on a development in which: ecologically: no more is consumed than is, of course, produced. Theoretically: knowledge is acquired permanently.”

“Development with conservation of the nature, society, economy.”

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**Slovenian and Austrian students understanding of SD**

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>Slovenian students</th>
<th>Austrian students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good understanding</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Basically right idea</td>
<td>21%</td>
<td>29%</td>
</tr>
<tr>
<td>Single right idea</td>
<td>5%</td>
<td>36%</td>
</tr>
<tr>
<td>Educational issue</td>
<td>17%</td>
<td>15%</td>
</tr>
<tr>
<td>Abstract understanding</td>
<td>16%</td>
<td>13%</td>
</tr>
<tr>
<td>Confusion of the concepts</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>No understanding</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**Figure 9: Slovenian (SI) and Austrian (A) students understanding of SD**
4.3 Analysis of students’ understanding of Education for Sustainable Development

First, students were asked to describe/define the term ESD. Their answers were coded into four categories (Table 4, Figure 10). Categories were developed based on the results of previous research (Burmeister and Eilk, 2013) and literature review (De Haan, 2006; McKeown, 2002; Paden, 2000; Sterling, 2004; UNESCO, 2005). Only a small number of participants did not answer the question (one student from Slovenia and three students from Austria).

First category was named No understanding. In this category were very small number of students (2% of Slovenian and 6% of Austrian students).

Second category was Abstract understanding. Students mentioned few ideas about education and sustainability. Ideas were general and not clear. Key words from the answers mentioned by participants were teaching about sustainability, sustainable development in schools, and build awareness about SD etc. In this category were 45% of Slovenian students’ answers and 30% of Austrian students’ answers.

Third and fourth category included more clear and precise understanding of the term ESD. These two categories could be also merged together; however, we decided to separate answers were students explicitly mentioned only environmental education, because this is very common misconception of ESD. Furthermore, in the fourth category named Pedagogical approach for ESD some answers could be also included into a third category, but from the answers provided we could not conclude this with certainty.

Third category was named Environmental Education. Students described environmental education or mentioned ideas about teaching environmental awareness. In this category was also students’ answers, which described pedagogical approach typical for ESD, but the main idea was environmental protection. Key words mentioned by participants were: create environmental awareness, environmental impact, to show learners sustainable way of living for the environment etc. In this category was 36% of Slovenian students’ answers and 22% of Austrian students’ answers.

Fourth category was Pedagogical approach for ESD. Students outlined the main ideas and aims of ESD. They knew the pedagogical approaches and methods that were recommended by ESD. Key words from the answers mentioned by participants: lifelong learning, to teach students values and competences, rethinking and alternative actions, learning by case studies, workshops and in-depth discussions on the topic of ESD, thinking on holistic level, to teach critical thinking, to demonstrate cross-disciplinary awareness, to engaged students for becoming active themselves. In this category were 17% of Slovenian students’ answers and 43% of Austrian students’ answers.
Table 4: Students` understanding of ESD

<table>
<thead>
<tr>
<th>NO</th>
<th>Category</th>
<th>Number of answers (f SI/A/T)</th>
<th>Typical answers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>No understanding</td>
<td>(f 1/3/4)</td>
<td>“I do not know.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“This term does not mean anything to me.”</td>
</tr>
<tr>
<td>2</td>
<td>Abstract understanding</td>
<td>(f 26/16/41)</td>
<td>“Teaching about sustainability”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Build the awareness about sustainability”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“The role of school is to educate for the future.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Lessons, so that students can also deal with the concept of sustainability.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“To bring the so-called concepts closer to everyone, especially in school.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“To pass on sustainable development in schools - as a task for teachers.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Teaching about ESD, following the trends in education.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Is the education and teaching towards sustainability”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Education creates an awareness of the necessity and feasibility of sustainability”</td>
</tr>
<tr>
<td>3</td>
<td>Environmental education</td>
<td>(f 21/12/33)</td>
<td>“Environmental education for now and future generation.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Education of specialists for ecological research areas.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“To make pupils aware that their behaviour has a significant impact on the environment and to show them ways to behave sustainably.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Activating awareness and making people aware of problems that affect the future of our environment.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“To show learners the sustainable use of resources, to motivate them to avoid garbage, e.g. to buy &quot;second hand&quot; goods, to replace</td>
</tr>
</tbody>
</table>
plastic bags with paper or fabric bags, etc. Making the consequences of 'waste' visible.”

“Paying attention to environmental influences that are bad for the environment! Everyone can do something! Ecological Footprint -> Create awareness!”

“To motivate students to treat the environment in an environmentally friendly and resource-conserving way.”

“To make students aware that we have only one planet Earth and that we need to use the given resources in the best possible way.”

“Newly developed technologies/inventions with protection of the environment in mind.”

<table>
<thead>
<tr>
<th>4</th>
<th>Pedagogical approach for ESD (10/23/33)</th>
<th>“Lifelong learning”</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(f % 17/43/30)</td>
<td>“Social and political development/education, rethinking and alternative actions.” “Learning by case studies”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Offer seminars, workshops and in-depth discussions on the topic.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“To teach students values and competences so that they can also become part of sustainable development.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Sustainable thinking lives on a holistic level and must include the world in which the students live. Therefore, sustainability issues need to be communicated to students on a holistic level.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“To demonstrate cross-disciplinary awareness raising and options for action.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“To raise awareness and knowledge among students at school, but also among the population through certain public events, in order to enable sustainable development and the help of people.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“To educate students/children/people critically, to become critical citizens, to question everything, e.g., Is Amazon good? No. Many do not know what is behind it.”</td>
</tr>
</tbody>
</table>
“Education that enable learners to develop competences that are preserved throughout their lives, thus opening up opportunities in many areas of life.”

“No answer (f 2/6/8)
(f % 3/10/13)

Figure 10: Slovenian (SI) and Austrian (A) students’ understanding of ESD
4.4 Analysis the contexts of school subjects where students would place Education for Sustainable Development

First, students were asked to write the school subject where they would place ESD. Their answers were coded into four categories (Table 5, Figures 11, 12). Categories were developed based on the results of previous research (Burmeister and Eilk, 2013) and literature review (De Haan, 2006; McKeown, 2002; Paden, 2000; Sterling, 2004; UNESCO, 2005). Only a small number of participants did not answer the question (two students from Slovenia and one student from Austria).

First category was Science subjects. In this category were different science school subjects. The most frequent answer was biology. This was expected, all students in our research studied biology education. In Austrian curriculum biology is named biology and environmental education. Following answers were chemistry, physic and science. Only Slovenian students mentioned the subject science (biology, chemistry and physic in one subject). Subject science is part of the curriculum in lower secondary school in Slovenia. In this category were 60% of Slovenian students’ answers and 42% of Austrian students’ answers.

Second category was Social science. In this category were different social science school subjects. The most frequent answer was Geography. Geography is in Austrian curriculum named Geography and Economy. The next answer was Ethics. In Slovenian curriculum, Ethics is named Citizen and Homeland Culture and Ethics. In Austrian curriculum Ethics is part of the Political Education and Religion Education (Schlenk, Kerstin, Kreß and Pfeil, 2015). The next answer was languages (mentioned only by Austrian students). Students mentioned languages in general, and English and German separately. Following answer was history. The last answer in this category was philosophy (mentioned only by Austrian students). In this category were 21% of Slovenian students’ answers and 45% of Austrian students’ answers.

Third category was Interdisciplinary subject. In this category, is only one school subject – Home Economics. In this category were 20% of Slovenian students´ answers and 1% of Austrian students’ answers.

Fourth category was All subjects. Students mentioned that all subjects were suitable to teach ESD. In this category were 2% of Slovenian students´ answers and 8% of Austrian students´ answers.
Table 5: School subject where students placed ESD

<table>
<thead>
<tr>
<th>NO</th>
<th>Category</th>
<th>Number of answers (f SI/A/T)</th>
<th>School subjects (f SI/A/T)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Science subjects</td>
<td>(f 117/69/186)</td>
<td>Biology (54/48/102), Chemistry (33/13/46), Physics (10/8/18), Science (20/0/20)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 60/42/53)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Social science subjects</td>
<td>(f 33/77/110)</td>
<td>Geography (17/28/45), Ethic (8/14/22), Languages (0/22/22), History (8/10/18), Philosophy (0/3/3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 17/45/31)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Interdisciplinary subjects</td>
<td>(f 38/2/40)</td>
<td>Home Economics (38/2/40)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 20/1/12)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>All subjects</td>
<td>(f 3/12/15)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 3/11/4)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No answer</td>
<td>(f 2/1/3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 3/2/5)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 11: Category where students placed ESD
Figure 12: Preferred allocation of ESD among the school subject
4.5 Analysis students' sources of knowledge about sustainability and Education for Sustainable Development

Students were asked to mark sources of knowledge regarding three pillars of sustainability, Brundtland’s definition of SD and ESD. The answers were represented graphically in Figure 13 and 14. Analysis students' sources of knowledge about three pillars of sustainability

First, students were asked to mark with yes, no or unsure sources of knowledge regarding three pillars of sustainability. 68% of Slovenian students and 55% of Austrian students heard about the model from biology study. 82% of Slovenian students and 23% of Austrian students heard about the model from a second subject. 22% of Slovenian students and 8% of Austrian students heard about the model from educational study. 73% of Slovenian students and 57% of Austrian students heard about the model from other resources.

22% of Slovenian students and 23% of Austrian students had never heard about the model from biology study. 10% of Slovenian students and 68% of Austrian students had never heard about the model from a second subject. 63% of Slovenian students and 73% of Austrian students had never heard about the model from educational study. 15% of Slovenian students and 25% of Austrian students had never heard about the model from other resources.

10% of Slovenian students and 22% of Austrian students were unsure about the model from biology study. 8% of Slovenian and Austrian students were unsure about the model from a second subject. 15% of Slovenian students and 18% of Austrian student were unsure about the model from educational study. 12% of Slovenian students and 18% of Austrian students were unsure about the model from other resources.

Pearson Chi Square test was conducted to determine the statistically significant between Slovenian and Austrian students’ sources of knowledge regarding three pillars of sustainability in biology study, other subject, educational study and other sources.

The results show (Appendix 3), that there was no statistically significant difference between Slovenian and Austrian students’ sources of knowledge regarding three pillars of sustainability in biology study ($\chi^2 = 3.481$, df = 2, p = 0.175), educational study ($\chi^2 = 4.195$, df = 2, p = 0.123) and other sources ($\chi^2 = 3.055$, df = 2, p = 0.217).

The statistically significant difference between Slovenian and Austrian students’ sources of knowledge regarding three pillars of sustainability was founded in other subject ($\chi^2 = 45.508$, df = 2, p = 0.001).
4.5.1 Analysis students' sources of knowledge about Brundtland’s definition of Sustainable Development

Second, students were asked to mark with yes, no or unsure sources of knowledge regarding Brundtland’s definition of SD.

38% of Slovenian students and 60% of Austrian students heard about the definition from biology study. 55% of Slovenian students and 25% of Austrian students heard about the definition from a second subject. 18% of Slovenian students and 8% of Austrian students heard about the definition from educational study. 37% of Slovenian students and 70% of Austrian students heard about the definition from other recourses.

55% of Slovenian students and 27% of Austrian students had never heard about the definition from biology study. 33% of Slovenian students and 68% of Austrian students had never heard about the definition from a second subject. 70% of Slovenian students and 75% of Austrian students had never heard about the definition from educational study. 55% of Slovenian students and 20% of Austrian students had never heard about the definition from other recourses.

7% of Slovenian students and 13% of Austrian students were unsure about the definition from biology study. 7% of Slovenian students and 8% of Austrian students were unsure about the definition from a second subject. 12% of Slovenian students and 17% of Austrian student were unsure about the definition from educational study. 8% of Slovenian students and 10% of Austrian students were unsure about the definition from other recourses.

Pearson Chi Square test was conducted to determine the statistically significant between Slovenian and Austrian students’ sources of knowledge regarding Brundtland’s definition of sustainable development in biology study, other subject, educational study and other sources.

The results show (Appendix 3), that there was no statistically significant difference between Slovenian and Austrian students’ sources of knowledge regarding Brundtland’s definition of SD in educational study ($\chi^2 = 2.883$, df = 2, p = 0.237).

The statistically significant difference between Slovenian and Austrian students’ sources of knowledge regarding three pillars of sustainability was found in biology study ($\chi^2 = 10.096$, df = 2, p = 0.006), another subject ($\chi^2 = 10.736$, df = 2, p = 0.005) and other sources ($\chi^2 = 16.141$, df = 2, p < 0.001).
4.5.2 Analysis students' sources of knowledge about Education for Sustainable Development

Third, students were asked to mark with yes, no or unsure sources of knowledge regarding ESD. 22% of Slovenian students and 48% of Austrian students heard about ESD from biology study. 52% of Slovenian students and 27% of Austrian students heard about ESD from second subject. 13% of Slovenian students and 25% of Austrian students heard about ESD from educational study. 38% of Slovenian students and 57% of Austrian students heard about ESD from other recourses.

53% of Slovenian students and 33% of Austrian students had never heard about ESD from biology study. 10% of Slovenian students and 68% of Austrian students had never heard about ESD from a second subject. 70% of Slovenian students and 64% of Austrian students had never heard about ESD from educational study. 52% of Slovenian students and 42% of Austrian students had never heard about ESD from other recourses.

20% of Slovenian students and 13% of Austrian students were unsure about ESD from biology study. 12% of Slovenian students and 8% of Austrian students were unsure about ESD from a second subject. 17% of Slovenian students and 12% of Austrian students were unsure about ESD from educational study. 10% of Slovenian and Austrian students were unsure about ESD from other resources.

Pearson Chi Square test was conducted to determine the statistically significant between Slovenian and Austrian students’ sources of knowledge regarding ESD in biology study, other subject, educational study and other sources.

The results show (Appendix 3), that there was no statistically significant difference between Slovenian and Austrian students’ sources of knowledge regarding ESD in educational study ($\chi^2 = 2.860$, df = 2, p = 0.239) and other sources ($\chi^2 = 1.224$, df = 2, p = 0.542).

The statistically significant difference between Slovenian and Austrian students’ sources of knowledge regarding ESD was found in biology study ($\chi^2 = 59.200$, df = 2, p < 0.001), another subject ($\chi^2 = 46.063$, df =2, p < 0.001)
### Slovenian students source of knowledge about sustainability and ESD

<table>
<thead>
<tr>
<th>Question</th>
<th>Source of Knowledge</th>
<th>Yes</th>
<th>No</th>
<th>Unsure</th>
</tr>
</thead>
<tbody>
<tr>
<td>I heard about this three pillars model of sustainability:</td>
<td>...from biology study</td>
<td>68%</td>
<td>22%</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>...from studies in my second subject</td>
<td>82%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>...from educational studies</td>
<td>63%</td>
<td>15%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>...from other sources like media, internet</td>
<td>73%</td>
<td>10%</td>
<td>7%</td>
</tr>
<tr>
<td>I heard about meaning of sustainable development:</td>
<td>...from biology study</td>
<td>38%</td>
<td>55%</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>...from studies in my second subject</td>
<td>55%</td>
<td>38%</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>...from educational studies</td>
<td>70%</td>
<td>38%</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>...from other sources like media, internet</td>
<td>55%</td>
<td>55%</td>
<td>8%</td>
</tr>
<tr>
<td>I got to know the concept of ESD:</td>
<td>...from biology study</td>
<td>22%</td>
<td>58%</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>...from studies in my second subject</td>
<td>52%</td>
<td>37%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>...from educational studies</td>
<td>70%</td>
<td>37%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>...from other sources like media, internet</td>
<td>52%</td>
<td>52%</td>
<td>10%</td>
</tr>
</tbody>
</table>

0%  20%  40%  60%  80%  100%

**Yes**  **No**  **Unsure**

Figure 13: Slovenian (SI) students’ source of knowledge about "sustainability" and ESD.
Figure 14: Austrian (A) students’ source of knowledge about "sustainability" and ESD
4.6 Analysis of students’ attitudes to implementing Education for Sustainable Development in biology class

Students were asked to mark, on 4-point Likert scale reflecting their attitudes towards implementing ESD in biology class. The answers are represented graphically in Figure 15.

The first question was about implementation of ESD in lower secondary school. Lower secondary school in Slovenian is the last tier of elementary school. Pupils in Austria choose NMS or AHS lower level. These names were written in the students’ questionnaire. Positive attitudes were expressed in 93% of Slovenian students and 90% of Austrian students (73% Slovenian students agreed and 20% somewhat agree; 63% Austrian students agreed and 20% somewhat agreed). In both groups of students, 5% of students partly agreed and 2% of Slovenian students and 5% of Austrian students did not agree.

The second question was about implementation of ESD in upper secondary school. Students’ attitudes about implementation ESD in upper secondary school (high school in both countries) had more various answers as implementation in lower secondary school. Positive attitudes were expressed in 95% of Slovenian students and 83% of Austrian students (77% Slovenian students agreed and 18% somewhat agree; 48% of Austrian students agreed and 35% somewhat agreed). 3% Slovenian students and 10% of Austrian students partly agreed and 2% of Slovenian students and 7% of Austrian students did not agree that ESD should be part of the curriculum in upper secondary school.

The third question was about personal attitudes regarding implementation of ESD in their own lessons. Students’ opinion was quite similar in both groups. 93% of Slovenian students and 90% of Austrian students (67% Slovenian students agreed and 30% somewhat agree; 72% of Austrian students agreed and 18% somewhat agreed) had positive attitudes about implementation of ESD in their own lessons. 3% of students in both groups were partly agreed. No Slovenian students and 7% of Austrian students did not agree about implementation of ESD in their own biology lessons.

T-test was conducted in order to determine whether there was statistically significant difference between Slovenian and Austrian student’s attitudes to implementing ESD in biology class (Appendix 3).

The results indicate that there was a statistically significant difference between Slovenian and Austrian students' regarding implementation of ESD in upper secondary school (t = 2.450, df = 118, p = 0.016). In this regard, more Slovenian students (M = 3.70, SD = 0.619) want to implement ESD in upper secondary school than Austrian students (M = 3.25, SD = 0.895).

No statistically significant difference was recoded between Slovenian and Austrian students’ attitudes to implementing ESD in lower secondary school (t = 1.233, df = 118, p = 0.220) and their own class (t = 0.875, df = 118, p = 0.383).
Figure 15: Slovenian (SI) and Austrian (A) students’ attitude to implementation ESD in secondary school.
4.7 Analysis of students’ previous knowledge about sustainability and Education for Sustainable Development

First, students were asked to describe a pupil’s previous knowledge about sustainability and ESD. Their answers were coded into six categories (Table 7, Figure 16). Categories were developed based on the results of previous research (Burmeister and Eilk, 2013) and literature review (De Haan, 2006; McKeown, 2002; Paden, 2000; UNESCO, 2005; Sterling, 2004). Categories were ranged from zero knowledge to advance knowledge. Only a small number of participants did not answer the questions (four students from Slovenia and three students from Austria).

The first category was No opinion. Students mentioned that they did not know or have enough experiences. In this category were 8% of Slovenian students’ answers and no Austrian students’ answers.

The second category was No knowledge. Students mentioned that pupils did not know a lot about sustainability and ESD. In this category were 8% of Slovenian students’ answers and 4% of Austrian students’ answers.

The third category was Limited knowledge. The most frequent answer was lack of knowledge. Only Slovenian students mentioned answers containing: education about sustainability should be included in the curriculum in primary school, not enough key studies and real-life examples, students do not know the definition of sustainable development and not enough critical thinking. Only Austrian students mentioned that knowledge of students depends on their parents’ knowledge/behaviour. In this category were 39% of Slovenian students’ answers and 12% of Austrian students’ answers.

The fourth category was Knowledge about environmental issues. Key words mentioned by participants were: waste management and recycling, and environmental conservation. Only Austrian students mentioned answers such as: ecological footprint, climate changes, plastic pollution and eat less meat. In this category were 48% of Slovenian students’ answers and 67% of Austrian students’ answers.

The fifth category was Knowledge about sustainability in general. Key words mentioned by participants were: Paraphrasing Brundtland’s definition of SD. In this category were 5% of Slovenian students’ answers and 6% of Austrian students’ answers.

The fifth category was Others. Key words mentioned by participants were: 7th and 9th grade and impact of social media to student’s knowledge. In this category were 5% of Slovenian students’ answers and 6% of Austrian students’ answers.
### Table 6: Slovenian (SI) and Austrian (A) student’s description of previous pupils’ knowledge about sustainability and ESD

<table>
<thead>
<tr>
<th>NO</th>
<th>Category</th>
<th>Total number of answers</th>
<th>Answers included in the category and their frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(f SI/A/T)</td>
<td>(f % SI/A/T)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % SI/A/T)</td>
<td>(f SI/A/T)</td>
</tr>
<tr>
<td>1</td>
<td>No opinion</td>
<td>(f 6/0/6)</td>
<td>I do not know. (3/0/3) I do not have enough experiences. (3/0/3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 8/0/4)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>No knowledge</td>
<td>(f 8/3/8)</td>
<td>Students do not know a lot about this topic. (5/3/8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 8/4/5)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Limited knowledge</td>
<td>(f 25/10/35)</td>
<td>Lack of knowledge (9/1/10), big differences in knowledge (0/5/5), depends on the teacher teaching in school (4/1/5), education about sustainability should be included in curriculum in primary school (3/0/3), not enough key studies and real life examples (3/0/3), do not know definition about sustainable development (3/0/3), the depends on their parents knowledge/behaviour (0/3/3), not enough critical thinking (3/0/3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 39/12/24)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Knowledge about environmental issues</td>
<td>(f 31/54/85)</td>
<td>Waste management and recycling (11/17/28), environmental conservation (11/9/20), renewable energy (3/7/10), ecology (5/3/7), ecological footprint (0/5/5), climate changes (0/4/4), transport problems (1/3/4), plastic pollution (0/3/3), eat less meat (0/3/3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 48/67/58)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Knowledge about sustainability in general</td>
<td>(f 3/5/8)</td>
<td>Paraphrasing Brundtland’s definition of SD (3/5/8)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 5/6/5)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Others</td>
<td>(f 3/3/6)</td>
<td>7th and 9th grade (3/0/3), students get knowledge from social media (0/3/3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 5/4/4)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>No answer</td>
<td>(f 4/3/7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 7/5/12)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>All answers</td>
<td>(f 76/71/147)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 52/48/100)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 16: Slovenian (SI) and Austrian (A) student’s description of previous pupils’ knowledge about sustainability and ESD.
4.8 Analysis of suitable topics and contents for teaching biology in order to implement Education for Sustainable Development

First, students were asked to write the topics and contents, which are suitable for teaching biology in order for implement ESD. Their answers were coded into eight categories (Table 8, Figure 17). Categories were developed based on the results of previous research (Burmeister and Eilk, 2013) and literature review (De Haan, 2006; Paden, 2000; Sterling, 2004; UNESCO, 2005). Only a small number of participants did not answer the questions (no student from Slovenia and two students from Austria).

The first category was Environmental issues. Key words from the answers mentioned by participants were environmental conservation and waste management. Only Slovenian students mentioned: environmental awareness, environmental education, species extinction and human and environmental. Only Austrian students mentioned: nature conservation, climate change, ecological footprint, plastic pollution, water pollution, water consumption. In this category were 38% of Slovenian students’ answers and 37% of Austrian students’ answers.

The second category was Ecology. Key word from the answers mentioned by participants was the same as the name of the category – ecology. Only Slovenian students mentioned: plants and animals adaptation. Only Austrian students mentioned: water cycle and bio indicators. In this category were 37% of Slovenian students’ answers and 24% of Austrian students’ answers.

The third category was Agriculture. Key word from the answers mentioned by participants was nutrition. Only Austrian students mentioned agriculture, local and regional production, farm animals, animal husbandry and bio product. In this category were 3% of Slovenian students’ answers and 18% of Austrian students’ answers.

The fourth category was Molecular biology. Key word from the answers mentioned by participants was genetics. Only Slovenian students mentioned biotechnology and microbiology. Only Austrian students mentioned biochemistry. In this category were 12% of Slovenian students’ answers and 2% of Austrian students’ answers.

The fifth category was Global world. Only Austrian students mentioned answers: tropical forest, globalisation, sustainable consumption, wildlife conservation. In this category were no Slovenian students’ answers and 9% of Austrian students’ answers.

The sixth category was Human. Only Slovenian students mentioned answer such as human body. Only Austrian students mentioned answers: anthropology and ethic. In this category were 2% of Slovenian students’ answers and 4% of Austrian students’ answers.

The seventh category was All topics. Students mentioned that sustainability could be part of each lesson. In this category were 2% of Slovenian students’ answers and 3% of Austrian students’ answers.

The eighth category was Others. In this category were 3% of Slovenian students’ answers and no Austrian students’ answers.
Table 7: Potential topics from the biology curriculum for ESD in biology lesson

<table>
<thead>
<tr>
<th>NO</th>
<th>Topics</th>
<th>Total number of answers</th>
<th>Answers included in the category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(f SI/A/T)</td>
<td>(f % SI/A/T)</td>
</tr>
<tr>
<td>1</td>
<td>Environmental issues</td>
<td>(f 49/54/103)</td>
<td>Environment conservation (17/20/37), waste management (5/7/12), environmental awareness (9/0/9), renewable energy sources (5/3/8), nature conservation (0/5/5), climate change (0/4/4), ecological footprint (0/4/4), environmental education (4/0/4), plastic pollution (0/4/4), water pollution (0/4/4), water consumption (0/3/3), species extinction (3/0/3), acid rain (3/0/3), human and environmental (3/0/3)</td>
</tr>
<tr>
<td>2</td>
<td>Ecology</td>
<td>(f 48/34/82)</td>
<td>Ecology (41/21/62), water cycle (0/5/5), plants and animals adaptation (4/0/4), biodiversity (3/5/8), bio indicators (0/3/3)</td>
</tr>
<tr>
<td>3</td>
<td>Agriculture</td>
<td>(f 4/26/30)</td>
<td>Nutrition (4/5/9), agriculture (0/4/4), local and regional production (0/4/4), farm animals (0/4/4), arable crops (0/3/3), animal husbandry (0/3/3), bio products (0/3/3)</td>
</tr>
<tr>
<td>4</td>
<td>Molecular biology</td>
<td>(f 16/3/19)</td>
<td>Genetics (7/0/7), biotechnology (5/0/5), microbiology (4/0/4), biochemistry (0/3/3)</td>
</tr>
<tr>
<td>5</td>
<td>Global world</td>
<td>(f 0/13/13)</td>
<td>Tropical forest (0/4/4), globalisation (0/3/3), sustainable consumption (0/3/3), wildlife conservation (0/3/3)</td>
</tr>
<tr>
<td>6</td>
<td>Human</td>
<td>(f 3/6/9)</td>
<td>Human body (3/0/3), anthropology (0/3/3), ethic (0/3/3)</td>
</tr>
<tr>
<td>7</td>
<td>All topics</td>
<td>(f 2/4/6)</td>
<td>Sustainability could be part of each lesson (2/4/6)</td>
</tr>
<tr>
<td>8</td>
<td>Others</td>
<td>(f 4/0/4)</td>
<td>9th grade in Slovenia (4/0/4)</td>
</tr>
<tr>
<td></td>
<td>No answer</td>
<td>(f 0/2/2)</td>
<td>/</td>
</tr>
<tr>
<td></td>
<td>All answers</td>
<td>(f 129/146/275)</td>
<td>(f % 47/53/100)</td>
</tr>
</tbody>
</table>
Figure 17: Potential topics from the biology curriculum for ESD in biology lessons
4.9 Analysis of teaching approaches to implement Education for Sustainable Development in biology lessons

First, students were asked to write examples of teaching methods, which are suitable for implementing for SD in biology lessons. Their answers were coded into five categories (Table 8, Figure 18). Student’s answers included various suitable methods and also strategies, approaches and form of teaching. Categories were developed based on the results of previous research (Burmeister and Eilk, 2013) and literature review (Blažič et al., 2003; Dochy and Janssens, 2010; Lavrnja, 1996; Milosevic Zupancic, 2018; Poljak, 1988; Tomič, 1997; Sterling, 2004; Struyven and Attard, 2010). Only a small number of participants did not answer the question (no student from Slovenia and two students from Austria).

The first category was Learner’s centre approach. This category was divided into two subcategories. The first subcategory was Teaching methods and strategies. Key words from the answers mentioned by participants were project-based learning, experiments, learning outside of classroom and poster presentation. Only Austrian students mentioned inquiry based learning and open learning method. The second subcategory was Teaching forms. Key words from the answers mentioned by participants were cooperative learning and working in pairs. In this category were 52% of Slovenian students’ answers and 67% of Austrian students’ answers.

The second category was Teacher’s centre approach. This category was divided into two subcategories, the same as in the first category Learner’s centre approach. The first subcategory was Teaching methods and strategies. Key word from the answers mentioned by participants were discussion, lecturing, inviting outside experts and demonstration. The second subcategory was Teaching forms. Key word from the answers mentioned by participants was frontal teaching. In this category were 34% of Slovenian students’ answers and 25% of Austrian students’ answers.

The third category was All approaches. Students mentioned that all approaches could be suitable for using ESD in biology lesson. In this category were 2% of Slovenian students’ answers and 3% of Austrian students’ answers.

The forth category was Others. In this category were 3% of Slovenian students’ answers and 1% of Austrian students’ answers.

The fifth category was No ideas. In this category were 2% of Slovenian students’ answers and 3% of Austrian students’ answers.
### Table 8: Teaching approaches mentioned by students

<table>
<thead>
<tr>
<th>NO</th>
<th>Teaching approach</th>
<th>Total number of answers</th>
<th>Methods/Strategies/Form mentioned by students</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(f SI/A/T)</td>
<td>(f SI/A/T)</td>
</tr>
<tr>
<td>1</td>
<td>Learner’s centre approach</td>
<td>(f 80/100/180)</td>
<td><em>Teaching Methods and Strategies</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 59/67/63)</td>
<td>Project based learning (10/18/28), Experiments (14/8/22), Learning outside of classroom (13/5/18), Poster presentation (5/11/16), Inquiry based learning (0/10/10), Working with IKT (8/4/12), Role play (3/7/10), Learning by case studies (5/3/8), Active learning (3/5/8), Using didactic games (2/4/6), Open learning method (0/5/5), Brainstorming (2/3/5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Teaching forms:</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cooperative learning (11/15/26), Working in pairs (4/2/6)</td>
</tr>
<tr>
<td>2</td>
<td>Teacher’s centre approach</td>
<td>(f 46/37/83)</td>
<td><em>Teaching Methods and Strategies</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 35/25/29)</td>
<td>Discussion (20/13/33), Lecturing (10/5/15), Inviting outside experts (8/6/14), Demonstration (5/8/13), Analyse of sources (9/0/9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><em>Teaching forms:</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Frontal teaching (3/5/8)</td>
</tr>
<tr>
<td>3</td>
<td>All approaches</td>
<td>(f 2/5/7)</td>
<td>All methods are suitable. (2/5/7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 1/3/2)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Others</td>
<td>(f 4/2/6)</td>
<td>Interdisciplinary learning (4/2/6)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 3/1/2)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>No ideas</td>
<td>(f 3/5/8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 2/3/3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>No answer</td>
<td>(f 2/0/2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % 3/0/3)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>All answers</td>
<td>(f 137/149/286)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(f % SI/A/100)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 18: Suitable approaches to implement ESD in biology lesson.
4.10 Students opinion about Education for sustainable development in society in general and in biology lessons

Students were asked about the importance of ESD in society and in general and in biology lessons. They had chosen on a scale from 0 to 10 (0 = not important at all, 10 = extremely important).

The results of rating the importance of ESD in society in general showed a high level of support between Slovenian and Austrian students (Figure 18). The results of Slovenian students were 8.97 and results of Austrian students were 8.95. T-test was conducted in order to determine whether there was a statistically significant difference between Slovenian and Austrian student’s opinion about importance of ESD in society in general (Table 14). The results indicate that there was no statistically significant difference between Slovenian and Austrian students' opinion about importance of ESD in biology lessons ($t = -0.373$, $df = 118$, $p = 0.710$).

![Students opinion about ESD in society in general](image)

**Figure 19: Students opinion about ESD in society in general**

The results of rating the importance of ESD in biology lessons showed the same results as the importance of ESD in society in general - high level of support between Slovenian and Austrian students. The results of Slovenian students were 8.7 and results of Austrian students were 8.82 (Figure 18). T-test was conducted in order to determine whether there was a statistically significant difference between Slovenian and Austrian student’s opinion about the importance of ESD in biology lessons (Table 14). The results indicate that there was no statistically significant difference between Slovenian and Austrian students' opinion about importance of ESD in biology lesson. ($t = -0.261$, $df = 118$, $p = 0.795$).
Figure 20: Students opinion about Education for sustainable development in biology lessons.
5 DISCUSSION

The study focused on understanding and knowledge about SD and ESD by Slovenian and Austrian students, and comparing the results between the two countries. Another aim of our research was to determine pre-service teachers’ PCK. In the following chapter is the discussion of the results.

Nowadays, environmental literacy, attitudes, and values that go beyond the understanding of environmental problems are one of the primary purposes of the education system worldwide. We were able to conclude this also in our research. Slovenian and Austrian students know environmental problems quite well. Nearly 70% of students from both cohorts explained SD in connection with ideas taken from the concept of SD: all three aspects of sustainability and inter-generational equitability. Less than 5% of Slovenian and Austrian students showed a complete understanding of sustainability. A similar conclusion was reached by Burmeister, Eilks in 2013, among German student teachers and trainee teachers of chemistry.

Students are linking SD strongly to environmental aspects, rather than economic and social ones. Students most often mentioned environmental aspects, followed by economic and social ones. In our study, we find three other categories: time issue, an educational issue and the definition of sustainable development. Time issue and the definition of sustainable development were not recognised in other studies. Some responses are mentioned only in one of the two cohorts. Only the Slovenian cohort mentioned green chemistry, European Union, home economics and competences. Meanwhile, only in the Austrian cohort could we find answers such as ecological footprint, vegan and vegetarian lifestyle, environmentally friendly, environmental organisation, wildlife conservation, local products, seasonal products, agriculture and GMOs, global thinking and first world vs the third world.

We could find reasons for different associations between the two cohorts in the university curricula, the second subject of study, content knowledge and the influence of mass media. Especially the second subject of study is entirely different between Slovenian and Austrian students. Slovenian students selected biology with either home economics or chemistry. Most of the Austrian students combine biology and one of the social science subjects. We could not recognise significant differences among categorisation between Slovenian and Austrian students’ answers.

These basic findings are consistent with research study by Hagevik et al. (2015). In 2007, Summers and Childs reported quite similar results in their research among English student teachers of science and geography. Uitto and Saloranta (2017) found similar sustainability dimensions by Finnish lower secondary teachers in their research. Results showed that science teachers, especially biology and geography teachers considered the ecological sustainability aspect rather than economic or social ones.

The next important topic in our study is ESD. ESD is an approach to education, which includes integrative and holistic view, linking knowledge and action. We asked students how they define/describe education for sustainable development. Three main categories were found: abstract understanding, environmental education and pedagogical approach for ESD (approximately 30% of answers in each category). Most Slovenian students defined ESD as environmental education.

Meanwhile, most Austrian students defined it as a pedagogical approach for SD. Environmental education was described as learning about environmental protection and creating environmental awareness. Pedagogical approach for ESD was defined as pedagogical
approaches and methods that were recommended by ESD (e.g. lifelong learning, working with students’ values and competencies, rethinking and alternative actions, learning by case studies etc.). When comparing our results to Burmeister’s and Eilks’ study in 2013, it must be pointed out that students in our research are able to outline more ideas following the aims and pedagogy of ESD.

Students had positive attitudes toward implementing ESD in lower secondary school. No statistically significant difference was recorded between Slovenian and Austrian students. A statistically significant difference was found regarding implementation ESD in upper secondary school. More Slovenian students wanted to implement ESD in upper secondary school. Both cohorts of students wanted to implement ESD in their class. There was no statistically significant difference there. Students in both cohorts showed high levels of support of the importance of ESD in general in society, and in biology education. Our results are broadly in line with Burmeister and Eilks studies in 2013.

Students’ reflection of the source of knowledge showed differences between Slovenian and Austrian students’ answers. For Slovenian students, the primary source of modern theory of sustainability was the second subject of study. For Austrian students primary sources were biology subject and other resources, such as mass media.

More than half of the students from both cohorts heard about the three pillars of sustainability from biology study. The statistically significant difference between the cohorts from biology subject was found in Brundtland’s definition and ESD. Approximately 40% of Slovenian students and 60% of Austrian students remembered Brundtland’s definition from biology study. Approximately 20% of Slovenian students and 50% of the Austrian students heard about ESD from biology study. The statistically significant difference between the cohorts from biology subject was found in Brundtland’s definition and ESD.

A statistically significant difference between Slovenian and Austrian students’ sources of knowledge was found in another subject for all three theories (three pillars of substantiability, Brundtland’s definition and ESD). More than half of the Slovenian students heard about the modern theory of sustainability and ESD from the second subject, while less than third of Austrian students did. We could find the reason for those results in second subject of study. Slovenian students select biology with either home economics or chemistry. In both of those subjects, students have courses, where they learn about sustainability. Pre-service biology and chemistry teachers at the University of Ljubljana, Faculty of Education take the subject: Environmental Education; one of the topics in this course is sustainability. Pre-service biology and home economics teacher at the University of Ljubljana, Faculty of Education take the subjects Consumer education, and Environment and Sustainable Development. Austrian students select a different second subject of study; more than 70% of other subjects are social science subjects. One of the limitations was found in this case. We will able to compare an understanding of students who select biology and geography subject to other students. Curriculum of the geography includes many subjects about sustainability.

The vast majority from both groups of students mentioned that ideas and concepts of modern understanding of sustainability did not play any role in the teacher education courses in which they have taken part. Less than 20% of students in both groups remember having any contact with those concepts. There was no statistically significant difference between the groups of students.

Other sources, such as mass media, were an essential channel of information for students in our study. Especially for Austrian students, besides biology study, were the other sources the
most important channel of information. The statistically significant difference between the groups was found in Brundtland's definition. More Austrian students heard about Brundtland's definition from other resources than Slovenian students. It is interesting to note that, because of the globalisation and impact of mass media. This result ties well with previous studies wherein Burmeister, and Eilks (2013) reported that the most often mentioned sources of information were sources outside of the university.

The next section discusses the students’ PCK. Studies showed that a broad and deep PCK is a key aspect for successful interdisciplinary collaboration and a holistic view on sustainability (Sterling, 2004). Prior knowledge affects the learning process. The learning theory, which supports this, is constructivism. Students’ description of the pupils’ prior knowledge showed that approximately 40% of Slovenian students describe prior knowledge as limited. In the Austrian sample, approximately 70% of student’s answers were in category Knowledge about an environmental issue. We could find reasons for a different assessment of prior knowledge in their personal experiences from primary/secondary school. Another reason could be the differences of the curriculum in Slovenia and Austria. In Austria, biology subject is named Biology and Environmental Education and includes more environmental topics compared to Slovenian curriculum. Environmental education in Slovenia is just one of the selected subjects in upper secondary school. Environmental topics in Slovenian curriculum are part of the biology, chemistry and home economics subjects. These results go in line with previous reports, showing that environmental topics were the most frequent answer (Burmeister and Eilks, 2013).

When we asked students which school subjects might be best for promoting ESD, the participants acknowledged the significant role of natural science subject (more than 50% of students in our research). Biology subject was the most frequently mentioned subject in both cohorts. Austrian students more often preferred social science subjects. This was the logical consequence of more than 70% of Austrian students choosing social science subject as their second subject. Slovenian students more often preferred chemistry or home economics as Austrian students did. Geography was the most often mentioned social science subject in both cohorts. The majority of the participants preferred the subject, which they were studying. From those answers, we could recognise PCK, which is a combination of both study subjects. Our results are broadly in line with research published by Burmeister and Eilks (2013).

Knowledge about the curriculum is an essential aspect of PCK. We asked students about suitable topics and contents in biology curriculum for teaching ESD. Environmental issues and ecology are the topics most often mentioned in both cohorts. Students have strongly connected SD and ESD to environmental aspects. Slovenian students mentioned topics from molecular biology more often; while Austrian students more often suggested topics from agriculture and global world. We can find the reason for differences in the curriculum on all levels of education, from primary school to university. By comparing the results to Burmeister and Eilks (2013) students in our study showed broader knowledge. However, when comparing our results to those of older studies in biology and environmental education, it must be pointed out that results are quite similar. Peer, Goldman and Yavetz (2007) revealed a lack of knowledge and missing conceptualisation for environmental education among Israeli pre-service teachers, even though the students’ attitudes towards the subject were quite positive. Esa (2010) researched ESD among pre-service biology teachers from Malaysia. She explained the high support to implement ESD in biology education, but on the other side provided a better understanding of the pedagogies for sustainability.

The main purpose of ESD is changing the education from transmissive to transformative teaching and learning. We asked students about suitable teaching approach to teach ESD.
Students most often mentioned teaching methods; sometimes they mentioned also teaching forms as well as teaching approaches. Students’ answers from both cohorts are similar. Most often was mentioned a learners’ centred approach, approximately 60% of students in our cohort; teacher’s centred approach was mentioned by approximately 30% of students. Students’ answers in category learners centred approach were such as project-based learning, experiments, learning outside of classroom and cooperative learning. Active learning processes were common in those approaches. Students showed understanding of transformative education quite well. The results reflect the methodological approach of the courses at the Universities and the students’ previous experiences from primary and secondary schools. In this study we investigated only students’ perceptions of pedagogical approaches for ESD. For the further studies it would be interesting how students implement the pedagogical approach for ESD in their teaching.
6 CONCLUSION

Pre-service teachers of biology understand SD quite well. There are no significant differences between Slovenian and Austrian pre-service teachers of biology. Pre-service teachers had a good understanding of the environmental approach of sustainability, but lack the interconnections between the environmental, political, economic and social concerns related to sustainable development.

Pre-service teachers of biology understand ESD quite well. There are no significant differences between Slovenian and Austrian pre-service teachers of biology. Pre-service teachers in both cohorts described and connected ESD with environmental education and environmental awareness. Few participants in this study possessed clear, theory-supported concepts about SD and ESD.

Pre-service teachers of biology do not know very well the concept of SD and ESD from biology studies. Between Slovenian and Austrian pre-service teachers were statistically significant differences in the sources of knowledge about the modern theory of sustainability. The primary source of knowledge for Slovenian pre-service teachers was the second subject of study (chemistry or home economics). The most frequent mentioned source of knowledge for Austrian pre-service teachers were biology study and other sources, such as mass media.

Pre-service teachers of biology from both cohorts can imagine teaching SD in their biology lessons. Both cohorts of pre-service teachers had strong positive attitudes about implementing SD and ESD in lower secondary school and future classes. Statistically significant difference was found regarding implementation ESD in upper secondary school, where Slovenian students show more commitment.

The difference between pre-service teachers of biology in the two countries is not statistically significant in the knowledge of sustainability. Between two cohorts of students, we could recognise little differences, because of the various curricula in all levels of education.

The difference between pre-service teachers in the two countries is not statistically significant regarding knowledge and attitudes of ESD. Students showed the various PCK. Students from both countries knew the pedagogical aspects of ESD, such as active learning and transformative education.

Limitation of the research is that we focused only on the biology pre-service teachers. Students study two subjects, and the combination of them is relevant for the CK and PCK. Some limitations were found in the questionnaire. The question about previous students’ knowledge is not specific enough. Furthermore, pre-service teachers have a lack of teaching experiences. They cannot adequately assess the pupils’ prior knowledge about SD. Another limitation is it does not include the question about the students’ view on interdisciplinary teaching and holistic view on SD. For example: How could biology teacher implement different dimensions and holistic views of SD in their teaching? Further studies might be needed to compare the understanding of SD and ESD between pre-service teachers, early career teachers and experienced teachers. Furthermore, the results and insights gained can be used in future studies to identify how students’ understanding of SD and ESD is changing from the first semester of the study to the last one. Future studies could also investigate the understanding of sustainability between biology students and pre-service teacher of biology.
6.1 ZAKLJUČEK

Bodoči učitelji biologije zadovoljivo razumejo TR. Pri tem ni zaznati statistično pomembnih razlik med slovenskimi in avstrijskimi študenti. Bodoči učitelji biologije dobro razumejo ekološki vidik trajnosti. Zaznati pa je pomanjkanje znanja v povezovanju med okoljskim, ekonomskim in socialnim vidikom TR.

Bodoči učitelji biologije dobro razumejo VITR. Pri tem ni zaznati statistično pomembnih razlik med slovenskimi in avstrijskimi študenti. Bodoči učitelji biologije v obeh državah povezujejo VITR z okoljskim izobraževanjem in okoljsko ozaveščenostjo. Le nekaj udeležencev raziskave ima odlično teoretično znanje o TR in VITR.


Med slovenskimi in avstrijskimi študenti nismo našli statistično pomembnih razlik v znanju o TR. Prepoznali so manjše razlike v znanju, ki so posledica različnih kurikulumov na vseh stopnjah izobraževanja.

Med slovenskimi in avstrijskimi študenti nismo zaznali statistično pomembnih razlik v znanju o VITR. Bodoči učitelji biologije imajo različno znanje za poučevanje (PCK). Obe skupini bodočih učiteljev biologije kažeta poznavanje pedagoških pristopov, ki so uveljavljeni v VITR, npr. aktivno (transformativno) poučevanje in učenje.


V prihodnjih raziskavah bi bilo zanimivo primerjati, kakšno je razumevanje TR in VITR med učitelji začetniki in izkušenimi učitelji ter študenti v prvem in zadnjem semestru študija na Pedagoški fakulteti. Lahko bi primerjali znanje in razumevanje študentov splošne biologije in pedagoške smeri.
7 REFERENCES


Bezeljak P. An understanding of sustainability and education for sustainable development among students teachers of biology. Master Thesis. Ljubljana, University of Ljubljana, Faculty of Education, 2018


Loughran J., Berry A. and Mulhall P. (2012). Understanding and developing science teachers' pedagogical content knowledge (2nd), Sense Publishers, Rotterdam, The Netherlands


Bezeljak P. An understanding of sustainability and education for sustainable development among students teachers of biology. Master Thesis. Ljubljana, University of Ljubljana, Faculty of Education, 2018


Bezeljak P. An understanding of sustainability and education for sustainable development among students teachers of biology. Master Thesis. Ljubljana, University of Ljubljana, Faculty of Education, 2018


8  APPENDICES

8.1 Appendix 1 - Questionnaire in German language

FRAGEBOGEN

Persönliche Daten

Studienort: _________________________________

Aktuelles Semester: __________________________

Alter: _______________________________________

Studiertes Lehramt:

• AHS
• Gymnasium
• Bachelor study
• Master degree

Zweites Fach: _______________________________

TEIL 1

Frage 1:


___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Frage 2:

 Wie würden Sie den Begriff „nachhaltige Entwicklung“ definieren/beschreiben?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

___________________________________________________________________________
Frage 4:
Was verstehen Sie unter „Bildung für eine nachhaltige Entwicklung“?

Frage 5:
Wo würden Sie eine „Bildung für eine nachhaltige Entwicklung“ im Kanon der Schulfächer verorten?
Das drei-Säulen-Konzept der Nachhaltigkeit integriert die drei gleichberechtigten Dimensionen Ökologie, Ökonomie und Soziales. **Dieses drei-Säulen-Konzept habe ich explizit kennen gelernt:**

- …im Biologiestudium
- …im Studium des zweiten Faches
- …im Studium der Erziehungswissenschaften/Pädagogik
- …durch andere Quellen (Medien, Internet)

Nachhaltige Entwicklung meint, die Bedürfnisse der heutigen Generation zu befriedigen, ohne zu gefährden, dass künftige Generationen ihre Bedürfnisse nicht mehr befriedigen können (Brundtland-Bericht). **Dieses Konzept kenne ich:**

- … aus dem Biologieunterricht
- … aus dem Studium des zweiten Faches
- … aus dem Studium der Erziehungswissenschaften/Pädagogik
- … aus anderen Quellen (Medien, Internet)

Bildung für nachhaltige Entwicklung soll Gestaltungskompetenzen vermitteln, um die Zukunft im Sinne nachhaltiger Entwicklung gestalten zu können. Dies umfasst partizipatives Lernen, innovative Strukturen und interdisziplinäres Wissen. **Dieses Konzept kenne ich:**

- … aus dem Biologieunterricht
- … aus dem Studium des zweiten Faches
- … aus dem Studium der Erziehungswissenschaften/Pädagogik
- … aus anderen Quellen (Medien, Internet)

Ich halte das Thema Bildung für nachhaltige Entwicklung für so wichtig, dass es im Biologieunterricht der Sekundarstufe I behandelt werden sollte.

Ich halte das Thema Bildung für nachhaltige Entwicklung für so komplex, dass es in nur im Biologieunterricht der Sekundarstufe II behandelt werden sollte.

Ich kann mir vorstellen, Bildung für nachhaltige Entwicklung später in meinem eigenen Biologieunterricht zu thematisieren.
Frage 6:
Bitte umreißen Sie, welche Vorkenntnisse SuS über Nachhaltigkeit und nachhaltige Entwicklung mit in den Unterricht bringen.

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Frage 7:
Welche Themen und Inhalte bieten sich Ihrer Meinung nach im Biologieunterricht an, um Bildung für nachhaltige Entwicklung umzusetzen?

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Frage 8
Welche Methoden halten sie für besonders geeignet, um im Biologieunterricht Frage der BnE umzusetzen?

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

___________________________________________________________________________

Frage 9
Für wie wichtig halten Sie eine Bildung für nachhaltige Entwicklung auf einer Skala von 0 bis 10?
(1 = überhaupt nicht wichtig, 10 = äußerst wichtig)

a) im Allgemeinen _______

b) im Biologieunterricht _______
8.2 Appendix 2 - Questionnaire in Slovenian language

VPRAŠALNIK

Splošni in demografski podatki

Kraj, v katerem študirate: ____________________

Letnik študija: __________________________

Dokončana izobrazba:

☐ srednja sola  ☐ gimnazija  ☐ prva bolonjska stopnja  ☐ druga bolonjska stopnja

Starost: ______________

Drug predmet študija:

☐ Kemija  ☐ Fizika  ☐ Gospodinjstvo  ☐ drugo ______________

DELI

Vprašanje 1:

Katere asociacije povezujete s pojmom trajnost? Naštejte 15 pojmov.

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________

Vprašanje 2:

Kako bi definiral/opisali pojem trajnostnega razvoja?

_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
_________________________________________________________________________
Vprašanje 3:
Kaj razumete pod pojmom vzgoja in izobraževanje za trajnostni razvoj?
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Vprašanje 4:
Pri katerih šolskih predmetih se vam poučevanje s poudarkom na trajnostnem razvoju zdi izvedljivo in primerno?
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
Bezeljak P. An understanding of sustainability and education for sustainable development among students teachers of biology. Master Thesis. Ljubljana, University of Ljubljana, Faculty of Education, 2018

**DEL 2**

| Definicija trajnostnega razvoja je sestavljena iz treh dimenzij: ekonomske, okoljske in socialne dimenzije. **Z definicijo trajnostnega razvoja, ki temelji na treh dimenzijah se bil/a seznanjena:** |
|---|---|---|
| …v času študija predmetov smeri biologija. | Ja | Ne | Ne ve m. |
| …v času študija predmeta druge smeri. | | | |
| …v času študija temeljnih pedagoških predmetov. | | | |
| …iz drugih virov (mediji, internet). | | | |

| Brundtlandina komisija je oblikovala definicijo trajnostnega razvoja kot zadovoljiti trenutne potrebe, ne da bi pri tem ogrožali zadovoljevanje potrebi prihodnjih generacij. **S to definicijo Brundtlandove komisije sem bil/a seznanjena:** |
|---|---|---|
| …v času študija predmetov smeri biologija. | Ja | Ne | Ne ve m. |
| …v času študija predmeta druge smeri. | | | |
| …v času študija temeljnih pedagoških predmetov. | | | |
| …iz drugih virov (mediji, internet). | | | |

| “Vzgoja za trajnostni razvoj je vseživljenjsko prizadevanje, ki spodbuja posameznike, institucije in družbe, da gledajo na jutri kot dan, ki pripada vsem nam – ali pa ne bo pripadal nikomur.” **S to definicijo vzgoje in izobraževanja za trajnostni razvoj sem bil/a seznanjena:** |
|---|---|---|
| …v času študija predmetov smeri biologija. | Ja | Ne | Ne ve m. |
| …v času študija predmeta druge smeri. | | | |
| …v času študija temeljnih pedagoških predmetov. | | | |
| …iz drugih virov (mediji, internet). | | | |

| Menim, da bi morali vključiti elemente izobraževanja za trajnostni razvoj pri pouku biologije v zadnjo triado osnovne sole. |
|---|---|---|
| Ne strinja m se. | Delno se strinja m. | Strinja m. | Popolno ma se strinjam. |

| Menim, da bi morali vključiti elemente izobraževanja za trajnostni razvoj pri pouku biologije v srednjo solo. |
|---|---|---|
| Ne strinja m se. | Delno se strinja m. | Strinja m. | Popolno ma se strinjam. |

| Znam si predstavljati, da bom v svoje poucevanje biologije vkljucil-a elemente izobraževanja za trajnostni razvoj. |
|---|---|---|
| Ne strinja m se. | Delno se strinja m. | Strinja m. | Popolno ma se strinjam. |
DEL 3

Vprašanje 6:
Na kratko opišite, kakšno je predznanje učencev v zadnji triadi osnovne šole na področju trajnostnega razvoja.

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Vprašanje 7:
Katere učne vsebine po vašem pri pouku biologije ponujajo možnost navezave na trajnostni razvoj?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Vprašanje 8:
Katerih metod bi se poslužili pri vključevanju elementov izobraževanja za trajnostni razvoj pri pouku biologije?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Vprašanje 9:
Kako bi na lestvici od 1 do 10 ocenili pomembnost vzgoje in izobraževanja za trajnostni razvoj?
(1 = sploh ni pomembno, 10 = je zelo pomembno)

Na splosno ______

Pri pouku biologije ______
8.3 Appendix 3 – Results of T-test and Chi-square test

Results of T-test

Education for sustainable development

<table>
<thead>
<tr>
<th>Group Statistics</th>
<th>ID</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
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<tr>
<td>Slovenian</td>
<td>60</td>
<td>2.65</td>
<td>.659</td>
<td>.085</td>
<td></td>
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<tr>
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<td>.813</td>
<td>.105</td>
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<td>.709</td>
<td>.092</td>
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<td>2.30</td>
<td>.850</td>
<td>.110</td>
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<td>60</td>
<td>2.52</td>
<td>.873</td>
<td>.113</td>
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Independent Samples Test

Levene's Test for Equality of Variances

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<tr>
<th>F</th>
<th>Sig.</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
<th>95% Confidence Interval of the Difference</th>
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</thead>
<tbody>
<tr>
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<td>3.046</td>
<td>.083</td>
<td>1.233</td>
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<td>.167</td>
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<td>.045</td>
<td>2.450</td>
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<td>.675</td>
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<td>.117</td>
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<tr>
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<td>.017</td>
<td>.675</td>
<td>99.591</td>
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<td>.117</td>
</tr>
</tbody>
</table>

Students’ opinion about Education for sustainable development in society in general and in biology lesson

Group Statistics

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<th>ID</th>
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<th>Austrian students</th>
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</thead>
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<tr>
<td>Ingeneral</td>
<td>Slovenian students</td>
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<tr>
<td></td>
<td>Austrian students</td>
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</table>
Results of Chi-square test

Three pillars of sustainability

Biology lesson

Chi-Square Tests

<table>
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<th>Value</th>
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<th>Asymptotic Significance (2-sided)</th>
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<td>.175</td>
</tr>
<tr>
<td>3.544</td>
<td>2</td>
<td>.170</td>
</tr>
<tr>
<td>3.291</td>
<td>1</td>
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</table>

N of Valid Cases 120

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.50.

Another subject

Chi-Square Tests

<table>
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<th>Asymptotic Significance (2-sided)</th>
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</tr>
<tr>
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<td>2</td>
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</tr>
<tr>
<td>22.781</td>
<td>1</td>
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</tr>
</tbody>
</table>

N of Valid Cases 120

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.00.
Educational study

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymptotic Significance (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>4.195a</td>
<td>2</td>
<td>.123</td>
</tr>
<tr>
<td>Likelihood Ratio</td>
<td>4.323</td>
<td>2</td>
<td>.115</td>
</tr>
<tr>
<td>Linear-by-Linear Association</td>
<td>2.812</td>
<td>1</td>
<td>.106</td>
</tr>
<tr>
<td>N of Valid Cases</td>
<td>120</td>
<td></td>
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</tr>
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</table>

a. 0 cells (0.0%) have expected count less than 5.
The minimum expected count is 9.00.

Other sources

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>3.055a</td>
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<tr>
<td>Likelihood Ratio</td>
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<td>.215</td>
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<td>Linear-by-Linear Association</td>
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<tr>
<td>N of Valid Cases</td>
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<td></td>
<td></td>
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</tbody>
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a. 0 cells (0.0%) have expected count less than 5.
The minimum expected count is 8.50.

BRUNDTLAND’S DEFINITION

Biology lesson

<table>
<thead>
<tr>
<th>Chi-Square Tests</th>
<th>Value</th>
<th>df</th>
<th>Asymptotic Significance (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
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<td>N of Valid Cases</td>
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<td></td>
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</tr>
</tbody>
</table>

a. 0 cells (0.0%) have expected count less than 5.
The minimum expected count is 6.00.
Bezeljak P. An understanding of sustainability and education for sustainable development among students teachers of biology. Master Thesis. Ljubljana, University of Ljubljana, Faculty of Education, 2018

Other subject

Chi-Square Tests

<table>
<thead>
<tr>
<th></th>
<th>Value</th>
<th>df</th>
<th>Asymptotic Significance (2-sided)</th>
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<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>10,736$^a$</td>
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<td>.005</td>
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<td>.012</td>
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Note: 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.00.

Educational study

Chi-Square Tests

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</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>2,863$^a$</td>
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<td>Likelihood Ratio</td>
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Other sources

Chi-Square Tests

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</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>16,141$^a$</td>
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<td>Likelihood Ratio</td>
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<td>N of Valid Cases</td>
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Note: 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.50.
EDUCATION FOR SUSTAINABLE DEVELOPMENT

Biology study

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<tbody>
<tr>
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<td>Likelihood Ratio</td>
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<tr>
<td>N of Valid Cases</td>
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a. 0 cells (0.0%) have expected count less than 5.
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Other subject

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<tr>
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<tbody>
<tr>
<td>Pearson Chi-Square</td>
<td>46.063$^a$</td>
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<tr>
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Educational study

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<tbody>
<tr>
<td>Pearson Chi-Square</td>
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<td>Likelihood Ratio</td>
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a. 0 cells (0.0%) have expected count less than 5.
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### Chi-Square Tests

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<th>Asymptotic Significance (2-sided)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Chi-Square</td>
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<td>.335</td>
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<tr>
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*a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.50.*