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Summary of the PhD Thesis

CONTRIBUTIONS REGARDING SUSTAINABILITY IN UNIVERSITIES

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CONTRIBUTIONS REGARDING SUSTAINABILITY IN UNIVERSITIES

Table of Contents

Key words

Sustainable development; sustainability education; sustainable university model; instruments for the transition towards the sustainable university; innovative pedagogies; sustainability info-platform; decision support system.

Phd Thesis Summary

"The volume of education has increased and continues to increase, yet so do pollution, exhaustion of resources, and the dangers of ecological catastrophe. If still more education is to save us, it would have to be education of a different kind: an education that takes us into the depth of things."

(E.F. Schumacher)

The World Commission on Environment and Development of the United Nations, led by Gro Harlem Brundtland, Prime Minister of Norway, in 1987 introduced a new concept, related to environmental issues and human society: "*Sustainability (as sustainable development) is development that meet present needs without compromising the ability of future generations to meet their own needs*" (UN, 1987). In this often cited definition appears the idea that the natural environment faces stress factors and overexploitation, and may not meet the growing needs of the people indefinitely.

For many of the challenges associated with sustainability, there can found connections with how modern societies produce and consume, with poverty issues or with those related to pollution and destruction of ecosystems. To solve these problems, new approaches are needed. In terms of sustainability, science cannot exist in a vacuum; it must interact with policy, legislation, the government, which come into the daily life of people. Economic factors structure how, where and how much the environment will be exploited. Communication between different sectors, which too often exist as compartmentalized units, is crucial. Scientists concerned about the environment can no longer be satisfied just to do "good" science; dialogue and persuasion become important parts of the scientist's role.

The call for Higher Education to take a leading role in education for sustainability, for a more sustainable future is more insistent. Education is recognized worldwide as a critical platform to enable all sectors of society to learn to manage change and make the transition to sustainable practices. Therefore, there is increasing emphasis on the role of formal education sector, in partnership with the community as a key player in facilitating the education of society, necessary to meet the growing challenges posed by environmental and social components of sustainable development. In addition, there is an expectation of the society that universities will play an important role in facilitating education that allows current and future generations to re-design their personal and professional activities to create a sustainable future.

1 The context of the research

One of the few areas of academic study that can compete with sustainability, in terms of multiplicity and plurality of definitions, is education (Cook et al, 2010). Not surprisingly, attempts to combine these two concepts into concepts such as *Education for Sustainable Development*, *Education for Sustainability* and *Sustainability Education*, have produced over the last two or three decades a significant amount of literature focused on definitions, sometimes reaching competitions in this respect, which

Shallcross and Robinson (2007) describe as "definitions dementia". These definitions are undoubtedly important, but authors like Rootes (2007) consider them responsible for distracting the academic community from more pragmatic actions.

The importance of sustainable development of society has been realised, and hence sustainability of higher education institutions. This doctoral research performed during the period 2009 - 2012 aimed at finding the main methods, models and tools to facilitate the transition of a university towards the sustainable university.

In the last years efforts have been made regarding this issue, but are these contributions truly effective to advancing sustainability, or do they have the role to ensure us that we are doing something? Do we not spend too much time to approve declarations and bold strategies, without realizing the fact that the formal education system as presently organized is unable to address this complex issue? (Cook et al, 2010).

2 The importance of the research

The research topic, "Contributions to the sustainability of universities" is part of the scientific research field of Engineering and Management. The originality of the work consists of the development of a recommended model for the sustainable university, developing an online tool to facilitate information, interaction and cooperation of teachers and students to facilitate the transition towards the sustainable university, an analysis of the Romanian universities on matters related to their involvement in transformation process towards sustainable universities. Also, a study in Romanian companies on the importance given by the employers to sustainability literacy and skills of the candidates, and a study concerning the efficiency of interdisciplinary teaching methods in education for sustainability are other elements of originality. This thesis also proposes a detailed process for the transition towards the sustainable university, based on the principles of IDEF0 diagrams. Alternative teaching methods such as movie making, outdoor activities and using Facebook for attracting students have been tested and assessed, and together with the suggestion of involving global networks for knowledge sharing constitute elements of originality.

The proposed research topic is a topical issue. The nature of sustainability requires fundamental changes to epistemology, and therefore education. Changes in curriculum, pedagogy, policies and institutional structures are necessary. The model proposed in Chapter 5 of this work attempts to trace the profile of the sustainable university and the actions necessary for the transition towards the sustainable university. Stephen Sterling contends that it is necessary to transform "higher education towards integrative and holistic education, involved in a systemic approach to sustainability in education and society" (Sterling, 2004).

The importance of sustainability in higher education has been highlighted by the academic society and by numerous international organisms. Agenda 21, the document emerging from the UNCED

conference in Rio (1992), identifies education as "crucial for promoting sustainable development and improving people's ability to address environmental and development issues."

Declaration by the UNESCO of the decade 2005-2014 as the Decade of Education for Sustainable Development once again underlines the importance of the research. According to UNESCO,

> "universities must function as centres of research and learning for sustainable development ... higher education should provide leadership by practicing what they teach, by acquiring sustainable investment and facilities that are integrated into teaching and learning ... Higher Education should focus on systemic, interdisciplinary, experiential approaches, based on investigation and problem solving and critical thinking "(UNESCO, 2004).

International alliances, consortia and networks of universities have promoted the involvement of institutions of higher education in sustainability issues. Talloires Declaration, a document resulting from the meeting of university presidents, chancellors and rectors to share their concerns about the state of the planet, emphasizes that education must play an important role in promoting a sustainable future (ULSF, 1990). This significant progress in declaring involvement in sustainability issues by the universities emphasizes the timeliness and importance of the chosen research topic.

3 The structure of the thesis

The thesis is divided into nine chapters, and the content is presented schematically in Figure 1.1.

After the first, introductive, chapter the current state of knowledge in the area of sustainability education, identified through literature review is presented in the second chapter. Chapter three shows the results of the research concerning the Education for Sustainability in Romanian Universities and chapter four consists of an exploratory research on the importance given to Education for Sustainability in Romanian companies. These three studies highlight the need of Sustainable Education in Romania. Thus, in the fifth chapter a model of the sustainable university is proposed, together with a well-structured process of transition towards the sustainable university. The following chapters present case studies at the University of Aberdeen and “Lucian Blaga” University of Sibiu, that recommend education as an important and efficient tool for raising awareness and developing skills and competencies to students. New teaching methods are tested and evaluated and the students who attended these courses have been interviewed.

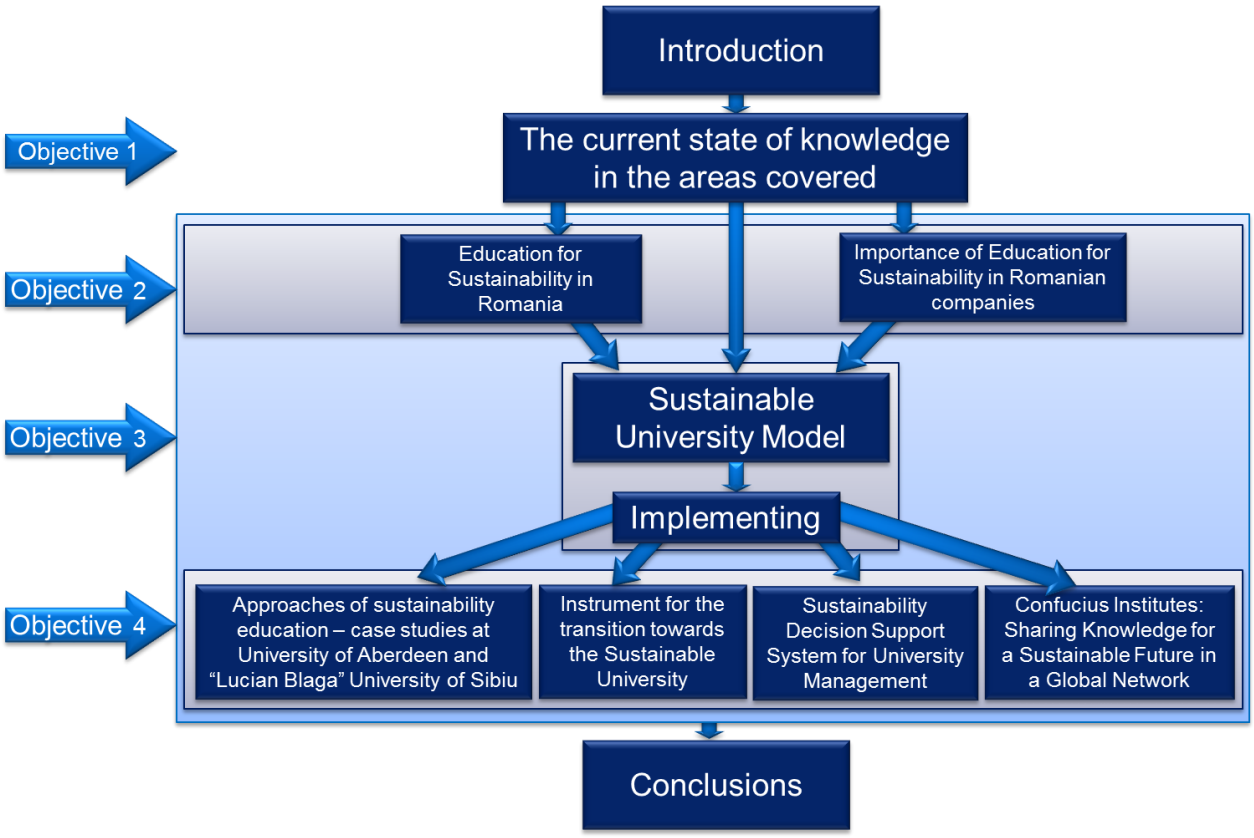

Figure 1 1Structure of thesis

The present work also proposes an instrument for the transition towards the sustainable university, based on Web 2.0 technologies, which is described in chapter eight. Another tool to assist university managers in the transition process towards the sustainable university has been developed – namely the sustainability decision support system. For an easier access and usage, the algorithm used in the decision support system has been made user friendly and encoded in an extension for Joomla! 1.5. Thus, any web developer can integrate this tool into any website built with Joomla! 1.5. The paper also contains a chapter which highlights the importance of knowledge sharing for fostering sustainable lifestyles and analyses the Confucius Institutes as key institutions that can be engaged into the process of sharing knowledge for a sustainable future. The work ends with a chapter that sums up the conclusions of all the undertaken researches, underlines the original contributions of the author and proposes future research directions.

4 Research hypotheses

Through the researches that have been undertaken during his doctoral stage, the author tried to find the answer to the questions "How should the sustainable university look like?" and "What should a university do in order to become sustainable?" With these questions in mind the following assumptions were made that led to the research:

- Hypothesis 1. Most universities realize the importance of sustainability and are concerned by these issues.
- Hypothesis 2. Most companies in Romania are aware of the importance of sustainability and appreciate the environmental and sustainability knowledge of their employees or job applicants.
- Hypothesis 3. Interdisciplinary approach to teaching sustainability and trying to provide a holistic view to the students are effective ways to transform society in a sustainable way.
- Hypothesis 4. Most teachers face obstacles in the implementation of sustainability in teaching.
- Hypothesis 5. Most teachers know and use Web tools to improve prospects for sustainability.

To confirm / refute the hypotheses there were conducted extensive bibliographic research, desk research and field research by applying questionnaires, direct observations, focus groups and interviews. Quantitative research generally had an exploratory and descriptive character, and interviews, focus groups and observations were used to confirm the results obtained from the quantitative research. Following the undertaken studies the author developed a model of the Sustainable University, the actions necessary for the transition to sustainable university and two tools to facilitate the transition towards the sustainable university.

5 Research goals

The overall objective of the doctoral internship is the generation of new knowledge within the chosen research topic, namely finding the answer to the questions "How should the sustainable university look like?" and "What should a university do in order to become sustainable?", and completing the thesis within the planned timeframe (three years).

The goal of the research is to study the concept of sustainability and the role and responsibilities of universities to promote a sustainable future, to identify directions and develop a model for the sustainable university, together with recommendations for its implementation and two intervention tools that allow Romanian university managers to arrange for the transition towards the sustainable university that will prepare future generations for a sustainable future.

The aims of the research, referred to in figure 1.1, are:

- **Objective 1** aims at understanding the concept of sustainability and the different approaches to this concept, identifying the actions of the international community for sustainability and the EU strategy for sustainable development. Also, this objective seeks to clarify the link between education and sustainability and the role of universities in the transformation of the society for a sustainable future.
    - Activities:
        - Documentation for the theoretical basis of the thesis.
- **Objective 2** seeks to establish the degree of implementation of sustainability in Romanian universities, but also to identify the importance given by Romanian companies to the sustainability

and environmental knowledge of their existing or future employees. In short, objective 2 aims to highlight the importance of education for sustainability.

- Activities:
  - Literature review;
  - Focus group with leaders of Romanian universities;
  - Analysis of discussions and activities within the discussion groups and outlining the current state of sustainability in Romania and identifying key changes needed, from the point of view of Romanian university leaders;
  - Making a quantitative research to identify the importance given to education for sustainability in Romanian companies;
  - Analysis and discussion of the results gained with the questionnaire.

- **Objective 3** aims to develop a model for the sustainable university and outline the activities that a university is required undertake in order to transform into a sustainable one. The model attempts to identify what universities should do to become sustainable, how to implement the changes and what are the conditions for their implementation.
  - Activities:
    - Literature review;
    - Critical approach to existing models and their improvement by combining multiple models and introducing the recommendations resulting from focus groups.
    - Developing an IDEF0 diagram for the transition process towards a sustainable university.
- **Objective 4** aims to identify the effectiveness of interdisciplinary teaching and developing two tools to facilitate overcoming obstacles in the transition to sustainable university. The potential that a global network, such as the one of the Confucius Institutes, for fostering sustainable lifestyles is also assessed.
  - Activities:
    - Literature review;
    - Observation of teaching (lectures and seminars) at the University of Aberdeen, for identification of best practices;
    - Developing interviews with students registered in the "Sustainability: Challenges and Opportunities" at the University of Aberdeen;
    - Making a longitudinal, quantitative research (at the beginning and end of the course), to identify the impact of the course "Sustainability: Challenges and Opportunities" at the University of Aberdeen on students, analysing knowledge, skills, attitudes, efforts to transform society sustainable one;
    - Developing an experimental course at “Lucian Blaga” University of Sibiu (LBUS), that integrates teaching techniques that have been successfully used at the courses given at the University of Aberdeen (in the interdisciplinary course “Sustainability:

Challenges and Opportunities" and in the outdoor course "Body, Mind and Nature") and experimenting new pedagogies for teaching sustainability.

- Assessing the impact of the experimental course at LBUS and the efficiency of the experimented pedagogies, through an online feedback form.
- Making a quantitative descriptive and exploratory research to identify the main obstacles faced by teachers in the transition towards the sustainable university. The research also investigates the web-literacy of teachers and their availability to use the Internet for information and collaboration with other teaching staff;
- Developing an online platform using Web 2.0 technologies to facilitate information and collaboration within teachers. The platform contains a discussion forum for sharing best practices, problems and obstacles faced by users. It also allows user to communicate in real time through a live chat and they have the possibility to comment, rate the content through a voting system, they can download documents or access useful resources online;
- Developing a sustainability decision support system that aims to help university managers in the transition process towards the sustainable university. The decision support system has a user friendly interface and is can be easily integrated into any website.
- Identifying future research directions and conclusions of the undertaken research;
- Completion of the thesis.

6 Research Methodology

Research methodology calls for mixed research methods and techniques: both qualitative and quantitative. Data collection was made by literature review, direct observation, interviews, focus groups, field research and by working with teachers involved in teaching sustainability.

The questionnaires used in quantitative research were largely adapted from other questionnaires used in similar researches. The author used the questionnaire developed by the National Foundation for Environmental Education in the U.S. (NEEF, 2009), to identify the importance of education for sustainability given in Romanian companies. In assessing the effectiveness of interdisciplinary teaching at the University of Aberdeen a questionnaire was developed based on the Nature Relatedness Scale proposed by Nisbet et al. (2009) and New Ecological Paradigm Scale developed by Dunlap et al. (2000) to identify pro-environmental attitudes. The questionnaire used to assess the need for online tool for transition to sustainable university was designed to verify hypotheses established for the study. This questionnaire was developed based on literature review and was pre-tested on an appropriate sample. In all quantitative researches, questionnaires were distributed online, using dedicated web sites (freeonlinesurveys.com, Snap Questionnaire, Google Docs).

Recommended software was used in order to process the information gathered from the application of research methods and to conclude as objective. The author proceeded to: define the studied statistical community, develop methods of data collection, develop questionnaires, determine sample size and structure, process information, analyse and interpret information, draw conclusions.

The research was carried out according to classical stages:

- Problem determination and establishment of research objectives;
- Development of the research plan to collect data and information;
- Implementation of research by collecting and analysing data;
- Interpretation and analysis of results.

The research process began by creating a bibliographic research to determine the current state of knowledge in addressing sustainability in universities. The literature review was followed by discussion groups (focus groups) of the project to improve university management and the quantitative research on the importance given to education for sustainability in Romanian companies. The next stage of the research was the critical analysis of existing models for the sustainable university, and the proposal of an improved model and the actions necessary for the transition to sustainable university. The mobility period was used for the study of the impact of interdisciplinary teaching and for developing the tool for the transition towards the sustainable university. Following the completion of research there have been reached conclusions and future research directions have been identified and outlined in Chapter 10.

7 General Conclusions

The researches that underlie this work sought to find answers to the questions "How should the sustainable university look like?" and "What should a university do in order to become sustainable?"

After the first, introductive, chapter the current state of knowledge in the area of sustainability education, identified through literature review is presented in the second chapter. Chapter three shows the results of the research concerning the Education for Sustainability in Romanian Universities and chapter four consists of an exploratory research on the importance given to Education for Sustainability in Romanian companies. These three studies highlight the need of Sustainable Education in Romania. Thus, in the fifth chapter a model of the sustainable university is proposed, together with a well-structured process of transition towards the sustainable university. The following chapters present case studies at the University of Aberdeen and “Lucian Blaga” University of Sibiu, that recommend education as an important and efficient tool for raising awareness and developing skills and competencies to students. New teaching methods are tested and evaluated and the students who attended these courses have been interviewed. The present work also proposes an instrument for the transition towards the sustainable university, based on Web 2.0 technologies, which is described in chapter seven. Another tool to assist university managers in the transition process towards the sustainable university has been developed – namely the sustainability decision support system. For an easier access and usage, the algorithm used in the decision support system has been made user friendly and encoded in an extension for Joomla! 1.5. Thus, any web developer can integrate this tool into any website built with Joomla! 1.5. Chapter eight

shows teachers' opinions regarding the necessity and usefulness of the proposed online instrument. The paper also contains a chapter which highlights the importance of knowledge sharing for fostering sustainable lifestyles and analyses the Confucius Institutes as key institutions that can be engaged into the process of sharing knowledge for a sustainable future.

8 Conclusions regarding the approached topics

The nature of sustainability and the prospect of unsustainability require a change of lifestyle and therefore of education. Changes are necessary in curricula, pedagogy, policy and institutional structures. Teachers should be encouraged to reinterpret their disciplines in light of a sustainable development agenda. Hence, a teacher development priority must be the generation of means whereby teachers can begin to engage with ideas which will very likely lie beyond their experiences of working within their disciplines (Stables and Scott, 2002).

In the XXI-st century we inherit industrial and technological growth systems that destroy or deplete simultaneously natural resources and threaten human and nonhuman species, while providing the highest standard of material living and the highest rate of consumption that mankind has ever known. These modern industrial and technological development systems must be re-imagined and re-created in ways that are no longer based on non-renewable natural resources, on the use of natural resources at unsustainable rates, or which cause damage to people or the natural world, in the present or future (Tuli, 2009).

It is recognized that environmental problems cannot be solved just by searching only a technological solution. Education is considered crucial for sustainable development (McKeown, 2002) and for improving people's ability to solve environmental problems. It also plays an important role in changing people's behaviour to their environment. According to Sterling (1999b), "*education is proclaimed at a high level as the key to a more sustainable, yet plays a role in reproduction of daily unsustainable society. If we were to fulfil its potential as an agent of change towards a more sustainable, sufficient attention should be paid to education as a subject of change itself*" (Sterling, 1996b).

The UN works to provide a new approach to current practice in education, leading to a more sustainable future. UNESCO declared the period 2005-2014 the Decade of Education for Sustainable Development. This new approach tries to go beyond education and the environment, and focus on equipping students with the skills necessary to take active measures to address a number of issues of sustainability. Governments, countries and nations must assume international environmental obligations and concerns to take into account the provision of education for sustainable development (ESD) in all formal and informal education sectors (Tuli, 2009).

Regarding the situation of Education for Sustainable Development in Romania, we can say that although it is mentioned in the mission and objectives of the National Education Act, the National Education Pact and the Strategy "Education and Research for the Knowledge Society", there has been made little progress in this direction in Romanian schools, compared with other states. There is a lack of coordination between the legislative acts and the National Strategy for Sustainable Development of

Romania, in which there were fixed objectives and horizons for connecting Romania to a new philosophy of development, imposed by the European Union and widely shared around the world - the sustainable development.

The research presented in chapter 4 of the present work shows that Romanian companies are giving increasing importance to the sustainability and environmental literacy of their employees and candidates. The objective of education on environmental sustainability for the employees is to help organizations to engage their employees directly, and enable them to address their actions towards the achievement of a superior performance in terms of sustainability. Thus, companies can produce innovative changes in the business process, reduce costs and their impact on the environment and society, or inspire employees to make sustainable decisions at home or in their communities. The starting point is the organizational culture of each company, and the employees' engagement to turn the organization's values and commitments on sustainability into reality.

This study highlights the importance of education for sustainability - which if done in higher education institutions - can reduce training costs of the companies, may facilitate synchronization of programs and sustainability efforts with business objectives. Benefits of implementing environmental and social initiatives must be quantified and expressed in business terms as relevant benefits in the medium and long term, to induce managers to make sustainable development a priority. Universities must educate future leaders of corporations and their employees to convince them that the adoption of responsible business strategies in terms of sustainability is a "win-win-win proposal for companies, environment and the society" (Willard, 2004).

The literature review, the recommendations of international organizations, of the academic society and the analysis of the current situation in Romanian universities and companies highlight the necessity of Education for Sustainable Development in Romanian Higher Education.

Sustainable development is the biggest challenge to universities in the twenty-first century (van Weenen, 2000). Since there are many different definitions and interpretations of the concept, the strategies of the universities that are beginning to strive for sustainability show some differences. Various universities have already become engaged in the process of integrating sustainable development in their activities (van Weenen, 2000).

The sustainable university is not easy to be achieved, but all the efforts, energy, resources and time invested in many universities around the world show progress (Velazquez et al, 2006). Implementing the model for a sustainable university, described in chapter 5, should be made through incremental steps, as shown, and should be a process of continual improvement in environmental, economic and social performance.

Universities have different approaches of the transformation process towards a sustainable university. Some incorporated sustainability in their visions and missions; others focus on sustainability education or research integration, while others have created environmental policies or campus strategies, but what is desirable is an approach that incorporates all the components of the model. A holistic approach, based on the proposed model can transform the university into a sustainable one, encouraging

students, professors and other members of the academic community to commit themselves to help society make the transition towards sustainable life styles.

The research goes on to investigate the implementation of the proposed model. The research presented in chapter 6 outlines that education is an essential tool for achieving sustainability. The case studies at the University of Aberdeen and "Lucian Blaga" University of Sibiu generated recommendations for teaching sustainability. The experience of using poster presentations as a method of assessment in Sustainability Education seems to be an efficient way of teaching through assessment and of developing presentation skills. It proves to be a trustworthy instrument for formative assessment of the learning and most of the students found this an enjoyable, challenging and rewarding experience. The innovative teaching method, with ten different lecturers with different fields of expertise, appears to be appreciated by the students, although some consider it "weird" and prefer having one tutor. However, this interdisciplinary approach offered the students a holistic perspective on the sustainability issues, making them aware of the multitude of factors and barriers in the transition towards a more sustainable society. And as one of the students mentioned in the interview, they learned that not always "*problem + knowledge = solution"*.

The overall message from this empirical research is encouraging. Sustainability concerns are significant for students and they are aware of their important role in the society and their responsibilities to ensure that the future generations will have the same chances of present generations to meet their needs. The courses taught at the University of Aberdeen and LBUS, through their character, managed to equip students not only with specific knowledge about these issues, but also with practical skills. such as locating and using research material, and selecting material from an extensive reading list, making effective use of IT for information retrieval and written presentation, developing and presenting arguments, giving effective presentations, group participation, etc. were also developed by the students who attended this course.

These case studies at the University of Aberdeen and "Lucian Blaga" University of Sibiu proved that education is an effective means for informing the population about the sustainability issues and for shaping their behaviour in order to achieve a sustainable society.

Teaching sustainability through movie-making activities is a new pedagogic approach that has proven to be very effective, as it is considered to be entertaining and challenging by the students. This is applicable for small groups of students and should be complemented by other teaching methods that have been experimented before.

The analysis of the feed-back forms filled in by the students seem to support that the chosen method was a successful one as it managed to develop an interdisciplinary understanding of complex issues in sustainability. Students gained knowledge, skills and competences for effectively and persuasively link knowledge and values in dealing with sustainability.

Furthermore it is recommended that a toolkit is developed to facilitate higher education institutions in incorporating sustainability within curricula. These recommendations have been considered

and, in chapter 7 of this work, an instrument for overcoming barriers in the transition towards the sustainable university is proposed.

Interdisciplinarity is considered to be the best method of approaching sustainability teaching, but in order to implement that in universities, lecturers must be informed about the principles of sustainable development, the responsibilities that they have in modelling the new generation and the benefits of interdisciplinary teaching. Due to organizational cultures of universities and natural human resistance to change, a series of barriers occur in the process of transition towards sustainability interdisciplinary teaching. Barriers such as lack of awareness, lack of information or resources for the teachers in order to engage in teaching sustainability could be overcome by the proposed instrument - a website (Grecu and Deneș, 2011).

The website presented in chapter 7 is not the only tool that the author developed to support the transition towards the sustainable university. Another instrument was developed to support decision making and therefore, university managers and decision makers have the possibility to use the Sustainability Decision Support System. The used algorithm is fairly complicated and requires good mathematical skills. In order to make the tool more accessible and easy to use, the Sustainability Decision Support System has been encoded in a Joomla! 1.5 extension and can be easily integrated in any website.

Chapter 8 consists of a research, conducted at "Lucian Blaga" University of Sibiu, which highlighted the need of the proposed website – as an instrument for the transition towards the sustainable university. Most of the lecturers appreciate the usefulness of an online info-platform for easy access to relevant information, examples and suggestions, collaboration and discussion with other learners or students. The features available in the developed platform foster collaboration and an easier integration of sustainability into teaching and learning practices.

The excellent attitudes of the lecturers regarding the issues of sustainable development and their awareness that universities have an important role in shaping the society encourage the implementation of the online info-platform. The web literacy of the lecturers ensures a good usage of the platform and good premises for a successful implementation.

It is encouraging that 86% of the respondents are willing to change their courses and teaching methods in order to switch from traditional education towards sustainable education, but 70% don't want to be told by their superiors what to do. The research confirmed the theory of Jones et al (2010), that academic staff sees education for sustainable development as an imposition, but the research results infirmed the ideas that sustainability is considered by lecturers as something that is not commensurate with their discipline or that they lack the knowledge, skills and expertise to implement sustainability related teaching and learning.

Thus, a legal framework to regulate sustainable education in Romania is demanded, both by the concerns of the international community, by companies that operate in Romania, by students and by lecturers, who are preoccupied by the future of our Planet.

Chapter 9 proposes another approach of fostering sustainable lifestyle. The global network of the Confucius Institutes can be channeled to support the principles of sustainable development. Despite the

complexity and interdependence of global situational variables, the leadership and knowledge sharing experiences of the Confucius Institutes offer valuable lessons for academic researchers as well as managers of for-profit and non-profit organizations (Li et al, 2009).

As shown in the holistic approach of sustainability in CIs, the Confucius Institute can engage in this global challenge to promote sustainable behaviors for the future societies by implementing the principles of sustainability into all its activities and using its well-developed world-wide network to meet this goal.

9 Main original contributions

The Original contributions made in the thesis cover both theoretical and practical –applicative aspects. The main contributions are presented below.

9.1 Theoretical contributions

- Synthesis of the main theoretical approaches of the concepts of sustainability and sustainability education;
- Synthesis of the main actions, conferences, treaties or conventions of the International Community that generated declarations, resolutions or sets of guidelines and policy recommendations, institutional measures and sustainable funding mechanisms.;
- Schematic interpretation of the key objectives of EU policies from the point of view of sustainable development;
- Original interpretation of the role of education for sustainability in relation with higher education institutions;
- Synthesis of the strategic objectives of the Romanian National Strategy for Sustainable Development;
- Critical analysis of the relationship between economic growth and sustainable development;
- Synthesis of emerging concepts at the sustainability/industry interface;
- Defining sustainable innovation;
- Comparative analysis of the importance given to sustainability education by companies in Romania and USA;
- Synthesis of the challenges and opportunities of Education for Sustainable Development and the skills and competences that it implies;
- Synthesis of sustainability pedagogies and teaching methods that have been advocated to sustainability and highlighting the changes needed to reorient teacher education to address sustainability;
- Identifying good practices of sustainability education and curriculum design;
- Synthesis of the main barriers and inhibitors to incorporating sustainability into teaching practices and proposing enabling approaches;

9.2 Practical-applicative contributions

9.2.1 Conducting studies and researches that confirmed that education is an essential element for reaching sustainability

- Assessment of the current situation of Sustainability Education in Romanian universities;
    - Analysis of university management;
    - Analysis of students' efforts and perceptions regarding sustainability;
    - Identification of the main obstacles to implementing sustainable development in Romanian universities;
    - Identification of the main changes required to transform the universities into sustainable ones;
- Study regarding the importance given to sustainability education in Romanian companies;
- Analysis of the effectiveness of interdisciplinarity in teaching sustainability;
- Investigating teachers' opinions regarding sustainability education and the need of a sustainability info-platform;

9.2.2 Developing and experimenting some teaching pedagogies

- Experiment new teaching pedagogies for sustainability education:
    - Learning through movie-making;
    - Learning through making posters and public presentations;
    - Using Facebook for raising awareness and involving students into sustainability projects;
    - Reconnecting with nature through outdoor activities;
- Validating the efficiency of the proposed pedagogies, showing that "poster presentations" and movie making"
    - are efficient methods of learning through assessment and of developing presentation skills,
    - prove to be trustworthy instruments for formative assessment;
    - are considered by most students to be an enjoyable, challenging and rewarding experiences;

9.2.3 Developing some managerial instruments to facilitate the transition towards the sustainable university

- Developing a model of the Sustainable University;
- Developing an IDEF0 diagram to explain the implementation process of the proposed model for the Sustainable University;
- Developing a strategy for the transition towards the sustainable university, by describing:
    - What universities should do in order to become sustainable;
    - How should the changes be implemented;
    - Which are the conditions for implementing the model;
- Developing an instrument for overcoming the barriers to incorporating sustainability into teaching practices, based on Web 2.0 technologies – the sustainability info-platform;

- Creating a mathematical algorithm that underlies the decision support system for the transition towards the sustainable university;
- Developing the online, useful and easy to use sustainability decision support system – a tool for university managers who seek to transform their university into a sustainable one;
- Proposing a strategy for fostering sustainable lifestyles through sharing knowledge for a sustainable future in the global network of Confucius Institutes;
- Developing a model of the holistic approach of sustainability in Confucius Institutes and a schematic presentation of the organization of Confucius Institutes that aim to promote sustainable lifestyles.

9.3 Extract of the personal contributions that have been disseminated, valued and published

The results and information gained following the undertaken researches have been disseminated and published in national and international journals, magazines, proceedings and conferences. Out of the 22 publications, contained in the references of this thesis, 11 were published as first author and one as unique author. There have been published 3 books, 7 articles in the volumes of some ISI conferences, 5 articles in B+ ranked journals and magazines, 5 papers in B ranked journals and 2 papers in the proceedings of international conferences. The 22 publications are presented as follows.

[1]. Butănescu-Volanin, R.C., Deneş, C. and **Grecu, V.** (2011), *Some Considerations on Economic Analysis of Conflict Management of the Firm*, Annals of the Constantin Brancusi University of Târgu Jiu, 2011, nr. 4, pp. 292-302,

[2]. Deneş, C. and **Grecu, V**. (2009), *Sweatshops in the Spotlight*, Acta Universitatis Cibiniensis, vol. LVIII, Technical series, Sibiu, pp. 83-88

[3]. Deneş, C. and **Grecu, V**. (2010) *Students' Perceptions on Sustainability in Higher Education – Case Study at "Lucian Blaga" University of Sibiu*, Annals of the Constantin Brancusi University of Târgu Jiu, 2010, nr. 4, pp. 328-338,

[4]. Deneş, C. and **Grecu, V**., (2011a) *Approach to Innovation and Sustainable Development in Higher Education*, Proceedings of the 5th International Conference on Manufacturing Science and Education – MSE , Sibiu, 2011, pp131-134

[5]. Deneş, C. and **Grecu, V**., (2011b) *Considerations on The Maintenance of Production Equipment*, Annals of the Constantin Brancusi University of Târgu Jiu, 2011, vol. 4, pp. 338-347

[6]. Deneş, C. and **Grecu, V**., (2012) *Innovating For Sustainable Universities*, Proceedings of the International Conference on Engineering & Business Education, Innovation and Entrepreneurship, Sibiu, Romania, 18 - 21 October, 2012, pp309-312

[7]. **Grecu, V**. (2010), *The Efforts and Perceptions Regarding Sustainability of Students From "Hermann Oberth" Engineering Faculty of Sibiu*, Acta Universitatis Cibiniensis, vol. LXI, Technical series, Sibiu, pp. 89-92.

[8]. **Grecu, V**. and Deneş, C. (2010a), *Comparison of Students' Knowledge, Awareness and Actions Concerning Sustainable Development*, Acta Universitatis Cibiniensis, vol. LXI, Technical series, Sibiu, pp. 93-96.

[9]. **Grecu, V.** and Deneş, C. (2010b), *Opinions, knowledge and attitudes of teachers from The Engineering Faculty of Sibiu towards Sustainable Development*, Acta Universitatis Cibiniensis, vol. LXI, Technical series, Sibiu, pp. 97-100.

[10]. **Grecu, V.** and Deneş, C. (2010c), *Assuring the Success of Change Through an Innovative Approach of Human Resource Management*, Acta Universitatis Cibiniensis, vol. LXI, Technical series, Sibiu, 2010, pp. 105-108.

[11]. **Grecu, V.** and Deneş, C. (2011a), *Changing Towards Sustainability Education – Trends, Barriers and Possible Solutions,* Annals of the Constantin Brancusi University of Târgu Jiu, no. 4, pp. 326-337

[12]. **Grecu, V**. and Deneş, C. (2011b), *Study on Sustainable Development of Romanian Universities*, Proceedings of the 5th International Conference on Manufacturing Science and Education – MSE , Sibiu, 2011. pp. 143-146

[13]. **Grecu, V**. and Denes, C. (2012a) *Sustainability Management in Romania: Challenges and Opportunities*, Proceedings of the 19th International Economic Conference: The Peristence of the Global Economic Crisis: Causes, Iimplications, Solutions, pp 203-212

[14]. **Grecu, V**. and Denes, C. (2012b) *Teaching Sustainability Through Movie Making Activities*, Proceedings of the International Conference on Engineering & Business Education, Innovation and Entrepreneurship, Sibiu, Romania, 18 - 21 October, 2012, pp313-318

[15]. **Grecu, V**. and Denes, C. (2012c) *A Decision Support System for the Transition Towards the Sustainable University*, Proceedings of the International Conference on Engineering & Business Education, Innovation and Entrepreneurship, Sibiu, Romania, 18 - 21 October, 2012, pp319-324

[16]. **Grecu, V**. and Denes, C. (2012d) *E-tools for the Transition Towards the Sustainable University*, paper accepted for publishing in the Proceedings of the 7th International Conference on Quality Management in Higher Education (QMHE), Iasi, Romania, November 16-17, 2012

[17]. **Grecu, V.** and Rosca, L. (2011) *Sa construim un site cu Joomla!*, Editura Universitatii "Lucian Blaga" din Sibiu, Sibiu, 2011

[18]. Grigorescu, L. and **Grecu, V.** (2010), Improving the Management Efficiency of Industrial Production by using the Benchmarking Method, Annals of the Constantin Brancusi University of Târgu Jiu, 2010, vol. 4, pp. 351-362,

[19]. Oprean, C., **Grecu, V.,** Deneş, C., Kifor, C.V. and Oprean, C., (2011), *Sustainability in Romanian Higher Education,* Proceedings of the 4th International Conference on Engineering and Business Education and 1st SAFRI Journey to Excellence Conference, 20-23 November 2011, Cape Town, South Africa, pp 197-208

[20]. Oprean, C., Miclea, R.O., Kifor, C.V., Leş, I., **Grecu, V**., Deneş, C. and Oprean, C. (2012), *The Sustainable Development in Romanian Higher Education*, VIII Taller Internacional "Universidad, Medio Ambiente, Energía y Desarrollo Sostenible", 14-17 February 2012, Cienfuegos, Cuba, pp. 1469-1482

[21]. Rosca, L. and **Grecu, V.** (2009) *Cercetari Operationale. Aplicatii*, Editura Universitatii "Lucian Blaga" din Sibiu, Sibiu, 2009

[22]. Ţuţurea, M., Miricescu, D., Morar G.M. and **Grecu, V**., (2010) *Leadership în organizaţii*, Editura Universităţii „Lucian Blaga" din Sibiu, 2010

10 Future research directions

The transformation of the society into a sustainable one can be achieved through the decisive contribution of universities. For this to happen, universities must first become sustainable. Then they would provide a good example to all and will offer students life experience for sustainable living. Upon graduation they will implement the learned not only at work but also in families and society.

Considering the overarching goal of this work – contribution to sustainability in higher education – there were identified the following future research directions:

- Testing the utility and usefulness of the developed software for supporting decisions;
- Research on methods to better use the resources of a university – shared resource use within different departments or faculties of the same university, or even sharing resources between different universities;
- Research on how the proposed pedagogies and teaching methods can be improved and used for teaching other disciplines;
- Research on how students can be involved into sustainable practices in the campus
- Integrating sustainability in the vision, mission and strategies of the university, in the curriculum and in every aspect of academic life;
- Research on possibilities to develop interdisciplinary courses in Romanian higher education, taught by teachers from different departments and even different faculties;
- Research on finding collaboration possibilities with the local community and business community on projects related to sustainable development, based on the theories proposed in the thesis.