

FORMATIVE ASSESSMENT IN SUSTAINABILITY EDUCATION OF ENGINEERS, THROUGH POSTER PRESENTATIONS

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ABSTRACT: The role of education in shaping the future is widely recognized. The world is becoming more complex, interdependent and unsustainable and this calls for a change in lifestyle. Thus, education for sustainable development is given increased attention in universities worldwide. Engineering schools make no exception from this trend. Transformation of education into sustainability education implies systemic thinking and interdisciplinary approaches. The course “Resource Management and Sustainability”, taught at “Lucian Blaga” University of Sibiu, aims to achieve an integrated approach to sustainability, fostering dialogue across multiple areas of knowledge. This paper presents an analysis of a formative assessment method through a poster presentation activity within this course and the impact that this assessment method has on the students. This research is based on the analysis and review of the literature and it also consists of an experimental part. The proposed formative assessment method was implemented and evaluated. The analysis of the posters and the feed-back forms filled in by the students is presented and it highlights the efficiency of poster presentations in sustainability education of engineers.

KEY WORDS: engineering education; sustainability, assessment, interdisciplinarity, poster presentations..

1 INTRODUCTION

Planet Earth has a limited capacity to meet the growing demand for natural resources in the socio-economic system and to absorb the destructive effects of their use. The impacts of overconsumption of resources have begun to have measurable negative effects on socio-economic development and people’s quality of life in vast areas of the planet (Hopkins and McKeown, 2002).

Education is one of the most effective means available to society to shape the future. One can generally say that in order to learn about sustainable development, one must be acquainted with several different branches of science. Paula Lindroos (2007) observed that “learning about sustainable development is guided by a principle of organizing science and at the same time focusing on the problem solving capabilities of the students. This means both content and learning methods become important for the courses” (p. 93).

Hart, Jickling and Kool also imply that environmental education should be “interdisciplinary, participatory, critical, community-based, values-based and inquiry-based” (1998).

Tilbury argues that “Environmental Education for sustainability is an innovative and interdisciplinary process requiring participative and holistic approaches to the curriculum” (2004) and considers that there is a need for innovation, rather than integration of education-for-sustainability.

Since 2012 the students of the Engineering Faculty from “Lucian Blaga” University of Sibiu can choose to attend the optional course titled “Resource Management and Sustainability”. The course utilizes expertise from a range of academic fields, thereby introducing a number of disciplines across the university, which may be chosen to study in greater depth in the future. The course aims to achieve an integrated approach to sustainability, fostering dialogue across multiple areas of knowledge. It tries to create dialog space for a transdisciplinary process, as it aims to be an interactive course which involves the learners, making them think across, beyond, and through the academic disciplines to encompass different types of knowledge about sustainability. Furthermore, it tries to give space for different perspectives – using, developing and reflecting specific methodological and research frameworks.

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2 WHAT KINDS OF TEACHING METHODS HAVE BEEN ADVOCATED TO SUSTAINABILITY?

In their chapter “It’s Not Just Bits of Paper and Light Bulbs”, Cotton and Winter (2010) present a literature review of the wide range of suggestions for appropriate approaches to teaching about sustainability and also for specific teaching methods. Potential learning approaches are: participative inquiry/action research, where students investigate an issue which is of importance to them personally; transformative sustainability learning (TSL) or action competence, when students are encouraged to envisage alternatives and solutions to unsustainable practices (Breiting and Mogensen, 1999).

Specific teaching strategies advocated for environmental education or ESD include those identified by Cotton and Winter (2010): role-plays and simulations; group discussions; stimulus activities (watching a video, looking at photos, poems or newspaper extracts to initiate reflection or discussion); debates; critical incidents; case studies; reflexive accounts; personal development planning; critical reading and writing; problem-based learning; fieldwork and modelling good practice – despite the teaching strategies, the importance of learning through the hidden curriculum and outside the classroom should not be underestimated (Cotton and Winter, 2010).

Many of the approaches presented require a significant amount of prior preparation, as well as a reasonable time allocation. Sterling (2003) advocates strongly for educational transformation to ‘sustainable education’ and argues for re-orientation of educational policies, programmes and practices using the synergy between ecological and systemic thought.

When promoting sustainable development, we should research and develop our work so that we become a part of the knowledge building community for sustainable development. In recent years, an increasing amount of universities have started organizing pedagogy courses for their teachers so as to specifically change the nature of teaching and learning (Kaivola and Ahlber, 2007).

3 EFFECTIVE ASSESSMENT IN HIGHER EDUCATION

According to Kearney and Perkins (2011), “innovative assessment practices have the capacity to significantly change the perceptions of students with regard to their tertiary studies”. Boud (1990)

suggests that assessment drives learning; but he highlights that the wrong type of assessment drives the wrong type of learning. Surface learning and memorization are reinforced by traditional assessment methods such as traditional tests, meaningless essays, research projects that do not have value outside of the classroom. Kearney and Perkins (2011) conclude that “authentic assessment practices that foster useful metacognitive skills and are focused on deep, sustainable, authentic learning need to be revived, as innovative assessment practices may be able to guide learning and encourage students to be more engaged”.

Following, one of the assessment methods used for the course: “Resource Management and Sustainability”, namely poster presentation, is described, and its outcomes are analyzed. The course is assessed by an on-line quiz, (weighting 10% of the final mark), the peer assessed poster (30%) and the final project (60%). The poster presentation assessment method has been analyzed in this paper because it is a visible and transparent method that enables the learners to take an active role in researching the sustainability issues. It enables dialog between learners and between learners and tutors, as it is a creative activity which doesn’t restrict or predefine what the outcomes will be. It is a visual method which enables the presentation of complex information in a synthetic form and it employs cognitive strategies to enable synthesis.

Adelaide Oliveira (2008) points out that “while an oral presentation favours learners who are linguistically, and sometimes, visually intelligent, the poster presentation will also include learners who are kinesthetically intelligent since everyone must walk around throughout the presentation, and the logically intelligent given the connections that are made during the session. In addition, both interpersonal and intrapersonal intelligences will be addressed given the cooperative and reflective nature of the presentation”.

Poster presentation is not a new assessment method and it is used extensively in courses that want to have a social constructivist approach, (Oliveira, 2008; Mills et al, 2000; Zevenbergen, 2001) but little has been reported about poster presentation in the context of Education for Sustainable Development.

4 POSTER PRESENTATIONS – ONE ASSESSMENT METHOD OF THE SUSTAINABILITY COURSE

All activities of the sustainability course are designed to help students develop trans-disciplinary competencies, such as reflection, negotiation and dialogue-building. The course will develop students' self-awareness as having a role and responsibilities in relation to the everyday problems of sustaining our environment. It will also encourage students to recognize their own capacities and potential contribution to those problems' resolution.

Through this module, students can further develop important practical skills such as: locating and using research material, and selecting material from an extensive reading list; generating their own source material, assessing and analyzing that material; making effective use of IT for information retrieval and written presentations; writing highly analytical essays/reports; developing and presenting arguments; giving effective presentations making appropriate use of IT resources; analyzing and commenting on the arguments of others; time and project management abilities and group participation. One of the methods used for this purpose is poster presentation.

Working in groups of 3-4, students were required to examine the sustainability implications of a particular issue. The group is expected to explore a general theme through the use of a case study. The case study may be at an international, national or local level (or all three). Posters will be presented in a poster display, with at least one member of the group to be available beside the poster to explain and answer any questions.

5 DATA COLLECTION AND ANALYSIS

In order to analyze the poster presentation assessment method, two types of data were considered: (1) the posters which were presented and (2) the student feed-back forms, which were filled in by the students who attended the course, at the end of the semester.

The Student Course Evaluation Form exercise is an essential part of Course Review and aims to enhance the student's experience of learning and teaching, and encourage self-reflection; monitor the quality of teaching and learning; improve the quality of teaching and learning; ascertain how well a course or programme of study is doing and identify good practice. The analysis of the posters

was focused on two dimensions: (1) the themes that they were centered upon and (2) the approaches that students choose for presenting the information. Each poster has been assessed prior to this analysis by peers and lecturers. The criteria for assessment of the posters (legibility and display; use of relevant sources; links between disciplines; criticality in the presentation of different points of view) have been presented to the students in the course handbook.

6 POSTER ANALYSIS

Until now, the course has been carried out for two semesters, in the years 2012 and 2013. Therefore, there were two poster presentation series, for a total of 17 posters, on an A1 format. Most of the posters were printed directly on the A1 format and laminated, but there were also posters made with glued pieces of typed or hand-written text. The students were challenged to use the English language for the posters in order to develop their communication skills and abilities to

Within this task, students had the chance to work in groups, to develop research abilities, to learn how to make effective presentations and think of methods for informing and persuading other people towards a more sustainable way of living. Most of the posters presented cases with a high emotional impact on the viewer, emphasizing ethical issues from different perspectives. Every poster contains information related to more than one discipline, showing that the course was indeed an interdisciplinary one and students were able to make links between different disciplines and points of view. Some examples of posters are presented in figures 1-2.

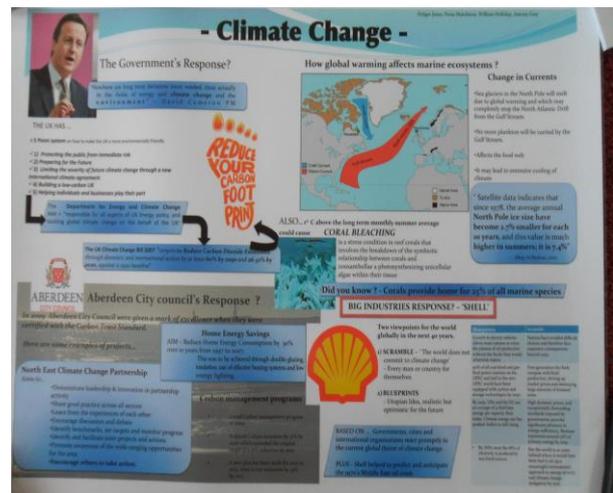


Figure 1. Poster presenting issues related to geography, economics and biology

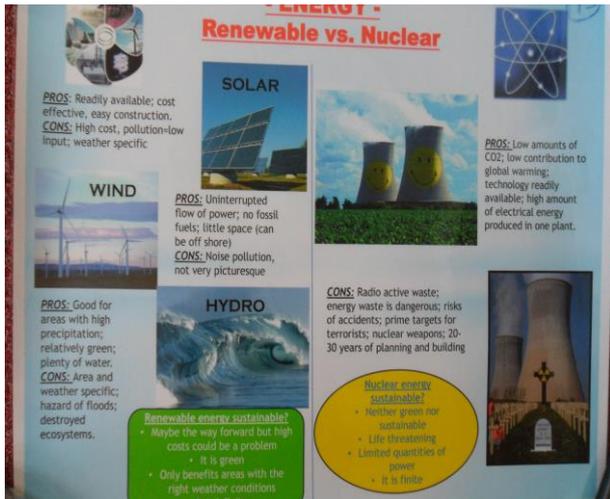


Figure 2. Poster presenting renewable and nuclear sources of energy from different perspectives

The topics presented in the case studies were ‘food production & agriculture’, ‘climate change & greenhouse effect’, ‘human behavior & consumerism’, ‘deforestation and its impacts’, ‘sustainable energy’ and ‘biodiversity’. Figure 3 shows which topics were most present in the posters. It can be seen that sustainable energy sources, climate change and human behavior & consumerism were considered most interesting by students and the issue of deforestation was the least covered.

The disciplines which were present in the posters were economics, geography, sociology, biology, psychology, marketing, international relations, physics and engineering. It is notable that economics is present in 13 of the 17 posters, followed by geography, sociology and biology.

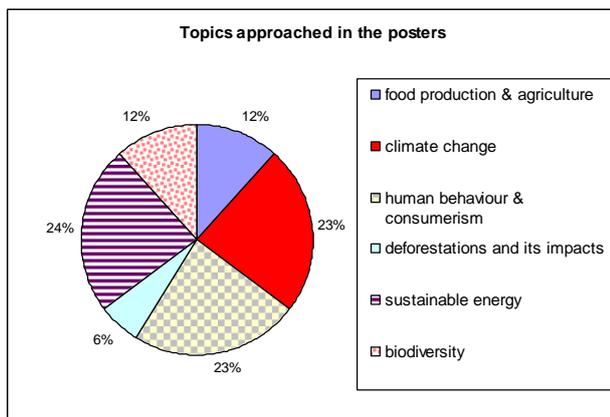


Figure 3. Topics approached in the posters

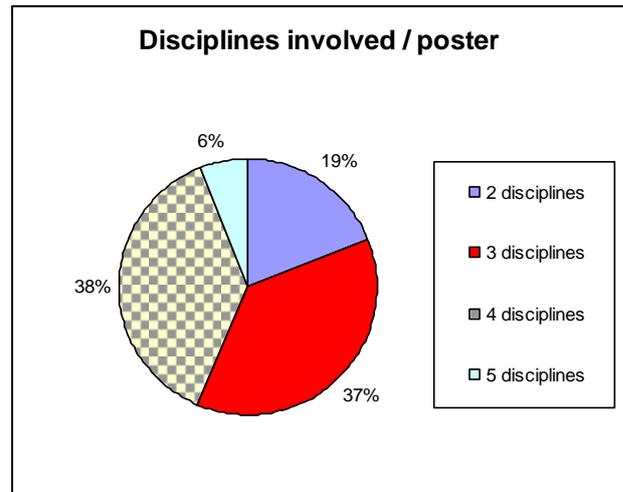


Figure 4. Disciplines involved / poster

This shows that in most cases students presented their case studies mostly from an economic point of view. Geographical information was used to show viewers that the problem is concerning us all; it isn’t something happening to “others”. Human unsustainable behavior was highlighted in 8 posters, raising awareness and sensitizing the viewers that we need to change our way of living. In some cases the conclusions were written explicitly on the posters, in others these were subliminal, letting the viewer to draw their own conclusions.

The course aimed to explore the meaning and challenges of sustainability, through a multi-disciplinary approach. The analysis of the posters shows that every poster presented the case study from more than one perspective. Therefore the goal of developing students’ interdisciplinary understanding of complex global and local environmental problems, and acquiring knowledge about the various actors involved in sustainability debates seems to have been reached. Figure 4 shows how many disciplines were involved in the posters.

7 THE STUDENTS’ FEED-BACK FORMS

The students’ feed-back concerning the course, in general, and the poster presentation, in particular, is polarized. The student feed-back forms show that many of the students were enthusiastic when writing their opinions, showing their appreciation: “This course should be compulsory for every student in the University”, “assessment like posters were engaging and rewarding”, “Workshops are very useful and develop communication skills”, “Clear passion for topic – cross-discipline content”, “Absolutely, I love this course”, “It was more intense than expected!”, “I enjoyed the topics and the discussions. The posters were interesting to

make”, “Poster presentation day was different – not really done on other courses. Public hearing was interesting – it was better than having a lecture”. There was also negative feedback. Some of the opinions about the course include statements like: “[the course] did not interest me”, “Poster assessment feedback too late to be useful”, “Lectures were not that useful”, “Workshops are quite long; perhaps a break is needed”, “A bit random, more structure needed. Takes a while to get into the flow of things.”

As presented above, most of the positive feedback highlighted the idea of the course, its interdisciplinary approach and varied teaching methods. Students appreciated the importance of the issue and the passion of the lecturers. The poster presentation was seen by the majority as a good thing, considering it challenging and rewarding. It is expected that students have different opinions about this course, as it is an interactive one and tries to engage them into debates, given their varied ability to engage with a cause that requires them to be participant rather than passive observer.

8 DISCUSSION

Considering the feedback from the students, given in class, in semi-structured discussions, on course feed-back forms and on a Facebook group, the optional course concerning sustainability issues, taught at “Lucian Blaga” University of Sibiu, was a success. This is also evident from the average grade that this course received from the students – 8.8 and from statements such as “it was a real pleasure and I was delighted to attend the optional course”. The aim of the course was to raise awareness on sustainability issues and experiment alternative teaching methods for sustainability in Romanian Higher Education.

The role of education is well understood by the students who appreciate that education “models young people to become responsible adults, who know their role in the society” (interviewee 8). The students also contend that education is good because it “opens our horizons and we know better what is happening around us”. They associated education with sustainability, showing that “all our actions have consequences that are reflected on the society and environment. If nobody would explain us some essential things about the link between us and the society it is likely that we would encounter certain events in life that instead of avoiding them, we create them ourselves” (interviewee 9).

The reasons for joining the course are questioned in question 4 of the course feed-back

form. Most of the respondents said that the topic seemed interesting and they wanted to learn as much, as they were aware of the issues that the Planet is confronting with. Another important reason, mentioned by more respondents is that “many of these extra activities are beneficial for all of us: we have the possibility to learn things that we do not know, to participate in certain activities that we would not ever think of. These activities 'stir' our imagination to come up with new ideas, and help us to better understand ourselves and the others” (interviewee 2).

Question 6 sought to identify what the students liked about this activity and the most appreciated was the teaching method and the atmosphere. Some of the other things appreciated by the students were: “the movies, the documentaries, the support materials, the initiative of [the] colleagues, the creativity, the freedom of expression, the open, interactive discussions, the fact that we can engage in various discussions or participate in planned activities”. They were not used to be listened to and therefore this was another thing that they liked about the course: “it was a pleasure to go to this course because of the freedom of expression and lack of binding (if I may say so), I came just for fun.” The flexibility of the timetable (“we can make our program as we like”) and of the topics (“we can choose what we want to discuss during the course”) were also appreciated. Concerning communication, the students consider that “everybody understood what it was all about” and that “there was no barrier between the students and the professor”. “The professor was always enjoyable and didn’t think of himself to be superior to us and that encouraged us to speak and think without being afraid to make mistakes.” More students said that they “could discuss without holdbacks” as communication was “opened, not very formal” and “each of [them] could express a point of view”.

The benefits for attending the course are evident for all the respondents. Some see the benefits as the information that they gained for living a “green” life. Some mentioned that after this course they are more careful about what they eat and try to leave a smaller footprint in the nature. Others consider that this course helped them develop team-work abilities and encouraged them to think.

9 CONCLUSIONS

Hopkins and McKeown (2002) show that education is an essential tool for achieving sustainability. They continue their advocacy saying that “people around the world recognize that current

economic development trends are not sustainable and that public awareness, education and training are key to moving society toward sustainability” (Hopkins and McKeown, 2002).

Stephen Sterling (2009) argues that “if we want the chance of a sustainable future, we need to think relationally”. The authors of the course “Resource Management and Sustainability” are aware of the fact that the world is increasingly complex, interdependent and unsustainable and try to change the approach of education, from a fragmentary and limited one, to an integrating and multidisciplinary approach.

The analysis of the posters and 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.

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