

Students' Attitudes and Threshold Concepts Towards Engineering as an Environmental Career: Research by Participatory Design of an Educational Game

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Introduction & Aim

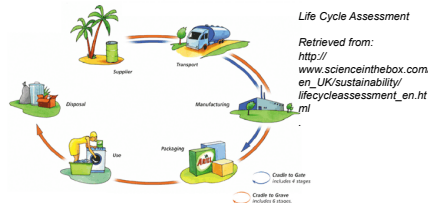
General awareness on ecological and environmental issues increased in the last years. Looking at available data, however, showed mixed results: a "confused public that performs poorly on basic environmental literacy questionnaires", and "95% of this public supports environmental education in our schools" (NEETF, p.3). Earlier work on environmental literacy in the field of engineering showed a similar pattern amongst engineering student.

The aim of this project is to research the attitudes and threshold concepts of beginning engineering students towards the relationship between environment/ecology and engineering, specifically towards choosing either (a) engineering as a career to make an environmental impact or (b) choosing environmental and ecological engineering as a specific engineering profession.

Theoretical Framework

The study is grounded in (1) 'social cognitive career theory' (SCCT) and the (2) theory of "threshold concepts" (TC). SCCT maintains that people's interests in certain careers stem partly from their self-efficacy (beliefs about personal capabilities) and outcome expectations (beliefs about the out-comes of engaging in particular courses of action) (Lent et al., 1994, 2003, 2005). This study researches students' change of attitudes and conceptions especially in regards to outcome expectations (as defined by SCCT), meaning: how well do students understand that their environmental/ecological impact is extremely high by choosing an engineering career.

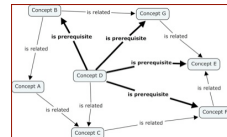
Life Cycle Assessment – What is it?



What are Threshold Concepts?

Humans naturally build simplified and intuitive theories to explain their surroundings. Students often ignore, reject, exclude, or reinterpret troublesome knowledge or they hold them in abeyance, which is largely due to beliefs and attitudes (Sinatra & Pintrich, 2003).

The new emerging theory of threshold concepts (Meyer & Land, 2006) argues that there are hierarchies within concepts, in which certain concepts are gatekeeper concepts. Attributes, of threshold concepts are (a) transformative (transforming the understanding of a domain), (b) irreversible (change of perception is unlikely to be forgotten), (c) integrative (exposes other relationships), (d) bounded (context-specific) and (e) troublesome (counter intuitive) (Meyer & Land, 2006).



'Concept D' is a threshold concept, meaning if concept D is not understood properly, it is most likely that concepts B, G, E, and F will not be properly understood, since concept D is the prerequisite for these other concepts.

Research Design

The methodological framework of the study is design-based research. Comparative-design based research and Participatory design are utilized to outline and elicit knowledge structures in the research. This research engages participants by providing hybrid workshops regarding content knowledge of LCA and game design and inviting participant students to co-design an educational game as designers. Multiple instruments like observation protocol, semi-structured focus group interview, team artifacts and student reflection will support the encoding and decoding of data focusing on the change of students' conceptual understanding and attitude toward core environmental and ecological concepts during the process.

Engineer of 2020 Target Attributes Addressed

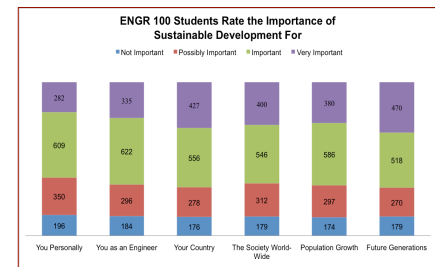
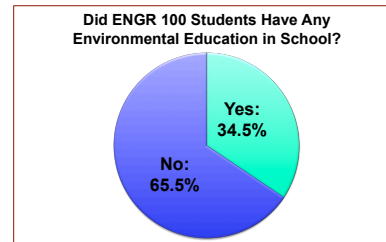
Abilities: Teamwork, Communication, Decision Making, Synthesize Engineering, Business and Societal Perspectives

Knowledge areas: Engineering fundamentals, analytical skills, open-ended design and problem solving skills, multidisciplinary within and beyond engineering,

Qualities: Innovative, ethically responsible in global, social, intellectual and technological context, curious and persistent continuous learners.

Project update / Base Line Data

During the first week of Fall semester 2008, the research team administered a survey to all ENGR 10000 students (return rate: 1437). This baseline test asked for (a) environmental education in school, (b) knowledge and (c) how important environmental issues are. The research reveal:



What comes next?

Our design workshops and data collection during the game design sessions will start in October and last till beginning of February.

The game design and consequently our research will contribute to a list of core concepts and recommendations on how to implement LCA into the teaching to achieve Engineering 2020 attributes. In addition, this research will result in the development of a prototype of a virtual game aimed at high-school and first-year students.

Expected Impact

Expected outcomes include a better understanding of students' attitudes and threshold concepts towards environmental engineering and a baseline to design new interventions to support a stronger view of engineering as a career for environmental impact. This research project will also build the foundation for further grants.

In addition, the research will have an important impact on program development in the Division of Environmental and Ecological Engineering.

Acknowledgements

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