

Understanding qualitatively different experiences of learning in Engineering: Variation as a learning tool

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What are session participants expected to learn?

Students experience and understand engineering curricula and education in qualitatively different ways; such differences often lead to qualitatively different outcomes. The aim of the session is to introduce phenomenography, a qualitative research approach that aims to identify these qualitative differences and shed light into how engineering students understand aspects of teaching, learning and assessment in the discipline. This research approach is widely known by the concepts of “deep” and “surface” approach and seeks to identify different conceptions of a phenomenon held by individuals within and across a group (Marton and Booth, 1997). The methodology helps researchers identify shared conceptions among group members and describe relationships among the various conceptions held. This can consequently allow educators to work towards the advancement of such conceptions from limited, less advanced to more advanced understandings of a phenomenon, concept, idea, taught topic, method etc.

The workshop adopts a hands-on approach; participants will therefore become familiar with the purpose and methods of phenomenographic research by analysing a dataset themselves. This is an effective pedagogical approach considering the workshop time constraints. The dataset will be selected extracts from a recent study of how engineering and architecture students understand design and knowledge creation in their disciplines, how this varies by professional degree program (architecture vs. civil engineering), and how student conceptualisations change over time. Participants will benefit from engagement with data and exposure to a ‘real’ research problem, i.e. how to provide an account of qualitative differences in engineering students conceptions of design and knowledge creation. Facilitators will provide guidance and support through the development of the group work and clarify points of contention or address misconceptions about the methodology.

This workshop has four expected learning outcomes (LO):

1. Describe aspects of the theories underpinning the phenomenographic approach to generating and analysing qualitative interview data.
2. Identify implications of variation for teaching and learning in Engineering Education.
3. Work effectively and efficiently within the time constraints of the workshop to analyse data and present results of phenomenographic analysis.
4. Discuss variation as a tool for enhancing student learning and pedagogical outcomes.

Why is the session relevant?

Phenomenography is a research methodology well suited to exploring how engineering students and academics experience engineering education. The significance of phenomenography to engineering education research (EER) and practice lies in its potential to account for differences and changes in meanings individuals hold about concepts and practices in their discipline. By emphasizing variation, this methodology highlights that existing forms of knowledge are not fixed and therefore these are possible to change.

How are session participants activated?

This workshop is limited to 20 participants. At the beginning of the workshop, they will be invited to introduce themselves by giving their affiliation, professional background and motivation for attending the workshop. Therefore, they will be involved from the outset and this approach is intended to be maintained throughout the workshop through regular questions to the audience. Following the assignment of the group work, participants will be asked to individually read the selected transcripts and collaboratively work on the identification of the emerging differences in engineering students' conceptions of design and knowledge creation.

Introduction to phenomenography [20 minutes]

In this workshop, participants will be introduced to the historical development of phenomenography and will examine its position within the wider qualitative paradigm (LO1).

Potential implications for Engineering Education [10 minutes] Group discussion

Participants are likely to have prior understanding of issues explored in the interview transcripts and will feel motivated to contribute to group work, discussing their research interests with facilitators and other participants (LO2).

Data analyses and presentation [50 minutes] Group work

Participants will discover and practice using this methodology in conducting engineering education research, applying phenomenographic approaches to

generating and analysing data. They will work in groups to undertake their own analysis of interview data from a study with architecture and engineering students exploring how they understand design creation. At the end of the hands-on data analysis activity, workshop participants will discuss their approaches to analysing the data and compare their findings (LO3).

Closing remarks [10 minutes] Group discussion

Ultimately, participants will discuss how the results of phenomenographic studies might contribute to more meaningful engagement in engineering education and research (LO4).

How will results be summarized?

Each group will give a very brief presentation of a visual representation of their findings. Participants will be invited to comment other groups' findings and the facilitator will summarize the discuss by offering an overview of the final results of the study.

How is this work significant for Engineering Education?

Case and Light (2011) identified phenomenography as one of the emerging qualitative methodologies in EER, as it can contribute to broadening the type of research questions and ways of thinking about engineering education. Variation is important to highlight how students understand important concepts of the engineering curriculum such as energy in solution processes (Ebenezer & Fraser, 2001) or how to enrich the curriculum with new concepts such as entrepreneurship (Täks, Tynjälä, & Kukemelk, 2016). It can also be helpful in identifying troublesome aspects of problem-solving processes in the engineering workplace and enhance how engineering curricula equip graduates for the workplace. Phenomenography can therefore support the design of engineering curricula, pedagogical approaches, and assessment methods as well as enhance aspects of the overall student experiences and how students meaningfully engage with the discipline and the profession.

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