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A phenomenographic study to investigate what we mean by the term “Professional Skills” – preliminary findings

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ABSTRACT

Recent calls for reform of engineering education have highlighted the importance of treating the engineering education system holistically; not only looking at developing curriculum components nor proposing new teaching pedagogies to enhance graduate skills. One aspect of this holistic view, which has not been given due cognisance is the impact that academic conceptions can have on the experience of the student in the educational system.

The authors propose that academics teaching on engineering programmes do not share a common understanding of what we mean by “professional skills”, nor assume the same teaching and learning processes which develop these skills. It is unlikely that large scale reform of engineering education will be successful until we better understand and therefore allow for variations in conceptions of what we term here, “Professional Skills”.

This paper reports on preliminary findings of a PhD study; a phenomenographic study of academic conceptions of the term professional skills in engineering graduates in Ireland. These preliminary results show that there are at least four qualitatively different ways in which the academics interviewed, conceive of the term professional skills. It is hoped that the results will enable academics to better understand how their own conceptions are similar to, or how they differ from their colleagues and so can enable them to better see how their own strategies can help reform engineering education.

This paper presents preliminary findings and hopes to generate discussion at the conference to help define, debate and shape the findings of the overall study.

1. INTRODUCTION

Engineering graduates in today’s world face a global industry where professional skills are as important as the intellectual prowess gained by obtaining a degree itself. The importance of these skills is abundant in literature, yet so too is an ongoing barrage from industry that Higher Educational Institutions (HEIs) are not developing sufficient professional skills within students [1].

This occurs against a background of accrediting bodies who have adopted programme outcomes which require employability/professional skills to be integrated into the curriculum. There is also evidence that many educators have attempted to employ innovative strategies, such as Problem Based Learning to expose students to opportunities to practice these skills. Why therefore, is there still a gap between what industry wants and what HEIs provide and whose fault is it? Industry may be demanding more than an academic can deliver, in an already overcrowded curriculum with dwindling funding, particularly in an Irish context [2-3].

The author's interest in preparing engineering students for a successful career in industry stems from personal experience of recruiting, mentoring and managing graduates in civil and structural engineering consultancies. The range of skills, abilities and values of each graduate was varied, and it became apparent that academic achievement, whilst important, was not the defining skill for achieving early responsibility or promotion within the company. More often, the graduate who could communicate well and self-direct his/her work was given more responsibility and opportunity.

1.1 Influence of Accreditation Bodies and Industry

Accreditation requirements for engineering programmes serve as a framework for programme design. Several accrediting bodies including Engineers Ireland (EI), and the Accreditation Board for Engineering and Technology (ABET) require degree programmes to include outcomes, which incorporate what may be considered professional skills [4-5]. These skills include; self-directed working, teamwork, multidisciplinary working, ethics, communication with the engineering community and with society at large. The EI programme outcomes have been developed in consultation with employers and should therefore address concerns about professional skills from an employer's perspective. Employers in Ireland however, still report that they are not satisfied with the level of competence of engineering graduates in non-technical skills. [1]. This suggests therefore, that although there are processes in place which should ensure that students have opportunities to develop these skills, there is a disparity between what the accreditation paperwork requires and the skills that students actually develop. One area where this disjoint may occur is in the classroom and may be influenced by how the academic teaches or how the students learn.

1.2 Literature Review

Whilst there were no studies identified as part of this literature review on the definition of the term Professional Skills, work completed by Barrie [6] sought to describe the term "Graduate Attributes". This phenomenographic study was carried out amongst multiple disciplines in various universities in Australia. The work concluded that not only did academics have a variety of understandings of the term graduate attributes, that they had differing conceptions of how these attributes were taught and learned. Barrie produced an outcome space which shows relations between academic conceptions of what graduate attributes are and how graduate attributes were developed. Four hierarchal understandings of generic attributes were identified as;

1. **Precursor Conception** (necessary basic precursor skills but irrelevant as they are a prerequisite for university entry)
2. **Complement Conception** (Useful skills that Complement or round out disciplinary learning)

3. **Translation Conception** (These are the abilities that let students translate, make use of or apply disciplinary knowledge in the world)
4. **Enabling Conception** (They are enabling abilities that infuse university learning and knowledge)

The conceptions identified above were taken from utterances in the range of transcripts that were collected from the interviewees. These results in themselves provide a unique understanding of the different conceptions that academics have in relation to generic graduate attributes. However, Barrie then reviewed the transcripts again, this time to identify relationships between the understanding of what graduate attributes were and how those academics conceived how students were meant to develop those skills. This work enabled him to present an outcome space showing the different approaches to teaching generic graduate attributes, which is available in the Barrie [6] paper. Whilst this research work follows a similar topic of interest to Barrie [6], there are several key differences. The term professional skills is used and not generic graduate attributes. Moreover, rather than considering generic graduate attributes as an outcome of university education, this study looks at professional skills of engineering graduates only, and the interviews are with academics teaching on engineering programmes only, rather than a multidisciplinary study. Finally, Barrie's work was carried out in Australia and this study concentrates on academics teaching on engineering programmes in Ireland [6].

1.3 Terminology

At this point, it is timely to explain why the term “Professional Skills” was used in this study. Terms such as; graduate attributes, soft skills, employability skills, key skills, transferable skills, transversal and generic skills are all used within the engineering education literature and are each meant to convey a list of skills that graduate engineers should have upon graduation [7-13]. Whilst there are many different definitions for skills and attributes, reference to the National Science Foundation funded project to develop a taxonomy of keywords for engineering education research is referenced here [14]. The final version of the taxonomy, available at <http://taxonomy.engin.umich.edu/> has 454 terms arranged in 14 branches under 6 levels. As part of the validity exercise, a keyword analysis was carried out on a subset of articles and *Figure 1* below is a reproduction of the word cloud for the most commonly used terms in the keyword frequency analysis. The term professional skills is highlighted here, in absence of other terms such as graduate attributes and so on, and this gave validity to the decision to use the term “Professional skills” in this study.

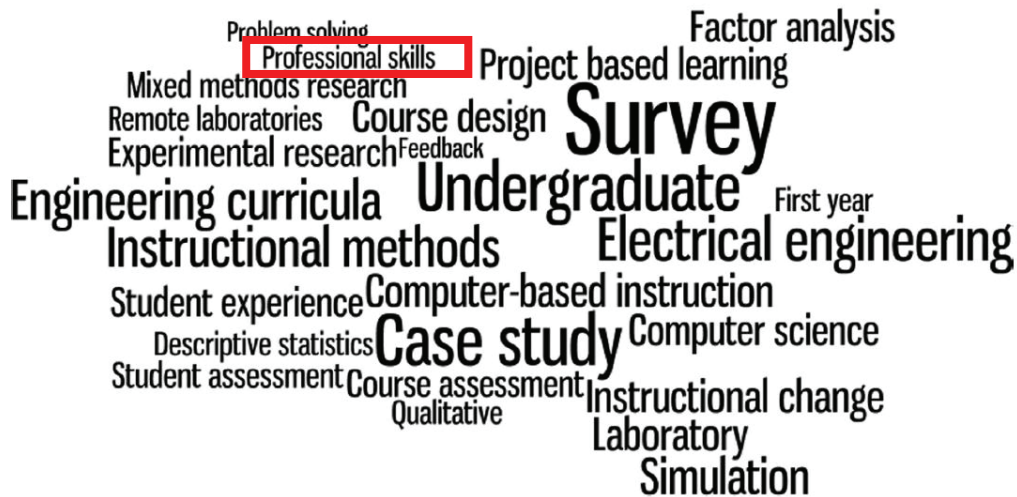


Fig. 1. Word cloud for keyword frequency analysis carried out as part of the validity exercise of the taxonomy project [Extracted from 14].

2 RESEARCH QUESTIONS

The research questions centre around the experience of the academic in the classroom, although we are also interested in factors which may have influenced how the academic contemplates the relative importance of professional skills. We also hope to relate our research outcomes to work carried out by Trigwell, Prosser and Taylor [15] which looked at academics' approaches to teaching and to Barrie [6] which investigates academics' conceptions of graduate attributes.

The overall research study aims to investigate relationships between different objects of interest as shown in Figure 2.

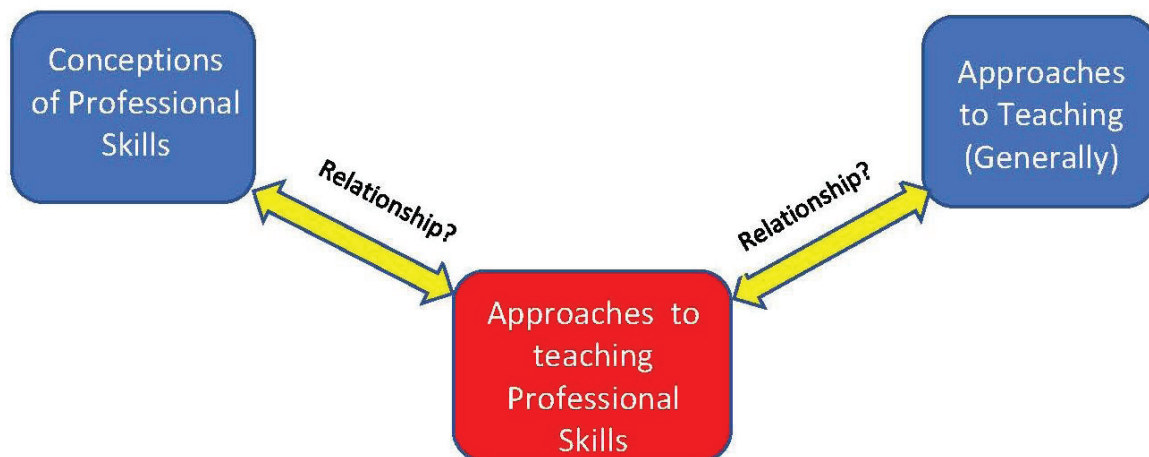


Fig. 2. Overall concepts and relationships to be investigated as part of this study

The overarching research question is;

- What are the qualitatively different ways that engineering academics approach the teaching of professional skills in engineering programmes in Ireland?

Sub-questions include;

- **What are the qualitatively different ways that engineering academics conceptualise what is meant by professional skills in engineering? (Preliminary results reported in this paper)**
- What are the qualitatively different approaches to teaching (generally) that engineering academics use in engineering programmes in Ireland? [20]*
- What are the qualitatively different approaches to teaching **Professional skills** that engineering academics use in engineering programmes in Ireland?
- How do academics manifest their conceptions of professional skills through their approaches to teaching professional skills?
- What is the relationship (if any) between approaches to teaching generally and approaches to teaching professional skills?

*results from this part of the study are presented in paper reference [20].

3 METHODOLOGY

3.1 Brief description of Phenomenography

The aim of the study is to build an understanding of academics' conceptions, perceptions and experiences of teaching professional skills. It is not to prove a hypothesis, to look at a particular case study nor a particular group of people. A descriptive method of enquiry was needed. Three research approaches were considered appropriate for the study; phenomenology, phenomenography and grounded theory. We determined that phenomenography would best answer the research questions.

Phenomenographers seek qualitatively different, but logically and hierarchically interconnected descriptions that a group of people experience in relation to a particular context [16]. Ference Marton, the original proposer of the term phenomenography, relates action and experience [17]. It follows that if we want to understand how people **handle** certain situations then we need to investigate how they **experience** those situations. "A capability for **acting** in a certain way reflects a capability **experiencing** something in a certain way. The latter does not cause the former, but they are logically intertwined" [17, p.111].

Phenomenography is proposed as an ideal fit for this research study for two reasons. Firstly, we believe that there are varied ways in which academics perceive, conceptualise and experience teaching professional skills. It is the variation we are interested in, not the commonalities which would be typical of a phenomenological study. The second reason is that a phenomenographic study is usually context bound. It refers to a particular instance that the interviewee is asked to reflect upon. We intend to investigate their experiences in relation to a particular context (teaching engineering students in Ireland) and not as an idea of teaching professional skills in the abstract.

3.2 Rationale and use of phenomenography in this research

This study aims to effect change in the way students are prepared for industry, particularly in relation to professional skills. This aligns well with the origins of phenomenography which was based in an educational setting. The study, while arguably based in education, focuses not on students but on the experiences and conceptions of academics. There is merit in this approach as it is argued that previous research studies in science education have sought to develop prescriptive solutions to problems in teaching and learning and that this is not effective, that descriptive results are much more powerful [18]. Phenomenography allows us to look at how academics approach their teaching in a natural setting and how these approaches affect the outcome for students. Research output in a descriptive form will allow academics to reflect critically on their own practice, which can account for their own individual perceptions [18].

Despite initial assertions to the contrary [17,19], phenomenography can be considered a research approach, and the researcher uses whatever research methods most appropriate to the study. In this instance, we undertook a two-phase approach. Phase One comprised an online survey, the primary purpose of which was to collect background information on the participants forming the population sample. The survey responses set the context for the research and informed the interview questions for the main phenomenographic study, which was undertaken in Phase Two. Some interesting results emerged from the survey and are presented separately in [20].

3.3 Research Participants

It was important that the interviewees selected for the data collection were appropriate to the purpose of the research, by representing a large cross section of views about the research topic. A purposeful sample of research participants have been selected for interview, based on a range of attributes which emerged from the survey data. It is intended that 20 interviews will be completed as part of the data collection. To date, four pilot interviews have been carried out, of which two were considered worthy of inclusion in the main data bank. This paper reports on preliminary findings from the analysis of those two interviews.

3.4 Analytical Methods

Phenomenography aligns with a subjective ontology, where the researcher interprets the outcome of interviews with people. It is accepted that the people will construe the world in different ways, as opposed to there being one truth. In fact, in phenomenography, researchers do not make any assumptions about reality, nor do they intend that their research outputs represent the **truth**. The findings of a phenomenographic study are presented in outcome spaces; hierarchically ordered sets of categories of descriptions, identified by qualitatively different variations of experience of the phenomenon. Researchers aim to present outcome spaces that reflect the phenomenon, but researchers can only provide more or less complete outcomes, not right or wrong outcomes [21].

Through uncovering variation, we hope to identify different **categories of description** which show **themes of expanding awareness** of how “professional skills” is conceptualised by academics. The hope is that the outcome spaces can show academics that there are **more complete ways** of conceptualising professional skills and as part of the larger study, how we can teach professional skills. It is hoped that

this new-found knowledge of more complete ways of understanding how to teach professional skills will encourage greater adoption by academics, even within technical subject areas.

4 PRELIMINARY FINDINGS FROM PILOT INTERVIEWS

Although only two pilot interviews have been analysed, the authors believe there were some interesting themes uncovered and would like to present preliminary findings of one of the Categories of Descriptions; that of “What do academics understand by the term Professional Skills”. These findings are still in infancy but outline the current understanding of the phenomenographical process of analysis. We hope to discuss these further upon presentation.

Four preliminary categories of description have emerged from the two interviews and there is no attempt here to put them into hierarchal order yet;

- W. Professional skills as the skills needed to succeed in the workplace.
- X. Professional skills as being something that a person learns, where the person is the object of focus.
- Y. Professional Skills as an umbrella term that includes Technical skills
- Z. Professional skills as being an enabler to undertake Technical Skills

Each category is now described with accompanying quotes to explain how the category emerged.

W. Professional skills as the skills needed to succeed in the workplace.

This is described from the aspect of what is needed to succeed in the workplace or in professional life. The focus is work and industry and what is needed to be an engineer in industry, rather than on the person themselves. The interviewees relate professional skills to the ‘profession’ of being an engineer, where industry is the object of focus.

“Well I suppose you know we’ve mentioned the whole question of the skills that they’ll be able to use when they go out into industry in terms of CAD, in terms of different things like that” Person D

“how can students actually perform when they enter industry. And I think different sectors would look at that different ways. And it will depend very much on what your first role within the company is.” Person D

“So it could be everything from writing a grammatically correct, well presented email. To chairing a meeting, to giving a presentation. I would see all of those things as skills which are potentially very useful in the workplace”. Person C

X. Professional skills as being something that a person learns, related to the person.

This category, which also references professional life has the person at the centre. The skills are something that a person learns, connected to the person and whilst there is mention of professional life, the object of focus is the person themselves.

“I suppose, I think of skills as things that are learnt. So say it's anything that a person learns, at any point in their life, which is useful in a professional context. So that's used or would be useful within their professional life”. Person C

“I mean the most important ones - they are more like meta skills... it's more like effective learning strategies and it's more about just recognizing the importance of meta cognition. So I spend time talking about this in class. So it's not I don't mean these are such airy fairy things that they're not actual..... It's just I don't know if they are skills so much as their sort of philosophies that I would want students to embrace”. Person C

Y. Professional Skills as an umbrella term which includes Technical skills

This category relates professional skills to technical skills, where technical skills are specifically mentioned within the description of professional skills. In this case, professional skills is an umbrella term which includes technical skills.

“There could be specific technical skills which are going to enable them to take on certain responsibilities within their professional lives. And so I think they're definitely professional skills. Then there's a whole other side of things which aren't maybe as specific to engineering but they are skills which are going to be useful in a professional workplace in the general sense”. Person D

Z. Professional skills as being an enabler to undertake Technical Skills

This category also relates professional skills to technical skills, but describes professional skills as a subset of technical skills, and an enabler of technical skills. The ability to be an engineer and present or communicate technical CAD drawings or a technical report requires professional skills. In this category, the emphasis is on being an engineer and being able to undertake technical work, but with professional skills as a subset of skills, as an enabler.

“I would look at it as being a subset of skills...would be professional”. Person D

“When the engineer goes out, they need to be able to communicate with people. I would say that communication is almost the price of entry. And then you can express that..... you can say well is that just being able to get up and talk to people, or is it actually being able to get up and present. Or is it actually being able to create a CAD model to express ideas”. Person D

“So students and engineers need an ability to communicate. Part of that communication is obviously through CAD packages and SolidWorks, being able to look at a report being able to interpret it. Being able to say is this actually a good report or not”. Person D

“And that's the point that I'm trying to come out.....that even within communication you can have some parts of communication that are professional, technical”. Person D

Once the relevant quotes have been extracted from the interview transcripts, the researcher must then define how the categories of description differ from each other, and this is achieved through considering the structural and referential aspects of each category. Whilst our analysis has not yet developed this far, several different aspects are coming to our attention.

- The object of focal awareness is industry – what industry wants, what the workplace wants.
- The object of focal awareness is the person - what the person needs to develop, skills that the person should develop for life.
- The object of focal awareness is in relation to technical skills; whether professional skills are inclusive of technical skills, separate to technical skills or an enabler for technical skills.

5 DISCUSSION AND CONCLUSIONS

It is recognised that the findings presented here were drawn from only two interviews, and this is why there has been no attempt to place them in hierarchal form. However, already there are aspects of these findings that relate to the outcomes of the study on Conceptions of Graduate Attributes [6]. Both the Complement Conception (Useful skills that Complement or round out disciplinary learning) and the Enabling Conception (They are enabling abilities that infuse university learning and knowledge) could be recognised in Category Y (Professional Skills as an umbrella term which includes Technical skills) and Z (Professional skills as being an enabler to undertake Technical Skills) here.

Equally importantly to note, is the aspect relating to the person or to industry which were not identified as structural or referential components of the Graduate Attributes study [6]. Although it is early to draw conclusions, this may be because of the emphasis of this study on engineering professional skills, as opposed to graduate attributes in general, which was the focus of the Barrie study [6].

We hope this paper presents the preliminary findings in a way which will allow us to generate debate at the SEFI conference to help us defend, define and refine the Categories of Descriptions uncovered as we move towards completion of the overall research study.

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