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Identifying the knowledge, skills and competences for Nanoscience and Nanotechnology research

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Abstract

Nanoscience and nanotechnology research has influenced the research activities in various scientific disciplines such as physics, chemistry, biology, engineering, molecular biology and biotechnology. The postgraduate researchers working on nanoscience and nanotechnology related research projects in any of these scientific disciplines experience the world of nanoscience and nanotechnology research closely. The examinations of the postgraduate researchers' lived experiences can certainly unfold the characteristics of nanoscience research as experienced by the researchers themselves and can further illuminate the knowledge, skills and competences required to successfully undertake this research

1. Introduction

Nanotechnology has a growing impact on research, industry and the economy [1]. An efficient workforce with the necessary knowledge, skills and competences is required to support the growth of nanotechnology [1]. A strong belief of the industry and research sector is that, the educational institutions will efficiently reform their activities to establish this workforce [2]. Over last fifteen years, many of the national and international nanotechnology research programmes have recommended the development and implementation of the educational programmes in nanoscience and nanotechnology [2- 4] however the recommendations are mainly about the contextual knowledge the students should develop. The knowledge, skills and competences the students are expected to learn, develop and practise through the educational programmes and trainings are still less understood. Furthermore, at what level these programmes can be introduced still remains under debate.

It is timely responsibility of science and technology curriculum developers to identify the necessary knowledge, skills and competence required to successfully undertake nanoscience and nanotechnology research and ensure that the students develop these attributes through the existing education and training programmes. Further it is important to identify if the emerging field of nanoscience and nanotechnology research require the students who have studied nanoscience nanotechnology at undergraduate level or students with different science disciplines introduced to nanoscience and nanotechnology area at later stages which can help to bring the necessary reforms. The postgraduate researchers working in the area of nanoscience and nanotechnology can play an eminent role in the study by sharing their life experiences of researching in nanoscience and nanotechnology research.

2. Methodology

The central research question of this study is to identify the *characteristics* of nanoscience and nanotechnology research in researchers' perspectives and examine the knowledge, skills and competences required to work in this area. The sample set will include approximately forty postgraduate and postdoctoral researchers involved in nanoscience and nanotechnology research across different institutes and universities in Ireland. These researchers will be selected from different research areas

related to nanoscience and nanotechnology research such as nanotoxicology, nanochemistry, nanomaterials, nanoelectronics and nanobiotechnology.

The study will be carried out under the methodological framework of 'phenomenology', which examines a 'phenomenon', in this case 'nanoscience and nanotechnology research' by analysing the '*lived'* experiences of the researchers working in this area [5]. The data will be collected from the participants by conducting qualitative interviews. The qualitative interviews are open-ended in nature and the interview questions are designed so as to probe the researchers' perceptions about nanoscience and nanotechnology research and encourage them to describe their experiences of *'researching in nanoscience and nanotechnology area'*. The actual questions that will be put to participants will be indirect to allow the data 'to emerge'.

3. Discussion

To date pilot interviews have been carried out with four participants to evaluate if the interview structure and question ensure the researchers' experiences are explored and hence the research questions can be answered. The participants had different background in terms of work areas (related to nanoscience research), years of research experience and undergraduate disciplines. The small sample size in the pilot interviews facilitated the examination of the rigor of the interview questions to answer the research questions and allow for the redefining of some of the interview questions for future interviews. The accounts of the researchers' experiences include findings such as i) variation in perceptions of different disciplines about nanotechnology; nanotechnology research; and nanotechnology researchers ii) interactions of researchers of different disciplines at instruments; meetings and conferences iii) need of 'common vocabulary' at workplace iv) dynamic nature of nanoscience and nanotechnology research v) link between disciplinary skills and 'ability to learn' the techniques used in nanoscience and nanotechnology research. To summarise, the pilot interviews provided an understanding of how the researchers link different elements of their education and training to nanoscience and nanotechnology research.

4. Conclusions

The pilot interviews served their purpose of exploring the research process and were useful for modifying the interview questions based on the experiences. The pilot interviews demonstrated the success of the interview questions to reach close to the participants' experiences of researching in nanoscience and nanotechnology research area. The pilot study also provided some glimpses of characteristics of nanoscience research as experienced by the participants within their educational background, training, research and social environment and further ensured a broad understanding of nanoscience and nanotechnology research with more participants. An addition of few probing questions structured in a way that they can circumcise the freedom of the participant/s to their lived experiences and avoid the opinions (that were collected in the pilot interviews at certain times) to a great extent was seen necessary. The pilot interviews therefore promoted a better construction of the experiences from the future interviews. The pilot interviews and its implications on future research will be discussed in detail in the presentation.

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