Incorporation of Practice Based Approach into Engineering Education at Master Level: Analysis of Needs of Teaching staff at Cape Peninsula University of Technology within PEESA III Project

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ABSTRACT

Company’s work, growth and development are facilitated by the synergy between employee education and working. However, fresh employees who recently graduated from higher education institutions are often mismatched to their jobs due to their imbalances between skills offered or, in other words, education, and skills needed or, in other words, practice in the world of work. For bridging the gap between graduates’ skills and company’s needs, technical universities traditionally devote much time to students’ practical training. The aim of the present paper is to analyse scientific literature on practice based approach underpinning empirical study of needs of teaching staff within PEESA III Project for incorporation of practice based approach into engineering education at master level in South Africa. The data was collected through focus group interview at Cape Peninsula University of Technology in May 2019. The findings of the present research are that university teachers’ experience in practice based approach at universities in South Africa has to be enriched. The following research question has been formulated: How to organize a teacher professional development within teacher training for effective incorporation of practice based approach into engineering education at master level in South Africa? Directions of further research are formulated.

Keywords: Definition, engineering education at master level, practice based approach, teaching staff needs.
INTRODUCTION

Company’s work, growth and development are facilitated by the synergy between theory or, in other words, education, and practice or, in other words, work. However, fresh employees who recently graduated from higher education institutions are often mismatched to their jobs due to their imbalances between skills offered or, in other words, education, and skills needed or, in other words, practice in the world of work (Department of Statistics, 2014). Skills mismatches can adversely affect labour productivity and can explain some of the existing cross-country productivity gaps (Nikolov, Nikolova, Ganev, Aleksiev, 2018). Consequently, skills mismatches are widely accepted as a factor that adversely affects potential economic growth and as such require concrete policy measures at the national level (Nikolov, Nikolova, Ganev, Aleksiev, 2018). Such a measure for bridging the gap between graduates’ skills and company’s needs, is students’ practical training to which technical universities traditionally devote much time (Tarev, 2015). Against this background, most of research efforts were made

- To analyse didactics of practice-based approach to teaching university students (Higgs, Barnett, Billett, Hutchings, & Trede, 2012; Tarev, 2015), and
- To explore a practice-based approach to foreign language teacher preparation (Troyan, Davin, Donato, 2013).

Particularly, there is a paucity of research linking theory and education in the South African context (Cherrington, 2017). In order to bridge the gap between theory and practice in engineering education at master level in South Africa, the Erasmus+ Programme KA2 – Cooperation for innovation and the exchange of good practices – Capacity Building in the field of Higher Education supports the project “Personalised Engineering Education in Southern Africa” (PEESA III).

The aim of the present paper is to define the practice based approach underpinning empirical study of needs of teaching staff for incorporation of practice based approach into engineering education at master level. The present research employs theoretical as well as empirical methods. The theoretical methods include analysis of scientific literature and theoretical modelling. The empirical methods were based on exploratory case studies that are set to explore any phenomenon in the data, which serves as a point of interest to the researcher (Zainal, 2007). Exploratory research was employed in the present investigation. Exploratory research is aimed at generating new research questions (Phillips, 2006). The interpretive paradigm was applied to the investigation.

DEFINITION OF PRACTICE BASED APPROACH

Practice based approach is an overall concept that refers to the opportunities provided to university students to integrate knowledge of theory and practice as part of their degree program (Thomson, da Silva, Draper, Gilmore, Majury, O’Connor, Vásquez, & Waite, 2017). The concept of “practice based approach” comprises the use of a variety of such terms as “practice based education”, “practice based teaching”, “practice based learning”, “work based learning”, etc. In the present research, the overall term “practice based approach” is mostly used.

For a proper incorporation of practice based approach into engineering education at master level, a definition of “practice based approach” is a necessity. In turn, the term “definition” has to be identified. The term “definition” is considered as the statement of the phenomenon notion, elements and process. (Ahrens, Zaščerinška, Andreeva, 2013, p. 35). Thereby, a definition’s components as depicted in Figure 1 by Ahrens, Zaščerinška and Andreeva (Ahrens, Zaščerinška, Andreeva, 2013, p. 35) include phenomenon’s notion, elements and process.
The notion of “practice based approach” means education, in which students are being prepared to practice in a diverse range of activities, profiles, and professions, that meets the needs of graduates and practitioners, as well as all the stakeholders: clients, employers, and colleagues (Tarev, 2015). Many researchers tried to identify structural elements of practice based approach. However, they focused only on one aspect of practice based approach, for example problem-oriented training (Tarev, 2015), industry-based tasks and/or projects as part of the curriculum, experiences in practice settings (i.e., workplaces) (Australian Learning and Teaching Council, 2011) and pedagogic practices (Australian Learning and Teaching Council, 2011). Analysis of the scientific publications on practice based approach allows the paper’s authors to determine that practice based approach is the unity of the phenomena considered by Tarev (Tarev, 2015), Australian Learning and Teaching Council (Australian Learning and Teaching Council, 2011) as well as other researchers. Consequently, the present paper’s authors imply that practice based approach is the unity of such structural elements as shown in Figure 2, namely problem-oriented training (Tarev, 2015), industry-based tasks and/or projects as part of the curriculum, experiences in practice settings (i.e., workplaces) (Australian Learning and Teaching Council, 2011) and pedagogic practices (Australian Learning and Teaching Council, 2011).

Regarding the procedural aspect of practice based approach, Australian Learning and Teaching Council recommends to organize “before,” “during” and “after” students’ practice-based experiences (Australian Learning and Teaching Council, 2011). Another pedagogical perspective on the implementation of practice based approach focuses on the cyclic nature of the educational process.
(Zaščerinska, 2011) as illustrated in Figure 3. The sequence of the implementation of the educational process gradually proceeds from teaching in Phase 1 to learning in Phase 3 through peer-learning in Phase 2 (Zaščerinska, 2011). Each phase of the educational process is separated from the previous one, and the following phase is based on the previous one (Zaščerinska, 2011).

A comparative analysis of the implementation of “before,” “during” and “after” students’ practice-based experiences (Australian Learning and Teaching Council, 2011) as well as the educational process (Zaščerinska, 2011) allows highlighting such advantages of the educational process proposed by Zaščerinska (Zaščerinska, 2011) as

- the social nature of the educational process (teaching and peer-learning) as well as
- the movement of the educational process from the external or, in other words, social perspective (teaching and peer-learning) to the internal or, in other words, individual perspective (learning).

Practice based approach is implemented in various forms: in the form of games, hybrid activities, distance learning, in the classroom, etc (Tarev, 2015). It is important that the focus on practice is fixed in the curriculum, which reflects all of these kinds of activities (Tarev, 2015). Along with formal education, practical orientation is realized on the informal and non-formal levels of the educational system (Tarev, 2015).

**EMPIRICAL STUDY DESIGN**

The present part of the contribution demonstrates the design of the empirical study. The guiding research question is as follows: What are the needs of teaching staff for incorporation of practice based approach into engineering education at master level in South Africa? The purpose of the present research is to analyse needs of teaching staff for incorporation of practice based approach into engineering education at master level in South Africa via a focus group interview underpinning elaboration of a new research question.

The qualitatively oriented empirical study allows the construction of only few cases (Mayring, 2004). Moreover, the cases themselves are not of interest, only the conclusions and transfers we can draw from these respondents (Mayring, 2007). Selecting the cases for the case study comprises use of information-oriented sampling, as opposed to random sampling (Mayring, 2007). This is because an average case is often not the richest in information. In addition, it is often more important to clarify the deeper causes behind a given problem and its consequences than to describe the symptoms of the problem and how frequently they occur (Flyvbjerg, 2006, p. 229). Random samples emphasizing representativeness will seldom be able to produce this kind of insight; however, purposive sampling
is more appropriate where some few interesting cases are chosen for their validity. Typically, focus group interviews within the present study are the method of data collection as focus groups interviews examine how knowledge, and more importantly, ideas, develop and operate within a given cultural context as well as explore exactly how the opinions are constructed (Kitzinger, 1995). Circle seating is usually used for a focus group interview (Krueger, 2002). A focus group usually includes from five to 10 participants (Krueger, 2002). The choice of participants for a focus group interview is based on three criteria: participant’s knowledge on a given topic, participant’s cultural difference and education’s diversity (occupation, training, etc) and participant’s hierarchy in the group. The number of participants depends on the heterogeneity of the focus group: the greater the heterogeneity of the group, the fewer the number of participants (Okoli & Pawlovski, 2004). Further on, smaller groups show greater potential (Krueger & Casey, 2000). Thus, five is a good number of participants for the study (Lopez & Salmeron, 2011).

The present focus group was composed of five university teachers from South Africa, Germany and Latvia in May 2019. All the respondents had been awarded doctoral degrees in different scientific fields such as mathematics, pedagogy, and engineering, etc. As the respondents with different cultural backgrounds and diverse educational approaches were chosen, the sample was multicultural. Thus, the group (age, field of study and work, mother tongue, etc.) was heterogeneous. The sample of six respondents involved two professors from Cape Peninsula University of Technology, South Africa, a PhD holder from Cape Peninsula University of Technology, South Africa, a professor from Hochschule Wismar, Germany, and a PhD holder from Centre for Education and Innovation Research, Latvia. In order to safeguard the confidentiality of information of the present research, the respondents’ names and surnames were coded as follows: two professors from Cape Peninsula University of Technology were given the code FG R1 (Focus Group Respondent 1) and FG R2 (Focus Group Respondent 2), a PhD holder from Cape Peninsula University of Technology was pointed as FG R3 (Focus Group Respondent 3), a professor from Hochschule Wismar - FG R4 (Focus Group Respondent 4), and a PhD holder from Centre for Education and Innovation Research – FG R5 (Focus Group Respondent 5).

Respondents’ cultural and educational experience emphasized the significance of each participant’s opinion on research question (Luka, Ludborza, Maslo, 2009) within the present empirical study. It should be noted that opinion is determined as individual’s view based on awareness and attitudes (Lūka, 2007).

The exploratory type of the comparative study (Phillips, 2006) was applied within the present empirical study. The exploratory type of the comparative study aims to generate new hypotheses and questions. The exploratory methodology proceeds (Melnikova, Zaščerinska, Glonina, 2015) from exploration in Phase 1 through analysis in Phase 2 to generating a new research question in Phase 3. The interpretive paradigm was applied to the investigation. The interpretive paradigm aims to understand other cultures and establishment of ethically sound relationships (Taylor, Medina, 2011). Interpretative paradigm is characterized by the researcher’s practical interest in the research question (Cohen, Manion, Morrision, 2005). The researcher is the interpreter. The focus group interview was semi-structured. The majority of questions of the semi-structured interviews are created during the interview, allowing both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues (Case, 1990). The semi-structured interview was based on the question, namely “What are the needs of teaching staff for incorporation of practice based approach into engineering education at master level in South Africa?” The collected data were processed via structuring and summarizing content analysis.

RESULTS OF THE EMPIRICAL STUDY

FG R1 (Focus Group Respondent 1) highlighted the importance of the implementation of practice based approach in engineering education in South Africa. Due to the reform of higher education in South Africa, the period for practical placement (workplace-based learning) of engineering students at universities of technology has generally been shortened. In most new engineering qualifications,
the period of practical training in industry has been halved, while in some it has been removed completely.

FG R2 (Focus Group Respondent 2) emphasized the lack of South Africa’s university teachers’ industrial experience. In certain engineering disciplines where the university experiences great difficulty recruiting academic staff, it is possible for lecturers to be appointed with strong research backgrounds but with limited or no industrial experience. Once university lecturers commence their academic career at university they rarely have an opportunity to update their industrial experience. FG R3 (Focus Group Respondent 3) pointed that South Africa’s university teachers in engineering departments are mostly qualified with degrees in their engineering discipline only. In South Africa, a pedagogic degree for university teachers is not a mandatory requirement for starting an academic career at university.

FG R4 (Focus Group Respondent 4) disclosed that students’ master theses in South Africa are led and supervised by the university’s academic staff only. Students’ master theses are mostly elaborated without an active participation of industrial partners and stakeholders.

FG R5 (Focus Group Respondent 5) focused on the significance of teacher training for university teachers. According to FG R5 (Focus Group Respondent 5), teacher training has to include modern teaching and learning methods and tools for incorporation of practice based approach into engineering education at master level in South Africa.

FINDINGS OF THE EMPIRICAL STUDY

The present empirical study allows finding that practice based approach is on a high demand at universities in South Africa. However, university teachers’ experience in the implementation of practice based approach at universities in South Africa has to be enriched. Teacher training has to enhance both, namely university teachers’

- industrial experience as well as
- pedagogical skills in the implementation of practice based approach to engineering students at master level.

CONCLUSIONS

The theoretical investigation carried out on practice based approach allowed defining practice based approach. The theoretical analysis of scientific publications on practice based approach resulted in identifying the model of practice based approach such as

- notion,
- structural elements as well as
- procedural aspect of practice based approach.

The novelty of the definition of structural elements of practice based approach proposed the authors of the present paper lies in the unity of structural elements such as problem-oriented training (Tarev, 2015), industry-based tasks and/or projects as part of the curriculum, experiences in practice settings (ie workplaces) (Australian Learning and Teaching Council, 2011) and pedagogic practices (Australian Learning and Teaching Council, 2011). Another novelty in the definition of practice based approach is that the emphasis in the procedural aspect of practice based approach is put on

- the social nature as well as
- cyclic nature of the process of practice based approach.

According to the scientific findings disclosed in the present paper, the process of practice based approach proceeds from teaching via peer-learning to learning.

The findings of the empirical study allowed drawing a conclusion that, for incorporation of practice based approach into engineering education at master level in South Africa, teaching staff needs training or, in other words, a training course.
The following research question has been formulated: How to organize a teacher professional development within teacher training for effective incorporation of practice based approach into engineering education at master level in South Africa?

The present research has limitations. A limitation is the theoretical basis on practice based approach set on the inter-relations between definition (notion, structural elements and process) and practice based approach. Another limitation is the empirical study carried out at one university, namely Cape Peninsula University of Technology, in South Africa.

Further work could concentrate on analysis of methods and tools effective for incorporation of practice based approach into engineering education at master level.

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