Lifelong Learning Skills as Essential Attribute for Engineering Graduates

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Structured Abstract

BACKGROUND
Lifelong education which is a precursor of lifelong learning (LLL) grew out of the notion that education is a continuous aspect of life. The concept of lifelong learning is widely used in different contexts. The meaning of LLL depends on the understanding of its 'subject' being the context of students' approach to their learning. The attitude toward self-perfection seems to be a personal trait of character. However, in the engineering degree programmes the concept of LLL has been brought to the fore more succinctly by the accreditation requirements. Great majority, if not all of the accreditation boards require engineering students to possess an ability to engage in LLL.

PURPOSE
The purpose of the research is to determine the attitudes of academic staff towards lifelong learning in the education of engineering students at the undergraduate level. However, the paper also discusses the educational concept of LLL and also presents the results of a survey to assess the understanding of LLL by engineering lecturers. The analysis is done in the background of the general stance of engineering lecturers towards professional skills required by the accreditation agencies. It covers also the strategies employed to promote LLL and the assessment methods whether LLL skills have been acquired.

METHOD
A structured, anonymous questionnaire was used as an instrument for gathering data from respondents. The respondents were engineering lecturers of different specializations and working at different universities. The questionnaire consisted of 16 items that covered such areas as personal details, views on professional skills in engineering education, definition, attitude and application of the lifelong learning in respondent's teaching.

RESULTS
According to the survey, the most common understanding of lifelong learning was that it was the way for an employee to stay competitive in the labour market. Most recognized LLL as an important element of the professional preparation of engineers; however there were still quite a number who classified it as 'not important'. Academic staff taking part in the survey was not sure about their knowledge and understanding of lifelong learning.

CONCLUSIONS
The paper opines that as technology advances in modern knowledge-based economies, industry and other employers will more and more require engineers who are multi-skilled, adaptable and who can operate flexible systems. Therefore professional engineers who are committed to lifelong learning will be in greater demand. In that context the role of lecturers in understanding and imbibing LLL competency cannot be overemphasised. However, in general lecturers are not sure about their knowledge of LLL and are to some extent reluctant to implement lifelong learning in their teaching.

KEYWORDS
lifelong learning, self-directed learning, graduate attributes

Introduction

Lifelong education which is precursor of lifelong learning (LLL) grew out of the notion that education is a continuous aspect of life. The concept of LLL is widely used in different contexts. Its meaning or understanding depends not only on the audience but also on the circumstance and author. McMillan Dictionary gives a relatively short and simple definition of LLL as '*a process of gaining knowledge and skills that continues throughout a person's life*.' It implies that learning must be viewed as an essential component of living itself. However, even that definition can be interpreted in a variety of ways. Lifelong learning can be perceived as a cognitive process for empowering employees to move from one area of employment to another one and usually with higher responsibility. That is the understanding mainly in the UK; in USA it is primarily considered as adult, continuing or distance learning (Riley & Claris, 2008)). Companies are also often interested in acquiring knowledge without necessarily hiring new employees so that the market of LLL, understood here as continuing education, is an important share of the business of education. This is especially true in the domains of medicine, business, engineering, and information technology where boundaries for professional practice are continuously shifting by advances in technology (Riley & Claris, 2008).

Lifelong learning in engineering

The meaning of LLL depends on the understanding of its 'subject' being the context of students' approach to their learning. In the engineering degree programmes the concept of LLL has been brought to the fore more succinctly by the accreditation requirements. Great majority, if not all of the accreditation boards require engineering students to possess an ability to engage in LLL. In that context, the LLL is considered as self-directed learning. The process of self-directed learning refers to the ability of students to identify goals for learning, access relevant information, assess their learning and make necessary modifications to improve their progress by own initiative. In addition, capacity for metacognitive awareness, i.e. "awareness of one's own cognitive process rather than the content of those processes together with the use of that self-awareness in controlling and improving cognitive processes", and disposition toward lifelong learning are considered essential ingredients for LLL. It follows that student-centred learning, which emphasizes the role and participation of student in the process of competence development and knowledge creation, is an important precondition for a successful LLL strategy (Moretti, Naessens & Allen, 2007).

Different types of knowledge

Lecturers have immense opportunities to help students develop LLL skills, mainly, because learning process functions on multiple levels of different types of knowledge (Streveler et al., 2008; Peat, Taylor & Franklin, 2005):

- declarative knowledge: recalling a fact, concept, or theory;
- procedural knowledge: knowing how to apply it;
- contextual knowledge: knowing when to apply it;
- conceptual knowledge: knowing why it is appropriate in a particular situation.

In other words, a student may know something at one level (recognize it) and still may not know how to use it gainfully.

The most important element in the facilitation process is always the instructor/lecturer's activity. Lecturers should see their role as facilitators of learning to help students to think, question and create knowledge. In fact, the nature of teacher's profession inherently implies that teachers should be committed and skilled lifelong learners in the first place. Once the

necessity of passing the skill to the student is recognized there are several strategies that can be applied in order for students to become self-directed, lifelong learners:

- assess the requirements for a particular task,
- evaluate their own knowledge and skills to solve a task,
- plan an approach in order to solve a task,
- monitor and evaluate progress,
- modify methods if necessary.

Attributes essential for engineering graduates

Graduate attributes form a set of individually measurable outcomes which indicate the potential competence and skills of a graduate (Shuman, Besterfield-Sacre & McGourty, 2005; Jarosz & Busch-Vishniac, 2006). The discussion regarding the desired attributes of engineering graduates has been on-going for some years (Nguyen, 1998; Abdullah et al., 2007; Walczak et al., 2013). However, a certain measure of uniformity and acceptance has been achieved through the Washington Accord which governs accreditation processes according to the principles of different collaborating professional engineering bodies (Graduate Attributes and Professional Competencies, 2013; ABET, 2012).

A graduate profile needs to address attributes within three broad domains: personal, professional and intellectual but these attributes are interrelated in the overall development of a graduate. The main attributes of the engineering graduate are as follows:

- in-depth technical competence with application of science and engineering knowledge,
- problem identification, formulation and solution,
- effective communication,
- function effectively as an individual and in teams,
- awareness of the social, cultural, global and environmental responsibilities,
- commitment to professional and ethical issues,
- ability to undertake lifelong learning.

Position of LLL among attributes for engineering graduates

The ability to undertake LLL should be considered as the most important of professional (soft) skills for graduate engineers. The LLL concept is no longer some additional training after graduation but it is inclusive of all activities covering the entire active life of a graduate. It is quite likely that engineering programmes that intend to remain up-to-date with industrial practice by just continually providing courses up-dates or new courses to reflect new developments in technology will be unsuccessful. Graduate engineers equipped with skills and committed to LLL would be able to face new challenges both in terms of the knowledge and also possible job profile change. It should provide engineers with the ability to rapidly update their knowledge and also to acquire those elements which they missed in the course of their formal education (Nair, Patil & Mertova, 2009).

Lifelong learning is the continuous building of skills and knowledge throughout the life of an individual. It should start as early as possible in the learning process and such skills should be introduced and initiated during regular teaching. Lecturers should not just be instructors who deliver the knowledge but they should rather guide and encourage students to acquire knowledge and reflect on their learning. The reflection on the learning process is an important part of the learning experience (Bath et al., 2004).

Methodology of Research

The intention of the research was to determine the attitudes of academic staff towards lifelong learning in the education of engineering students at the undergraduate level. For that purpose a structured questionnaire was used as an instrument for gathering data from respondents. The respondents were engineering lecturers of different specializations and working at different universities. There was no special key in selecting the institutions and individuals chosen for the survey, it was rather a *convenience* sample. The questionnaire consisted of 16 items that covered such areas as personal details, views on professional skills in engineering education and definition, attitude and application of LLL concept in respondent's teaching. In some items/questions a possibility of open answer was provided.

In majority of items respondents had to indicate the level of the importance or relevance of a statement. There were also items where it was necessary to select responses from a list which is not normally mutually exclusive. A trial-test questionnaire was administered to identify and remove any ambiguities in the statements and also to ensure that respondents understood the purpose of the study.

Results of the Survey & Discussion of Results

The survey responses were received from 56 academic staff representing 25 universities from 17 countries. The numbers of females and males respondents were respectively 13% and 87%, the ages varied from 30 and above and 6 branches of engineering were represented.

Importance of Lifelong Learning

The importance of life-long learning was assessed by asking respondents to rank six essential professional skills listed by Accreditation Board for Engineering and Technology (ABET) (ABET, 2012). It was recognized as an important element of the professional preparation of engineers by 70% of the respondents. However, almost one third classified it as '*not important*' and ranked it only better than '*knowledge of contemporary issues*' (Fig. 1).

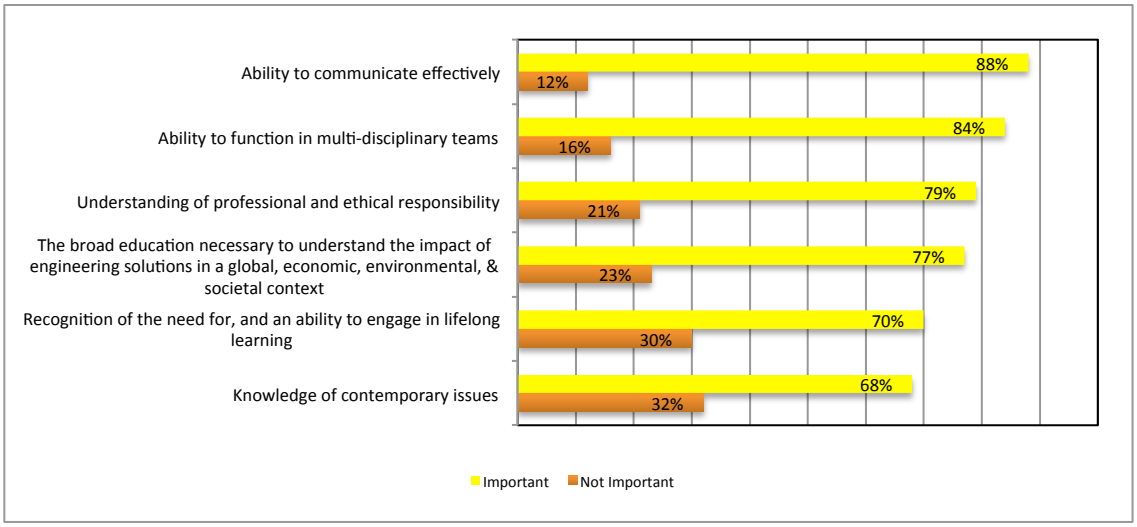


Figure 1: Respondents' assessment of 6 professional skills

All the six professional skills were acknowledged as important (all had a rating above 60%); the '*ability to communicate effectively*' and the '*ability to function in multi-disciplinary teams*' were considered the most essential ones (88% and 84% rating as '*important*' respectively).

Professional Skills

In general, the hard engineering skills were rated almost double in comparison to professional (soft) skills (Fig. 2). Most respondents weighted soft skills at 30% to 50% (Fig. 3), with the most frequent answer of 40%. Nevertheless, there were 24% of answers which weighted soft skills above 50%, i.e. above the hard engineering skills, with the extreme of 85%.

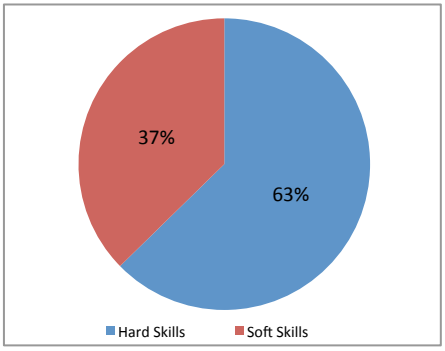


Figure 2: Hard vs. Soft Skills rating (average)

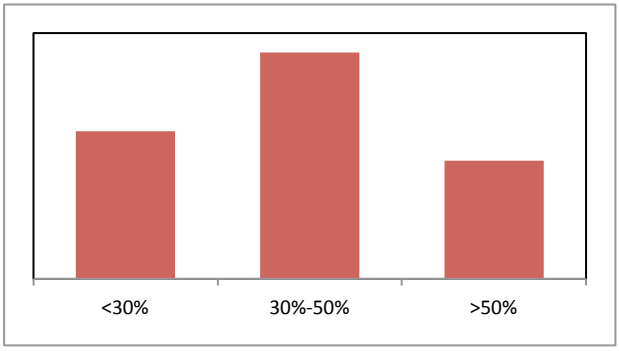


Figure 3: Soft skills rating (percentage)

Definition and Different Aspects of Lifelong Learning

The survey requested respondents to rank the importance of different aspects of LLL. A large number of the respondents (25 answers) opted for LLL being the way for an employee to stay competitive in the labour market (Fig. 4). Nineteen (19) respondents selected the option of self-directed learning, only a few opted for LLL as the possibility to undertake a postgraduate programme or continue education using adult, continuing (6 answers) or distance education (2 answers).

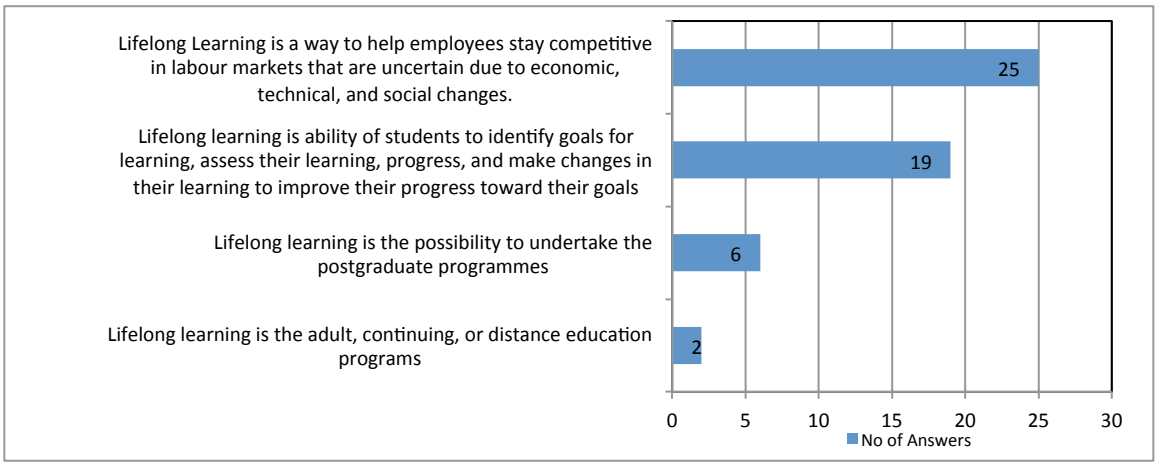


Figure 4: The importance of different aspects of Lifelong Learning

There were also some other answers given by the respondents, such as:

> *Lifelong learning is a continuous process that enables one to keep abreast with changes and developments, technological or otherwise in one's career path.*
>
> *The ability to keep up with and assimilate new technologies, integrated with experience to keep one competitive and able to make a significant contribution.*
>
> *Lifelong learning is impartation of necessary life skills to enhance independent and continued learning.*
>
> *Lifelong learning is being "receptive to newer ideas and emerging technologies"!*

And some answers showed frustration regarding the definition with statements similar to the one below:

> *I don´t know and understand what the hell is lifelong learning. Life is long and people never learn. When I am an old man ready to die I would like to have a break and stop learning!*

There are many circumstances through which academics would have learnt or come across LLL. It is assumed in this study that nobody would have learnt about LLL as an element of teaching through formal education (like postgraduate diploma in education or similar programme).

Lifelong Learning in Curriculum

To improve learning and stay abreast with current developments in a chosen field was considered by the respondents as the most important reason to include LLL in engineering curriculum, with 93% of them agreeing that it is '*important*' (Fig. 5). That was followed by preparation for global economy (79%), engagement in self-direct learning (75%), critical thinking in application to life situations (73%) and problem-solving ability (66%). Other responses were preparation to engage in outside of engineering activity (59%), continuing/distance education (59%) and improving the ability to work in teams was rated the lowest (52%), rated almost '*not important*'.

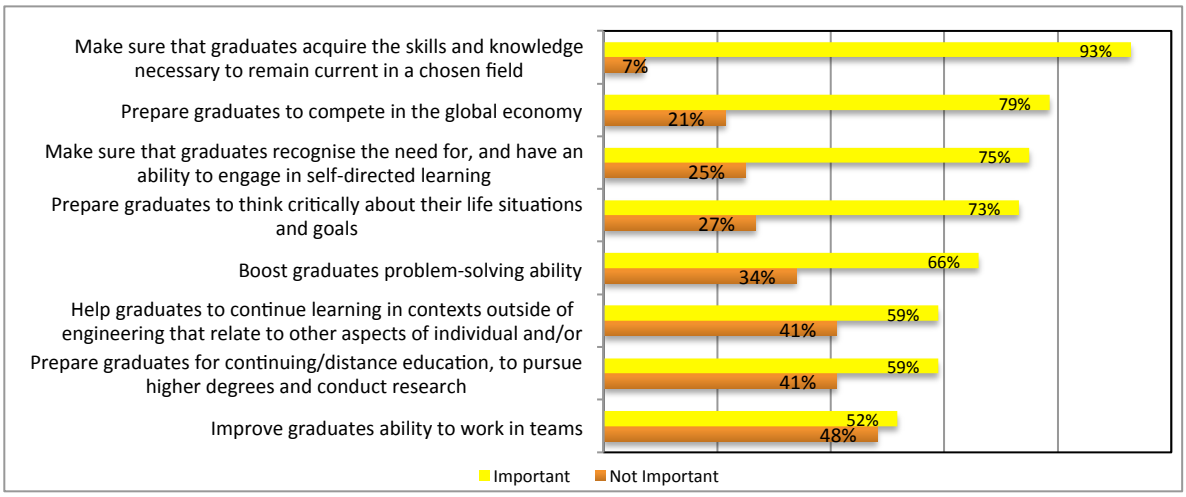
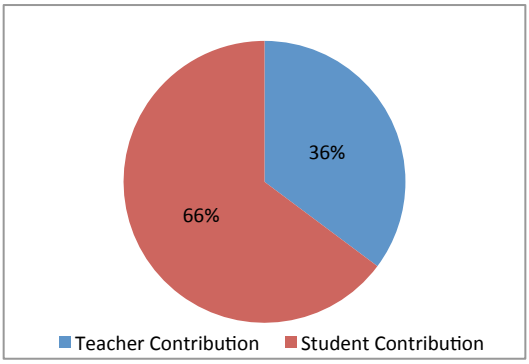
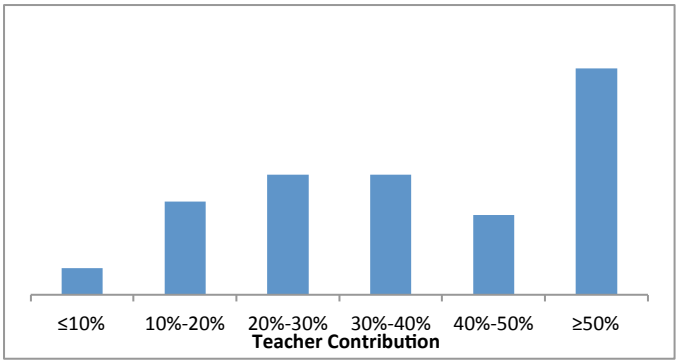


Figure 5: Reasons to include Lifelong Learning in engineering curriculum.

Lifelong Learning in Teaching



(a) Average



(b) Individual answers

Figure 6: Teacher and Student contribution to promoting Lifelong Learning of a student

Almost all participants in the survey feel responsible for fostering LLL skills in their students (82%), they also claimed that they emphasized LLL in their teaching (73%). Most of the respondents were of the opinion that teachers' contribution to promote LLL is less important than students' role (36% vs. 66%, Fig. 6a). However, individual responses varied in terms of teachers' contribution with only 34% of the participants agreeing that it is above 50%, meaning higher students' contribution (Fig. 6b).

Project work, design projects and research papers were suggested as the main effective strategies for introduction and consolidation of LLL skills. Again, project work, together with presentations, was considered as the most effective methods for assessing the attainment of those skills. The most used methods were project work and presentations or both. Structured assessment, such as use of rubrics, was not considered as effective and also not often used.

Conclusions

Lifelong learning ability is one of the professional skills required by various accrediting bodies. The professional (soft) skills cover a variety of aspects and are not in contrast but rather complementary to the hard skills. The study used a questionnaire based survey to assess the attitudes of academic staff towards lifelong learning in the education of engineering students at the undergraduate. It also looked at the level knowledge of lecturers about LLL skills. The study confirmed that hard engineering skills were weighted almost double in comparison to professional (63% for hard skills vs. 37% for professional). Most respondents weighted soft skills at 30% to 50%, with the most frequent response being 40%. There were however about 24% of respondents who weighted soft skills above the hard engineering skills.

Among those professional skills, LLL ability was not considered to be really crucial. It was ranked second to last of all six professional skills listed by ABET; the only less important was '*knowledge of contemporary issues*'.

According to the survey, the most common interpretation of LLL was that it was the way for an employee to stay competitive in the labour market. The second most selected option was of self-directing learning. Most recognized LLL as an important element of the professional preparation of engineers (70%) however 30% still classified it as '*not important*'.

Academic staff taking part in the survey were not sure about their knowledge and understanding of LLL. Quite a number of them admitted openly in the survey that they do not really know the definition nor understand it. Some also admitted that the survey brought '*more questions than answers*'. In that context some of them were reluctant to provide responses to certain questions, especially those related to teaching strategies and assessment of LLL, with statements like:

> *Since we are not sure about the definition and actually do not understand lifelong learning, how could we implement it in our teaching?*
>
> *I cannot clearly assess any evidence of lifelong learning as I do not know enough on the topic.*

Almost all participants in the survey feel responsible for fostering LLL skills in their students (82%), they also declared that they emphasized it in their teaching (73%).

Most of the respondents were of the opinion that teachers' contribution to establish commitment to LLL is less important than students' role (36% vs. 66%). However, access to learning resources (66%), teacher's personal style (57%) and previous learning experience of the student (54%) were listed as major contributors. Project work, design projects and

research papers were suggested as the main effective strategies for introduction and consolidation of LLL skills.

Finally, successful professional development and the job which entails constant development of some skills were considered the most important measures of actual attainment of lifelong learning skills.

In conclusion, the right attitude of students and knowledgeable lecturers are essential in enhancing development and sustenance of LLL ability of engineering students.

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