



MULTILEVEL SYSTEM OF FORMATION OF MATHEMATICAL COMPETENCE OF TEACHING ENGINEERING PROFILE UNDER TERMS OF CONTINUOUS EDUCATION

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Abstract

Purpose of Study: The aim of this paper was designing a multi-stage model for the learning of maths of engineering college students under continuous learning. This was a content analysis study, then we first outlined the basic and key mathematical topics that engineering students should be mastering. We then identified a multi-stage model of expected learning levels for each of these topics, after that, we categorized the topics based on the levels desired and put them in the form of a pattern of continuous learning courses and finally, the time and type of evaluation were determined in each period. Accordingly, the length of each period was considered to be 3 months, and the upgrade criterion in each course was considered as a step in 80% of the topics.

Methodology: This was a content analysis study, in which mathematical topics were first categorized in the field of engineering.

Results: In this research, a five-level model was designed in 12 courses. The criterion for determining the levels, the degree of deepening and the importance of learning, and for the determination of courses, were the key to the basic concepts and concepts that students had difficulty with. The model was designed in five levels, moving from top to bottom, math problems became more abstract and complex. Then, for each level, steps were taken to determine the expectations of the course for students.

Implications/Applications: Mathematical concepts are crucial in engineering, but students over time forget them and face a lot of problems in their work. Accordingly, it is imperative to use This model for continuous learning of these concepts for Russian engineering students.

Keywords: *Continuous Learning, Multi-Stage Model, Engineering Profile, Math*

INTRODUCTION

Today, the role of education for the future of society cannot be ignored. The foundation of social solidarity, economic progress, sustainable development, human excellence, peace, and friendship all depend on education and learning lessons. But college education does not work to achieve such transcendental goals. Consequently, a fundamental rethink is needed in the structure, methods, content, organizing methods, and in particular the focus on the learning pathways that lead to education improvement. In such a way that the individual becomes involved in a constant, conscious and responsible process, and he promotes his commitment to self-learning through the creation, strengthening and consolidation of the "continuous learning" approach ([McLean, 2007](#); [Bayat et al., 2014](#)).

Continuous learning has also come under other titles such as "life-long learning," "endless learning," "continuous learning." Continuous learning has a generalization that embraces all levels and stages of the process and seeks to connect out-of-school learning environments with the school-based learning environment and eliminate artificial learning boundaries. Continuous learning indicates that each environment is a potential learning environment, and as a result, the school is no longer the only place of education ([Kirby, Curran, and Hollett, 2009](#); [Dmitriyeva, & Nikiforova, \(2016\)](#)).

The challenge that today's man faces is a phenomenon called "information explosion". The effects of these changes and developments have been the source of many writers and scholars. Regardless of the extent to which these developments evolve, the result of this is the inescapable proposition of two fundamental questions. The first question is, what are the effects of these transformations on the educational system? And the second question is, how should the educational system face this challenge? The flood of information is constantly on the rise. With the development of new knowledge and its aging. Ideas are refined so that even with retraining it is difficult to update it. Therefore, the concept of "life-long learning" is considered as one of the keys to entering the 21st Century, which requires its implementation, solutions and implementation ([Schütze and Slowley, 2012](#), [Gorard, Fevre and Rees 1999](#); [Trámpuz, Juan Pablo, and Daniel Barredo Ibáñez, 2018](#); [Jenaabadi & Issazadegan, 2014](#)).

Known forms of post-public post-graduate learning activities in this area include Grade Credit Credits by Non-Traditional Students, Professional Training, College Retraining, Workforce Training, and Official Formal Enrichment (Grepperud and Johansen, 2000). In the field of continuing education, professional continuing education is a specific learning activity that is usually identified by issuing a license or continuing education unit to document attendance at a specified seminar or training course. Licensing agencies apply different requirements for continuing education to licensed members to continue their education in a particular profession. These requirements are intended to encourage professionals to expand their knowledge base and achieve new advancements (nonuevo, Ohsako and Mauch, 2001; Selomo, and Govender, 2016).

One of the areas that are heavily dependent on continuing education is the engineering field. Developments and quick innovations of garden engineering will require engineers to continuously update their information and skills (Bryce and Wither, 2003). In Russia, this is very important because of industrial growth, because as an industrial country, engineers are one of the pillars of excellence. Previous research has shown that engineering students are generally poorly engineered in mathematics. This has led the continuous learning institutes to always have math engineering courses that will cost extra time. Therefore, the purpose of this study was to design a multi-stage model for the learning of maths of college students under continuous learning.

METHODOLOGY

This was a content analysis study, in which mathematical topics were first categorized in the field of engineering. Then, the main issues that students were having difficulty were identified and based on them, a multi-stage model for continuing education in engineering mathematics was designed. The design of the model was based on the fact that both the level of difficulty and the type of evaluation should be determined. Accordingly, at first, the levels of assignments were determined, then the type of evaluation and criteria for success were designed for them.

RESULTS AND DISCUSSION

In this study, we first outlined the basic and key mathematical topics that engineering students should be mastering. We then identified a multi-stage model of expected learning levels for each of these topics. These five levels were:

1-Describe what a function is and determine its inverse, if it exists, 2-Describe what a limiting process is, calculate a limit and how it applies to real-world situations, 3-Determine the derivative of a function, and in particular, to find the minimum or maximum value of a function and apply it in a real-world sense, 4-Evaluate the integral of a function and understand what this means in the context of a particular example and 5- Derive and solve simple first order ordinary differential equations that arise in a scientific context (figure 1).

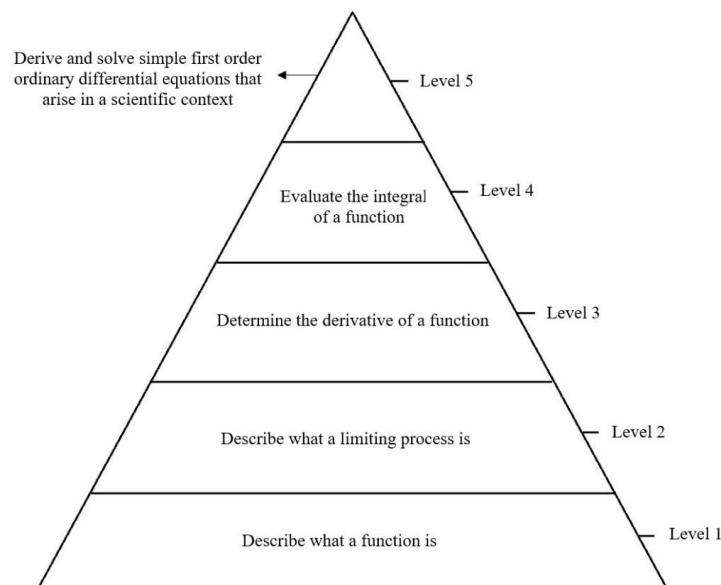


Figure 1. A multilevel system for teaching mathematical competence of engineering profile

After determining the levels, we categorized the topics based on the levels desired and put them in the form of a pattern of continuous learning courses (figure 2)

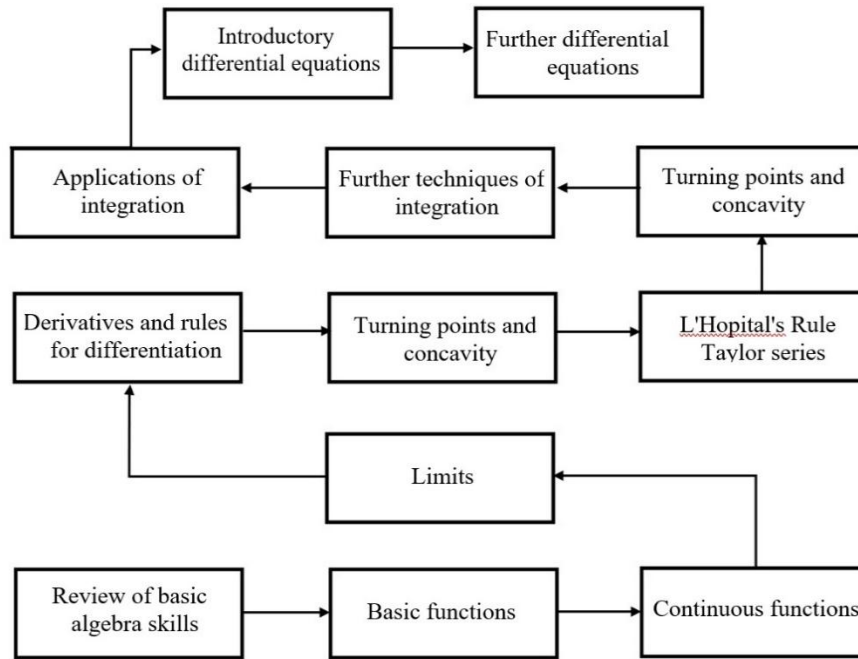


Figure 2. Continue learning the curses of mathematical competence of engineering profile

The combination of levels and curses can be seen in Table 1:

Table 1: Multilevel system and curses for teaching mathematical competence of engineering profile

Curses	Levels				
	1	2	3	4	5
Review of basic algebra skills					
Basic functions	•				
Continuous functions	•				
Limits		•			
Derivatives and rules for differentiation			•		
Turning points and concavity			•		
L'Hopital's Rule, Taylor series			•		
Basics of Integration				•	
Further techniques of integration				•	
Applications of integration				•	
Introductory differential equations					•
Further differential equations and applications					•

Finally, the time and type of evaluation were determined in each period. Accordingly, the length of each period was considered to be 3 months, and the upgrade criterion in each course was considered as a step in 80% of the topics.

CONCLUSION

Mathematical concepts are crucial in engineering, but students over time forget them and face a lot of problems in their work. Accordingly, it was imperative to design a model for continuous learning of these concepts for Russian engineering students. This research was conducted with the goal of one, and based on that, a five-level model was designed in 12 courses. The criterion for determining the levels, the degree of deepening and the importance of learning, and for the determination of curses, were the key to the basic concepts and concepts that students had difficulty with. Finally, the model was designed and the criteria for upgrading as well as the duration of the courses were estimated. The model was designed in five levels, moving from top to bottom, math problems became more abstract and complex. Then, for each level, steps were taken to determine the expectations of the course for students. Finally, based on the nature and level of difficulty of each step, the type and criterion of the evaluation were also designed.

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