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Professional Culture of the Specialist of the Future

**THE CONTEXT AND CONTENT APPROACHES TO TEACHING
MATHEMATICS AT THE ECONOMIC UNIVERSITY**

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Abstract

Fast changes in the scientific and technological and information space of the modern world require a prompt restructuring of the educational processes in the higher school. Modern graduate should possess not only an enormous amount of professional knowledge and skills, but also be ready for constant improving. Formation of the professional competencies is one of the main requirements of the educational standards for higher education. The achievement of the goal is due to the early start of profiling, practical orientation of all subjects starting from the first year of study. The ideas of this profiling are in the strategy for the development of the educational activity of the Financial University under the Government of the Russian Federation. The authors of the article actualize the ideas of early profiling within the 'Computer Practicum' discipline which is conducted for the first year bachelors of the 'Economics' and 'Management'. Two modern educational approaches, context and content are used to intensify the learning process. The experience of the applying considered approaches to teaching of basic baccalaureate subjects is discussed in this article. It is supposed to expand the using of the Content and Language Integrated Learning (CLIL), implementing it with the context approach to computer practicum where the basics of computer technologies based on mathematical content are being studied with the use of economic context. Authors' experience shows the effectiveness of the proposed methodology making it promising for the future use and improvement.

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Keywords: Activity Teaching Methods, Computer Practicum, Context Approach, Content And Language Integrated Learning (CLIL), Higher Education Profiling.



1. Introduction

The preparation of highly qualified specialists has always been the aim of higher education institutions. Over the time the qualification requirements, basic levels and fields of training have changed, but as a rule these changes were gradual and took place over decades. Nowadays the rapid development of the scientific and technological, economical and information space requires the same quick response from higher educational training. Its objective is to prepare a specialist who is needed not only in the present moment, but in future. This specialist should have an in-depth knowledge and professional competences, be able to find creative solutions and achieve set goals, and, that is also equally important, be prepared for embracing anything new, for constant development and self-education.

In the strategy for the development of the educational activity of the Financial University under the Government of the Russian Federation special emphasis is placed on the *forested teaching*, its aim being the developing of the specialists' personal and professional potential and their mobility. The important part of this educational program is the *early profiling*, that is the strengthening of the applied approaches of all disciplines since the first year of study. In this regard, the program development and teaching basic, previously considered as general education subjects have to meet special requirements.

2. Problem Statement

Mathematical disciplines are among the basic disciplines traditionally studied in the first year of baccalaureate. The requirements for the level of the modern economist and financier's mathematical training are very high. Among them are the confident possession of mathematical tools, the construction of mathematical models, the systematic analysis of the processes under conditions of uncertainty. Training programs contain a sufficient number of mathematical courses, however the practice shows that students face difficulties while using a mathematical tool for solving specific economic challenges. This is *the first contradiction*: the study of mathematics is occurring, and using it causes problems. It's particularly illustrated by sequential construction of disciplines in the curriculum: mathematical first, special economic ones next. The parallel construction of the process appears to be more effective, and in the last academic year the Department of Data Analysis, Decision Making and Financial Technologies of the Financial University made readjustments of the sequence of 'Mathematics' training topics for synchronization with 'Microeconomics'. Still, the parallel alignment is not enough. The changes in the mathematical disciplines are needed: both in the content and the syllabus.

It should be noted that mathematical science is rapidly evolving, the math apparatus is changing and process models are being refined. Today almost everything, especially applied mathematics research are executed by the computer programs. Therefore it is impossible to train a modern specialist without taking these tendencies into account. This is *the second contradiction*: mathematics heavily relies on the computer technologies, yet it is taught on the principle of the 'pen-paper' principle.

Authors' main task was to develop a teaching methods for mathematical disciplines allowing the resolving of the contradictions mentioned above: teaching mathematics should be adapted to the modern trends in the development of mathematics with the continued reliance on the practical orientation of the course.

3. Research Questions

First of all, the authors turned to the already existing practice-oriented methods of teaching. Among them a context approach, that allows to form a learning process with the account of the professional needs of future graduates, has been singled out.

Introducing a new discipline 'Computer Practicum' to the first-year bachelor of 'Economics' and 'Management' curriculum stimulated the search for new and modern teaching methods. Since the new subject was based on mathematical issues, it was decided to view mathematics as the content filling of the subject and to explore the possibility of using in teaching process content-technologies widely used in teaching professional disciplines in a foreign language (Content and Language Integrated Learning - CLIL).

Therefore, the following objectives were formulated:

- to study the concept of the context approach in teaching and to include the issues of the economic context in 'Computer Practicum';
- to consider the possibilities of using the content-technologies for integrating 'Mathematics' and 'Computer Practicum'.

4. Purpose of the Study

The study of the questions posed made it possible to formulate a hypothesis: the combined use of two types of practice-oriented technologies in the educational process (context and content) meets the requirements of modern standards for the education profiling and satisfies the educational needs of today's students.

The purpose of the study was to develop a methodology for conducting 'Computer Practicum' classes on the basis of mathematical content with the active use of the economic training context.

5. Research Methods

5.1. Literature review

The combined use of several technologies usually has an integrative nature. It takes more than a decade to study integrative aspects in professional higher education. Integration as the convergence and unification of particular elements on the basis of their relationship implies qualitative transformation of both the entire system and its particular elements. Makarova (2008) identifies two areas of the integration study:

- education reflects the integrative tendencies of the science and culture developing and united in a single global picture, they create the basis for the learner's worldview;
- education represents an integrated field of activity where the learner's personal and professional becoming takes place.

The experience of the integrative approach to the basic mathematical preparation of the bachelors of Economics is represented in the works of the lecturers of the Financial University (Denezhkina, Popov, & Samylovskiy, 2012; Goncharenko, Denezhkina, Popov, & Shapoval, 2014). The early profiling in teaching of mathematical disciplines to the students in Economics, according to the authors (Konnova, Rylov, & Stepanyan, 2016a), contributes to the increased interest in the subject, a deeper understanding of

economic patterns and the conscious use of mathematical models in the solving of the practical-oriented challenges.

It's a comprehensive vision of education that represents a context-based learning that is an activity-based educational technology formulated by Verbitskiy in the 1990s successfully tested in Russian education, remaining relevant today. Verbitskiy (2004, 2017) provides three origins, on its basis the theory and technologies of context learning have been developed:

- the activity learning theory developed in Russian psychology;
- theoretical generalization of the diverse experience of uses, forms and methods of the active learning including problem-based ones;
- the influence of the subject and social context of the student's future professional activity on the process and the results of their academic activity.

European university professors share their unique experience in the use of integrative and context learning technologies in the teaching of foreign languages. For example, Gil-Salom and Benloch-Dualde (2016) present a methodology that was used for the integration in the evaluation of oral presentation in German (as a foreign language) done by the Polytechnic University of Valencia students. Tareva (Tareva & Tarev, 2018) views methods implying rethinking (redefinition) the role and status of a foreign language:

- in the continuous humanitarian person education (Life-Long Learning - LLL);
- in the organic combination of productive work with learning a foreign language and student's activities, such as research, rationalization, invention and innovation (Practice-Based Professional Learning - PBPL);
- in the enhancing of the interconnection between learning a language and the subject content of professional disciplines (Content and Language Integrated Learning - CLIL).

The last one (CLIL) presents a particular interest to our research since it creates the best opportunities for the character development that is able to independently set and overcome professional challenges, to effectively communicate in the professional sphere in native and foreign languages. Ting (2010, 2011) who led the development of the methodology, writes that CLIL has the potential for a significant revision of both the content of education and the language training through kinds of induction. She believes that the teacher should guide students to the deep understanding of the conceptions of the studied discipline through interactive sessions and suggests using the 50:50 ratio for Content: Language in the educational training and the foreign language teaching.

Salisbury's (2018) work presented a study on the effect that the lecturer who has previous experience of Course Management System (CMS) has on the quality of education and students' end results. Pavón & Gaustad's (2013) study analyzes key issues faced by universities in the developing of bilingual programs and proposes effective measures for dealing with them.

The work of Goldfarb et al (2018), as the origin of the classification of the complex problematic cognitive-communicative tasks in the field of technical education, should be highlighted among the studies of the CLIL methodology. Also the Bahls & Wray's (2015) work is noteworthy that describes the effect of using the technical software on the undergraduates' mindset and computational processes in the fields of science, technology, engineering and mathematics.

5.2. Comparative analysis of context and content approaches

As a promising method for the embodiment of the ideas of early profiling it was decided to use context and content approaches in an integrated manner. Let us compare them. (Table 01)

Table 01. Comparative analysis of two types of educational technologies

	Context approach	Content approach
Concept	Using the context of professional activity in education	Integrated approach in teaching subjects on the basis of content
Objective	Profiling of the educational process	Intensification of the educational process
Implementation forms	Filling the course content with profile assignments	Learning subject content through a foreign language
	Activity-based learning: projects, cases, business games	
Practice applications	Mostly in use in higher education through teaching profile subjects	In use in middle and high school through teaching subjects through a foreign language
Prospects for implementation	Wider implementation in the teaching of basic subjects	Studying the possibilities of applying a wider range of subjects in teaching these disciplines together

6. Findings

6.1. Integration of context and content approaches in ‘Computer Practicum’

For several years the authors have been working on the creating of an integrated comprehensive approach to early profiling of the educational process (Konnova, Rylov, & Stepanyan, 2016a). Its ideas include the gradual transformation of the presentation of the mathematical courses and teaching methods. The authors attempted to develop a system of accessible practice-oriented challenges in the textbook ‘Economic applications of higher Mathematics in case studies’ (Konnova, Rylov, & Stepanyan, 2016b).

‘Computer Practicum’ has been introduced in the Financial University’s first year ‘Economics’ and ‘Management’ baccalaureate curriculum since 2017. The main goals of the new discipline are (Zadadayev, 2017):

- to provide students with the knowledge of computational methods in the implementation of mathematical models;
- to form practical skills for applying the computer technologies used in economics and finance.

The programming language R and Microsoft Excel are used as tools. As for the content course it is based on the higher mathematics’ material. It should be noted that together with the ‘Computer Practicum’ discipline the students study ‘Mathematics’ which provides important opportunities for a deeper understanding of mathematical patterns and a practical use of mathematical methods in future professional activity.

The ‘Computer Practicum’ classes take place in computer rooms and, naturally, aim to introduce students to the modern information technologies’ abilities, to form specific technical skills. However, it’s irrational for Economics’ students to study ‘Computer Science’ only as a discipline itself: time requires

the intensification of teaching, to study several subjects simultaneously. This approach allows not only to expand the students' knowledge on specific subject areas but also to draw a connection between them and their interpenetration (diffusion). All this positively influences the effectiveness of the process of subject mastery and corresponds with the students' educational needs.

Challenges met by students with the practical use of mathematical methods and the objective difficulty of the mathematical disciplines' content have become a major cause for expanding the mathematical component in educational process. The content of 'Mathematics' discipline was the foundation of 'Computer Practicum', that is a content for the new discipline. Furthermore, the new opportunities for filling the educational activity with the professional economic context have emerged (Figure 01).

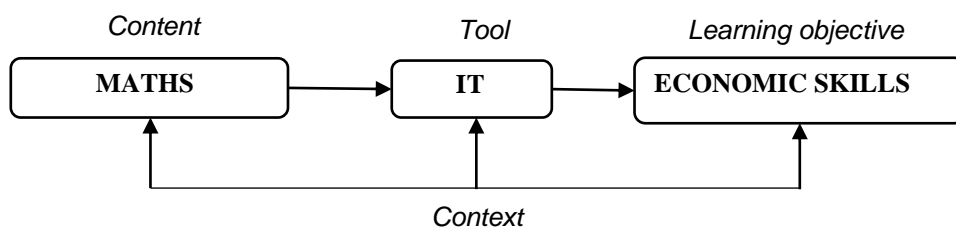


Figure 01. The relationship between 'Mathematics' and 'Computer Practicum'

Table 02, presented below, contains information on the approximate distribution of the course's theoretical input, indicating the formed computer skills and the affected economic context.

Table 02. Distribution of mathematical topics with the indication of computer skills and economic context

№	Mathematical content	Computer skills	Economic context
Calculus			
1	Sets and functions		
	Different ways of specifying dependencies, numeric and other functions, graphs of functions	Data input and processing, formatting and programming of cells, sequence generation, building different types of diagrams (Excel)	Initial data analysis skills, demand functions and supply schedules, cobweb model
2	Differential calculus of functions of one variable		
	Approximate estimations of the derivative, plotting the tangent line, approximate calculations using the Maclaurin formula, graphing functions with the numerical investigation of its behavioral	Performing different calculations, making and editing of graphs (Excel)	Finding extremum, concept of elasticity
3	Integral calculus of functions of one variable		
	Calculation of a numerical value of definite and improper integrals with an appropriate degree of accuracy	RStudio console, programming variables, assigning custom functions (R)	Calculation of the financial flows by density investments, Lorenz curve

4	Functions of several variables		
	Construction of the level's contour lines and surfaces, calculation of partial derivatives	Symbolic differentiation (R)	Production function, utility function, limit values, marginal rates of substitution
5	Differential equations		
	Numerical solutions for differential equations	Cycles, conditional statements, programming recurrence relations (R)	Exponential growth and Verhulst-Pearl equation
	Linear algebra		
6	Vectors and matrices		
	Actions with large vectors and matrices	Assigning vectors and matrices, vector and matrix operations, types of arrays, multidimensional data, export and import of data (Excel and R)	Working with large amount of economic data
7	Systems of linear algebraic equations		
	Numerical methods/solutions of linear equation systems, matrix equations	Computing determinants, inverse matrices, additional packages (R)	Illustration of the solution to the economic challenges with a large amount of data
8	Vector spaces. Eigenvectors, eigenvalues		
	Numerical determination of the matrix of a linear mapping, eigenvectors and eigenvalues of a linear operator	Eigendecomposition and singular-value decomposition (R)	Leontief model
9	Linear programming		
	Main objectives of linear programming, simplex algorithm, transportation theory	Installing additional packages and working with them (Excel and R)	Addressing the linear programming problems of economic spectre

It should be noted that the material of the mathematical content does not duplicate the content of 'Mathematics' discipline but effectively complements it with visualization and approximate numerical computations. It is these calculations that are most commonly used in applications. Yet, in the traditional mathematics they are not being paid enough attention, so naturally they cause problems for students.

It is noted that the integration of the context and content approaches is not a mechanical combination of the three columns of Table 02. In the process of the parallel learning of 'Mathematics' and 'Computer Practicum' all three components are being strengthened since they occur through mutual necessity and are in constant interconnection.

The professional context is not limited by adding economic issues to the material. According to Verbitskiy (2004, 2017) we can also identify the substantive and technological and the social context, both of them relating to the students' future professional activity. The *substantive and technological context* includes:

- work with data;

- the study of functional dependencies;
- linear programming;
- introduction to the simplest financial instruments.

The *social context* is presented by:

- the individual learning curves;
- group work;
- development of the information culture;
- basic skills of dealing with crisis situations;
- project activity.

6.2. Feed back

Let us cite the results of the survey of the Financial University students of two faculties who have studied the ‘Computer Practicum’ discipline for two semesters. 58 students of the Faculty of Public Administration and Financial Control (Audit and Control) and 182 students of the Faculty of Financial Markets took part in the survey.

The questions of the anonymous electronic survey were given to the students after they have received their final grades and were referred to the satisfaction with the received knowledge, teaching materials and the accessibility of the discipline presentation. The distribution of responses to the questionnaire providing an important information about the usefulness of our experiment is shown below (Figures 02-04).

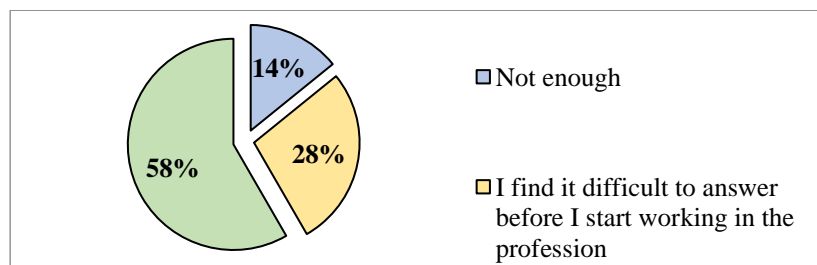


Figure 02. Have you been provided with enough knowledge for effective professional activity in ‘Computer Practicum’?

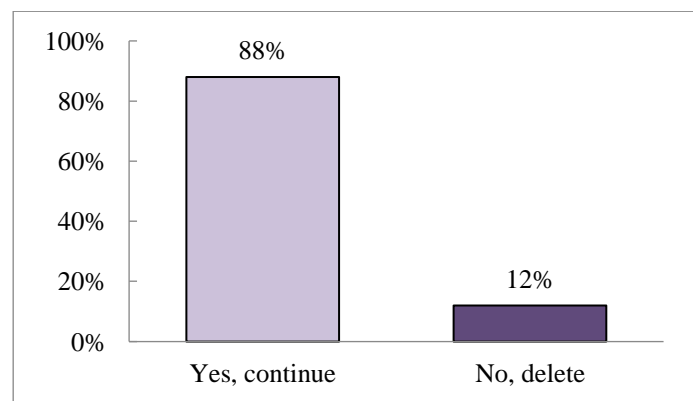


Figure 03. Would you rather keep ‘Computer Practicum’ as it is or have it removed from the curriculum?

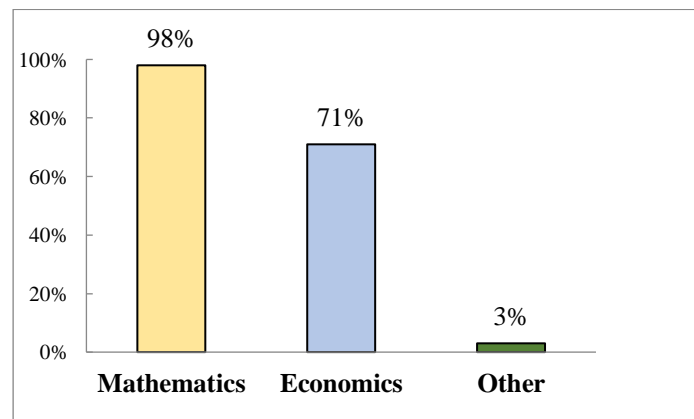


Figure 04. What disciplines is 'Computer Practicum' useful for?

According to the responses, 58% of the students understand the usefulness of the studied practicum for their future professional activity, 88% consider the course useful. 98% of respondents see the direct ties of the basic of computer technology knowledge to resolving mathematical challenges, and 71% of respondents are aware of their potential application in meeting economic challenges.

7. Conclusion

The current pace of life, the growing amount of information, rapidly changing computer technology also make the educational process change. The higher education training should be effective, modern and intensive. The activity technologies are becoming increasingly popular: they are designed for students, contribute to the substantive and academic skills. Among such technologies one could certainly include context and content approaches.

Analysis of scientific and methodological literature showed that the context approach is mainly used in teaching of profile subjects, while the content approach is considered to be a method of a foreign language teaching. At the same time, the context approach is an effective way of profiling, and the content approach allows the integration of several subjects. This enlarges the learning opportunities that meet the modern requirements for the training specialists. Thus these both approaches to teaching basic subjects should be appropriately used since the first year of study.

On the base of 'Computer Practicum' the authors have implemented and applied the methodology for the combined use of both approaches: on the basis of both mathematical content and the intensive use of the economical training context. The classroom practice and the final survey demonstrated the effectiveness of the proposed methodology and the promise of such methods synthesis in the modern educational process.

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References

- Bahls, P., & Wray, A. (2015). LaTeXnics: the effect of specialized typesetting software on stem students' composition processes. *Computers and Composition*, 37, 104–116. doi: 10.1016/j.compcom.2015.06.006
- Denezhkina, I.E., Popov, V.J., & Samylovskiy, A.I. (2012). Formirovaniye matematicheskogo komponenta professionalnogo instrumentariya vypusknika Finansovogo universiteta [Forming professional component of mathematical instruments of the Financial University graduate]. *Financial University Bulletin*, 16(6), 100–111.
- Gil-Salom, D., & Benlloch-Dualde, J. (2016). Student assessment of oral presentations in German as a foreign language. *Procedia - Social and Behavioral Sciences*, 228, 656–661. doi: /10.1016/j.sbspro.2016.07.100
- Goldfarb, V.I., Krylov, E.G., Perminova, O.M., Barmina, N.A., & Vasiliev, L. (2018). Aspects of teaching “Advanced GEARS” for future mechanical engineers within “Bachelor of Sciences” programs at technical universities. *Advanced Gear Engineering, S. “Mechanisms and Machine Science”*, 271–287. doi:10.1007/978-3-319-60399-5
- Goncharenko, V.M., Denezhkina, I.E., Popov, V.J., & Shapoval, A.B. (2014). O roli matematiki v sovremennoj jekonomicheskoy nauke [About a role of mathematics in modern economic science]. *Financial University Bulletin*, 18(5), 131–136.
- Konnova, L.P., Rylov, A.A., & Stepanyan, I.K. (2016a). Elementy integrativnogo podhoda k bazovoj matematicheskoy podgotovke ehkonomistov [Elements of integrative approach to basic mathematical training of economists]. *Financial University Bulletin*. 20 (5), 158-166
- Konnova, L.P., Rylov, A.A. & Stepanyan, I.K. (2016b). *Ekonomicheskie prilozheniya vysshej matematiki v kejsah: uchebnoe posobie [Economic applications of higher mathematics in case studies: a tutorial]*. Moscow: Financial University Publ.
- Makarova, E.E. (2008). Soderzhanie i struktura integrativnogo podhoda v vysshem professional'nom obrazovanii [Maintenance and a structure of the integrative approach in higher professional education]. *Integracija obrazovanija [Integration of education]*, 3, 8–11.
- Pavón Vázquez, V., & Gaustad, M. (2013). Designing Bilingual Programmes for Higher Education in Spain: Organizational, Curricular and Methodological Decisions. *International CLIL Research Journal*, 2(1), 1-13. Retrieved from https://www.unifg.it/sites/default/files/allegatiparagrafo/17-12-2014/pavon_vazquez_and_gaustad_bilingual_clil_programmes_in_spain.pdf
- Salisbury, L.E. (2018). Just a Tool: Instructors' Attitudes and Use of Course Management Systems for Online Writing Instruction. *Computers and Composition*, 48, 1-17. doi: 10.1016/j.compcom.2018.03.004
- Tareva, E.G., & Tarev, B.V. (2018). The assessment of students' professional communicative competence: new challenges and possible solutions. *XLinguae*, 11(2), 758-767.
- Ting, Y.L.T. (2010). CLIL appeals to how the brain likes its information: examples from CLIL-(Neuro)Science. *International CLIL Research Journal*, 1(3), 1–18. Retrieved from <http://www.icrj.eu/13-73>
- Ting, Y.L.T. (2011). CLIL not only not immersion but also much more than the sum of its parts. *English Language Teaching Journal*, 65(3), 314–317, doi: 10.1093/elt/ccr026
- Verbitskiy, A.A. (2004). Kompetentnostnyj podhod i teoriya kontekstnogo obucheniya [Competence approach and the theory of context learning]. *Materialyi k chetvertomu zasedaniyu metodologicheskogo seminaru 16 noyabrya 2004 g. [Papers to 4-th meeting of the methodological seminar. November 16, 2004]*, Moscow, IC PKPS Publ.
- Verbitskiy, A.A. (2017). *Teoriya i tekhnologii kontekstnogo obrazovaniya [Theory and technologies of context education]*. Moscow, MPGU Publ.
- Zadadayev, S.A. (2017). *Komp'yuternyj praktikum. Rabochaya programma discipliny dlya studentov, obuchayushchihsya po napravleniyu podgotovki 38.03.01 «Ekonomika», vse profili ochnoj formy obucheniya. [Computer Practicum. Curriculum for students majoring in 38.03.01 'Economics', all full-time education programs.]* – Moscow, Financial University. Retrieved from https://portal.fa.ru/Files/Data/4ba415ba-880a-43f8-a8e0-ac843c1eea06/kp_bak_ec.pdf