

## Artículo de investigación

**Integrative Teaching of Mathematics as a Means of a Forming Modern Economist****Интегративное Обучение Математике Как Средство Формирования Современного Экономиста**

Recibido: 5 de noviembre del 2019

Aceptado: 3 de enero del 2020

Written by:

**Larisa P. Konnova**<sup>192</sup>[https://elibrary.ru/author\\_items.asp?authorid=691336](https://elibrary.ru/author_items.asp?authorid=691336)

ORCID: 0000-0002-8816-6341

**Alexander A. Rylov**<sup>193</sup>[https://elibrary.ru/author\\_items.asp?authorid=123619](https://elibrary.ru/author_items.asp?authorid=123619)

ORCID: 0000-0001-9474-8519

**Irina K. Stepanyan**<sup>194</sup>[https://elibrary.ru/author\\_items.asp?authorid=568410](https://elibrary.ru/author_items.asp?authorid=568410)

ORCID: 0000-0003-2942-0976

**Abstract**

**Introduction:** A modern specialist in practically any field should not only possess professional expertise but also have a good command of modern computer technologies and main mathematical methods of data modeling and processing. It is employers' requirements and, at the same time, students' demands to receive this exact type of education. The study examines various ideas of educator-researchers striving to change the educational process to match the new goals. Meanwhile, the authors place the main emphasis on teaching mathematics. Drawing on the experience of teaching at the Financial University under the Government of the Russian Federation, the authors propose an integrative model of teaching mathematics that utilizes the contextual approach and content-based teaching.

**Materials and Methods:** The main methods of the study are the analysis of scientific works and pedagogical modeling based on the following methodological approaches: competency-based, integrative, activity-based, as well as the concept of the zone of proximal development. The authors place special importance on the contextual approach and content-based teaching.

**Results:** The analysis of works confirms the significance and relevance of interdisciplinary courses. The necessary modernization of the educational process and its contents is based on the integrative approach. The contextual

**Аннотация**

Современный специалист практически любой отрасли помимо профессиональных знаний должен владеть современными компьютерными технологиями и основными математическими методами моделирования и обработки данных. Это требование работодателей и, с другой стороны, запрос студентов на получение именно такого образования.

В работе рассматриваются различные идеи педагогов-исследователей, стремящихся к изменению образовательного процесса в соответствии с новыми целями. При этом основной акцент авторы делают на обучении математике.

Опираясь на опыт преподавания в Финансовом университете при Правительстве Российской Федерации, авторы предлагают интегративную модель обучения математике, использующую контекстный подход и контентное обучение.

**Материалы и методы:** Главными методами исследования являются анализ научных публикаций и педагогическое моделирование, основанное на следующих методологических подходах: компетентностном, интегративном, деятельностном, а также концепции зоны ближайшего развития. Особую роль авторы

<sup>192</sup> Financial University under the Government of the Russian Federation, Russian Federation<sup>193</sup> Financial University under the Government of the Russian Federation, Russian Federation<sup>194</sup> Financial University under the Government of the Russian Federation, Russian Federation

approach is increasingly used in higher education to reinforce professional orientation. As for content-based education, it is currently used only in foreign language teaching. Within this study, the authors propose an integrative model of teaching mathematics at economics universities. To enforce the focus on the application in basic student training, the contextual approach is utilized which allows giving professional substance to the content of an educational course. The second part of the model is content-based teaching. The authors enhance its potential uses and believe that studying interconnected subjects together allows one to show common patterns and makes the educational process more efficient, intensive and mindful.

**Discussion and Conclusions:** The relevance of having command of mathematical methods and computer technologies for multidisciplinary specialists makes it possible to generalize the creative model by adding various professional contexts.

**Key Words:** Profilization of teaching mathematics, integrative model, contextual approach, content-based teaching, computer workshop.

## Introduction

Active implementation of modern technologies in all areas of public life presents professional education with increasingly difficult challenges. It must prepare a professional who possesses professional expertise and has a good command of modern computer technologies and main methods of mathematical analysis and modeling. Moreover, the state's demands, as well as students themselves, change the perspective on the educational process. The modern student wants to obtain knowledge in a more intensive way while extensively using activity-based and practice-oriented interactive methods.

придают контекстному подходу и контентному обучению.

**Resultados de la investigación:** El análisis de la literatura muestra la actualidad y la necesidad de cursos interdisciplinarios. La necesaria modernización del proceso de enseñanza y su contenido se construye en un enfoque integrativo. Cada vez más para reforzar la orientación profesional en la educación superior se utiliza el enfoque contextual que permite dar sustancia profesional al contenido de un curso educativo. La segunda parte del modelo es la enseñanza basada en el contenido. Los autores mejoran sus usos potenciales y creen que el estudio de temas interconectados juntos permite mostrar patrones comunes y hace el proceso educativo más eficiente, intenso y consciente.

En el trabajo se propone un modelo integrativo de enseñanza de matemáticas en un instituto económico. Para reforzar el enfoque en la aplicación en la formación básica del estudiante, se utiliza el enfoque contextual que permite dar sustancia profesional al contenido de un curso educativo. La segunda parte del modelo es la enseñanza basada en el contenido. Los autores mejoran sus usos potenciales y creen que el estudio de temas interconectados juntos permite mostrar patrones comunes y hace el proceso educativo más eficiente, intenso y consciente.

**Discusión y conclusiones:** La relevancia de tener dominio de métodos matemáticos y tecnologías de la computadora para especialistas multidisciplinarios hace posible generalizar el modelo creativo agregando varios contextos profesionales.

**Palabras clave:** perfilización de la enseñanza de matemáticas, modelo integrativo, enfoque contextual, enseñanza basada en el contenido, taller de informática.

The modern standards of professional training that are defined in terms of competencies are aimed at satisfying the needs of society and each individual student.

The competency-based approach has been used in the educational process of higher education institutions for a while; its main principles and methods of implementation have been defined. An important stage in the implementation of this approach is marked by the fact that during the final state certification, situational (case) tasks are used that check the development of necessary competencies and require the comprehensive application of knowledge of different subjects.

Such tasks are developed by the community of educators and introduced into the learning process. However, even with special training students have difficulties with case tasks. The difficulties are related to combining methods, approaches and algorithms used in different fields in order to solve a complex task, especially when it comes to using mathematical tools and modern computational methods.

We believe that two contradictions are responsible for this. First, to solve complex applied problems one must simultaneously use mathematical tools, modern computer technologies and professional knowledge, whereas these fields are taught according to the curriculum and as part of separate subjects. Second, to master complex mathematical methods and computational technologies one requires significantly more time, but the number of hours dedicated to classroom work continues to decrease.

The abovementioned contradictions may be solved by intensifying the educational process and enforcing the focus on knowledge application. The structure of the educational process, as well as the content of subjects and teaching methods, should be changed. The methodological basis for such changes is the integrative approach. It implies a comprehensive modification of the substantial, methodological and organizational approaches of professional training. Moreover, we believe the contextual approach and content-based teaching to be the most promising in light of employers' demands and modern students' needs.

The contextual approach is based on the principles of immersing students into solving professional issues (or their imitation) during educational activities that lead to thematic knowledge acquisition.

It is proposed to use content-based teaching (which we understand as teaching one subject within another) to intensify and transform the quality of the knowledge acquisition process.

*This study aims* to examine the existing educational experience in using modern approaches to mathematical training of a modern economist for profilization and intensification of this process. We provide theoretical grounds for the creation of our own education model based on the joint implementation of the contextual approach and content-based education. The contextual element should enhance the professional focus, while the content-based

element will allow intensifying the process by studying multiple subjects at once. As for the contradictions mentioned above, one could say that they could be solved by studying mathematics, informational technologies and a professional subject simultaneously.

### Literature review

The reviewed literature can be divided according to the following principle:

- 1) Issues of training staff for the digital economy;
- 2) Problems of pedagogical modeling;
- 3) Contextual approach and content-based learning.

Members of the pedagogical community all over the world write about the need to introduce to educational institutions various methods of training qualified professionals. They summarize and structure national, as well as global, experience of the educational process aimed at developing professional skills in university students. The study by an international team of educators from 16 American and Chinese flagship universities (Jacob et al., 2018) contains recommendations on the best practices in professional education. One of the main conclusions made by the researchers is that profession-oriented programs are often more efficient than traditional general programs. As highlighted in the previous works by the team (Jacob, 2015; Jacob et al., 2015) and in the article by the researchers from Saudi Arabia (Al-Majed et al., 2017), higher education institutions can no longer prepare students to solve various problems based on a single-subject source. *Interdisciplinary approaches to research and education are the best basis for meeting the dynamic needs of modern students at higher education institutions.* The colleagues from Kazakhstan write about the possibilities of using any forms of educational activities as motivation for future professional work (Shinysherova et al., 2018).

Another important trend is integrativeness, which can be roughly divided into the following two directions (Makarova, 2008):

- education reflects integrative trends in science and culture development that come together into a single global picture and create the basis for a student's worldview;

- education is an integrated field of work where a student's professional and personal development takes place.

We believe that the implementation of a particular pedagogical model requires common approaches that combine concepts, integrated technologies, teaching methods and techniques. At the same time, the choice of components is determined by the realities of the onset of the digital economy and pedagogical modeling is based on concepts that are most appropriate to the goal. One of such "combining" concepts of the teaching process is reviewed in this article.

### Issues of training staff for the digital economy

The general issues of training staff for the digital economy have been thoroughly analyzed in the recent article by V.D. Shadrikov (2019). The author proposes two ways of increasing and effectively using the innovative potential of higher education institutions:

- first, a significant change needs to take place in the content of education and its methods of training creative staff who possess fundamental knowledge (including computer-related and mathematical subjects) that helps one understand theoretical, technological and technical matters relevant to every profession;
- second, they must prepare specialists at the request of employers considering the development of innovation in a particular field.

A number of researchers note the particular importance of mathematical subjects in providing high-quality education: they write about integrating mathematical sciences into professional standards (Wood, 2011), the metadisciplinary nature of teaching mathematics to train students to analyze data from various fields with the help of mathematical tools (Hsu, Chang, Hun, 2018; Nakakoji, Wilson, 2018).

The article (Dvoryatkina, Dyakina, Rozanova, 2017) is dedicated to integrating the knowledge of mathematics, humanities and information technologies into the teaching process in higher education. The researchers describe the genesis and the main aspects of synergy (i.e. the growth of efficiency as a result of integrating separate parts into a single system) of humanities and mathematical knowledge with the help of information technologies. As a tool, the authors present the "Statistical style analyzer" software

implemented in C# to solve the applied professional task of literature style analysis and comparison. The article goes on to feature the project of the integrative course "Mathematical methods in linguistics", its optimal module structure and practice-oriented philological tasks.

Various levels of integration implemented in the process of teaching mathematics to bachelor students specializing in economics are described in one of our previous works (Konnova, Rylov, Stepanyan, 2016).

Different pedagogical models proposed by educator-researchers are aimed at addressing the challenges of training modern creative specialists.

### Problems of pedagogical modeling

Pedagogical modeling is a versatile and multifarious notion. We believe that the range of interpretation of models used in pedagogy is well represented in the works by M.V. Yadrovskaya. In the work (Yadrovskaya, 2013), model classification is based on the most important categories of pedagogy – education, upbringing and instruction, which enables one to discover the whole range of available models. The researcher believes that models are used either as a research *device* that presents the object of the study or as an *instrument* that allows one to influence the structure or operation of a pedagogical object based on the model. To sum up the approaches to educational modeling, the author identifies the main components of an educational model: the subject of education, teaching, learning, the interaction of subjects of education based on the transfer and reception of educational information by means of a methodological system.

E.A. Lodatko proposes a slightly different typology of pedagogical models (Lodatko, 2014). The researcher distinguishes between basic types of models (content, structural and functional) and their derivatives (content-structural, content-functional, structural-functional). In the work (Yadrovskaya, 2014), the researchers create and justify the model of the educational process in a technical higher education institution, while the competency-based model of an engineer and all the components of the pedagogical system are viewed from the point of optimizing the educational process.

The monograph by M.V. Klarin (2016) is dedicated to the review of innovative teaching practices and global pedagogical technologies. The basis for the author's classification of pedagogical models is the type of educational activities (productive and reproductive). The education model is additionally characterized by the type and order of education stages in time, the type of teacher-student interactions and the expected results of education. The author describes in detail search models, game models, as well as educational discussion models. The article (Panarina, 2017) contains the pedagogical model of the organization of collaborative learning activities for adults in further professional education. The author proposes the provisions of the activity-based, contextual, situational-contextual and student-centered approaches as the methodological basis for the organization of learning activities. It is concluded that the organization of collaborative learning activities is the design, implementation and reflection on the profession-oriented situations in collaborative activities.

Pedagogical modeling is widely used in higher education for certain training fields for specialists: pedagogical, technical, economic and others. O.D. Nikitin (2017) presents a model of creative development of pedagogy students in higher education institutions and designed technology of developing creativeness that facilitates the activation of the creative potential in students and the formation of professional working skills. The article (Nuriev, Starygina, Gibadullina, 2016) deals with the creation and justification of the model of an engineer's training in the metric competency-based format. The study is based on the ideas of "zones of proximal development" by L.S. Vygotsky and "developmental learning" by L.N. Zankov, utilizing the methods of taxonomy, didactic engineering in the technical education environment and mathematical-statistical tools. For a functioning model of an engineer, the authors set the parameters of the probability of the engineer's success, created a taxonomic scale for competency assessment and proposed methods to evaluate the difficulty of tests and academic courses within the model of the education system. In the work (Rodionov et al., 2018), the authors approach the creation of an integration model of the future engineer's mathematical training. The purpose of the study is to design the technological component of the methodological system of teaching mathematics based on the principle of integration of mathematical and engineering training for bachelor engineering students. According to the

authors, the system-wide goals have the highest priority in the mathematical education of an engineer and the main purpose of the mathematical subjects is to instill in the future specialists not only mathematical but also professional engineering culture with the use of mathematical tools. In view of this, the authors predict the growing trend of mathematical education professionalization for future engineers on the basis of integrated education technologies with the maximum preservation of the development potential of the actual mathematical content.

In the article (Somova, 2015), M.N. Somova presents the structural model of the mathematical competency of bachelor student specializing in economics as part of their professional expertise. The author constructs the model in the form of a complex of nine mathematical competencies that specify the universal cultural and professional competencies from the Federal State Education Standards of Higher Professional Education in the specialty "Economics".

There are interesting and useful studies that feature the analysis of education results within different models (Mierdel, Bogner, 2019; Voskoglu, 2019), as well as pedagogical models that enhance the teaching of a subject through interdisciplinary interaction (Förtsch et al., 2018; Katsounidou et al., 2019). Teachers at the Hong Kong Polytechnic University studied the universal education model that encourages interactivity in teaching subjects from various fields and utilizes the student reaction system in education (Cheung, Wan, Chan, 2018). In the article, the authors stress the influence of the technical-pedagogical and the technologically substantial knowledge of the teachers for efficient specialized education. Despite the fact that these technologies also pose serious threats to the security of the system and personal privacy (Mayes, Natividad, Spector, 2015), the expanding Internet network, the increasingly powerful mobile devices and other innovations make the task of creating formal and informal education more efficient.

### **Contextual approach and content-based learning**

One of the components of the developed model is the *contextual* approach that originates from the studies by A.A. Verbitskii who believed that the main contradiction of traditional higher education was that within educational activities, the student must master a professional activity that is completely different in purpose, form and

content. The idea of contextual education is to “lay the student’s acquisition of theoretical and other knowledge on the ‘outline’ of the professional and generally practical activity and thus solve the aforementioned contradictions” (Verbitskiy, 2017).

Let us dwell on recent publications on contextual technologies in an aspect similar to the subject of this article. In the article (Nasonova, Batyukov, Grechushkin, 2017), the authors consider the essential characteristics of the contextual approach as the basis for preparing future economists for innovation and present a method of specific situations that allows using such situations to model the future professional activities of economists. The authors of the article (Artyuhina, Artyuhin, 2018) develop the concept of interactive mathematics teaching for humanities bachelors using contextual technologies such as the case method. In another recent study (Artyuhina, 2018), the concept is generalized to the contextual model of professional education aimed at the student’s professional and personal growth. The contextual model of education is based on the comprehensive implementation of contextual technologies, e-learning, visual modeling methods and interactive forms of teaching. According to the author, the contextual content is reflected in the creation of the semiotic (processing of sign information, speech and meaning-searching activity), imitational (correlation with professional activity) and social (personally important nature) models of education. Interactive learning enables one to integrate several models of contextual content aimed at the formation of research activities of students. We should also note the article (Yanushchik, Dalinger, 2017) where the experience of the Tomsk Polytechnic University is used as an example that students’ compilation of contextual tasks contributes to deeper assimilation of the subject and professional knowledge and skills and also generally ensures the development of professional competencies. The authors view contextual tasks as tasks aimed at the optimal solution of non-typical situations (subject-related, interdisciplinary or practical) with the use of mathematical knowledge.

*Content learning* is another component of the model presented in this article. However, this concept has not been sufficiently specified in Russian literature. The experience of utilizing content-based learning technologies in teaching foreign languages plays an important part in our study. There is a number of methods that imply

the reinterpretation of the role and status of a foreign language (Tareva, Tarev, 2018):

- in continuous personal education in the field of humanities (lifelong learning – LLL);
- in the organic combination of productive labor (practice) and learning a foreign language with research, rationalization, inventive (innovative) student activity (practice-based professional learning – PBPL);
- in strengthening the interconnection of language learning and the subject of professional disciplines (content and language integrated learning – CLIL).

CLIL is of particular interest to us as it creates the best opportunities in the development of a person that is capable of independently setting and solving professional problems, as well as carrying out effective communication in the professional field in their native and foreign languages (Konnova, Rylov, Stepanyan, 2018). The implementation of integrated education on a subject and a foreign language has become the cornerstone for education changes all over Europe (Xabier, 2018; Climatic, Karpova, Kondrakhina, 2019; Dubinina, 2015). Y.L.T. Ting, who stood at the origins of the method (Ting, 2010; Ting, 2011), believes that CLIL has the potential for significantly updating the content of education, as well as teaching a language, through reasoning methods. In interactive studies, the researcher proposes to teach the subject and the foreign language in equal proportions (50:50/Content: Language). Nevertheless, some Russian researchers believe this model to be less efficient than information-communication technologies in foreign language learning (Belyaeva et al., 2019).

### Materials and methods

The aims of the study determined the goals and the choice of methods.

*The object* of the study is the early profilization of teaching mathematics to bachelors specializing in economics.

*The subject* of the study is the integration of the contextual approach and content-based education during first-year classes on the subject “Computer workshops”. The primary method of the study is *pedagogical modeling*, with the active implementation of *studying literature on the subject and observation*.

In accordance with the purpose of the study, the following goals were set:

1. To study the scientific experience of implementing early profilization in higher education, of creating pedagogical models of education, as well as of utilizing the contextual approach while working with students from economic universities; to identify opportunities to expand the range of application of content-based education.
2. To create the basis for the integrative model of teaching mathematics by means of computer technologies in the context of economics.

The basis of the new education model is formed by the following methodological approaches:

- *competency-based approach* (V.D. Shadrikov): the development of professional competencies is one of the most important goals of higher education;
- *integrative approach* (E.O. Galitskikh): the educational process integration implies the transformation of the entire system through bringing together and combining certain elements in their interconnection;
- *concept of the zone of proximal development* (L.S. Vygotsky, V.P. Zagvyazinskii): the zone of proximal development contains tasks that students cannot solve by themselves but manage to solve with the guidance of the educator. For these actions to become the student's personal achievements, one must create a system of increasingly more complex tasks to ensure progress from the zone of actual development to the zone of proximal development;
- *activity-based approach* (A.N. Leontev, V.V. Davydov): intensive and ever-increasing activities make the student the subject of the educational process.

The special part in our modeling is played by:

- *contextual approach* (A.A. Verbitskii): during its utilization, the focus shifts from transferring knowledge to developing students' abilities to skillfully perform professional functions, solve problems and tasks, become proficient in a comprehensive professional activity;

*content-based education* (CLIL): when used, this method allows to intensify the educational process by teaching one subject through another (currently used in foreign language learning).

## Results and discussion

The presented study was conducted in line with our work over many years that implemented the ideas of early profilization in teaching mathematics to first-year bachelors specializing in economics at the Financial University under the Government of the Russian Federation. The content of mathematical subjects, as well as the methods of teaching them at the university, are being transformed on the basis of the integrative approach. The results of this work are presented in detail in the scientific monography (Konnova et al., 2019a). We created a system of increasingly difficult practice-oriented tasks – from convergent to divergent, with multiple correct answers and requiring additional analysis of the economic content – that formed the core of the textbook (Konnova et al., 2019b). Nevertheless, the two contradictions identified above initiated the creation of a new, more efficient pedagogical model.

The implementation of mathematical methods while solving economic tasks usually proves difficult for students, which seems the most apparent when solving cases – multifaceted economic tasks. To enhance the applied orientation of mathematical subjects and intensify the educational process, it was decided to utilize the contextual approach and content-based learning *in combination*.

On the one hand, the contextual approach offers the way of the gradual transformation of the learning activity into professional activity, while the contents of an educational course are filled with professional substance (Verbitskiy, 2017).

On the other hand, content-based technologies are widely used in foreign language teaching: the method of CLIL enables one to learn a foreign language while using it to teach another subject. However, this method has not been used to indirectly learn non-language related subjects.

Based on the examined pedagogical experience, in order to study the possibility of combined implementation of the contextual and content-based elements, we identified their main characteristics.

*Contextual approach:*

- used to form the context of professional activity;
- aimed at profilization of the educational process;
- supplements the content of a subject by subject-related technological and social context;
- often used sufficiently in higher education to teach profession-oriented subjects.

*Content-based learning:*

- can be used for integration of teaching subjects;
- creates an opportunity to intensify the educational process;
- currently used mainly in secondary and higher education to teach subjects in foreign languages.

The conducted analysis allowed us to conclude that the two elements are not contradictory, moreover, they can be used in combination.

The purpose of education in the field of economics in the wake of the transition to the digital economy is to prepare a *specialist who possesses comprehensive professional knowledge and is familiar with main applied mathematical models and methods, as well as modern computer technologies*. The traditional structure of the educational process, wherein the first years are dedicated to basic subjects (including mathematics in an economic higher education institution) and senior years are dedicated to specialized profession-related subjects, has shown insufficient efficiency. The application of mathematical knowledge proves difficult for students when solving problematic case tasks and conducting research. This is due to their objective difficulty, as well as to the theoretical nature of mathematical courses. We are convinced that the applied nature of the subject “Mathematics” should be apparent at the first stages of education, which means that there is a need for a new pedagogical model aimed at first- and second-year bachelor students.

Considering the difficulties that students have when using mathematical tools to solve economic tasks, the heads of the Department of Data Analysis, Decision-Making and Financial Technology set a course for the strengthening of mathematical training by introducing a new first-year course “Computer workshop”.

The main goal of this subject in the curriculum of economics and management bachelor course is to instill in students the knowledge of computational methods of mathematical model implementation and the practical skills of using computer technologies in economics and finance. From the content point of view, the computer workshop is based on the materials of higher mathematics and the tools include the programming language R and the digital spreadsheet editor Microsoft Excel. Studying the subjects “Mathematics” and “Computer workshop” in parallel provides students with great opportunities for a deeper understanding of mathematical patterns and practical application of mathematical methods and computational technologies in future professional work.

Thus, “Mathematics” acts as the core content of the new subject: this means learning a new subject in addition to the basic course. The contents of both subjects “Mathematics” and “Computer workshop” are synchronized in the course schedules and the workshop offers additional opportunities for mathematics, for example, with approximation techniques and determining their accuracy. Usually, there is little time for these matters during the traditional mathematics course at an economic university, while they are crucial for solving applied economic tasks. Moreover, the utilization of computer technologies allows one to visualize many patterns and note the immediate reaction to the change of a parameter.

There are a few examples below:

- when considering the numerical evaluation of the limits of functions, students have the opportunity to compare the exact values that they learned to calculate in the mathematical analysis classes, with approximate ones in the Excel environment;
- during the study of discontinuity points of a function and its asymptotes, graphic illustrations make this process more conscious (in this case, special attention should be paid to issues related to the accuracy threshold of the editor);
- when identifying the extrema of a function, it is possible to apply approximate root search methods (for example, by the tangent method), use the neighborhood selection and step reduction, as well as the parameter selection procedure built into the Excel editor;

- joint presentation of graphs of the function itself and its derivatives (first and second order) make the analysis of the behavior of the function more understandable; in addition, with a full study of the function, one has to experiment with the choice of the step and interval of consideration (first, for individual details and then for the integrity of the function behavior reflection);
- Excel provides an opportunity to quickly obtain decompositions of functions in a Taylor and Maclaurin series with varying degrees of accuracy and clearly demonstrate the approximation of a function in different degrees of quality.

The main goal of studying mathematics at an economics university is to instill in students the competencies related to the confident implementation of modern mathematical methods used in economics and finance. Most of them utilize computer technologies. That is why it is the most appropriate that the tasks presented during the computer workshop have an economic context.

According to A.A. Verbitskii (2017), a professional context is characterized by two components: subject-related technological and social. In this case, *the subject-related technological component* may include: work with data (various formats and data types in the Excel editor and in the programming language R, export, import of data); study of functional dependencies (ability to identify functional dependencies, discussion of the behavior of important economic functions: supply and demand functions, production functions and utility functions); modeling by means of linear programming and acquaintance with the simplest financial tools.

The *social* component of future professional activity includes: the possibility of forming an individual learning path (individualization by level and pace of knowledge acquisition, development of software product priorities); teamwork practice (group tasks, counseling, brainstorming); the development of an information culture (independent search and selection of information from various resources), the basics of project activities (the opportunity to participate in simple research projects with data processing in R and Excel) and the initial skills in solving crisis situations (situations when it is necessary to make a decision and choose the best

option occurring both at the content and at the instrumental level). (For more detail, see (Konnova, Rylov, Stepanyan, 2018)).

The process described from the point of view of pedagogical modeling makes it possible to talk about the *integrative learning model*: the subject “Mathematics” is used as the content of the model and computer technologies serve as the means of implementation, while the applied orientation of the course is highlighted by the economic context.

The proposed *model can truly be considered integrative. Its comprehensive implementation in the educational process changes:*

- *the content of the subject “Mathematics”* – there is a deeper study of methods of approximate calculations and estimates using computer technologies, with an added focus on application. All this is extremely important for the development of professional competencies of a modern specialist;
- *methodological support of the education* – activity-based methods and group work are utilized wider, more attention is paid to individual work of students. All this makes the educational process more conscious and motivated;
- *the structure of the educational process* – in addition to the traditional subject “Mathematics” there is a separate subject “Computer workshop”.

Moreover, the model actualizes numerous connections on the following levels:

- *interdisciplinary* – it activates the cross-curriculum connections that mathematics has with other economics-related subjects;
- *intradisciplinary* – enhancement of the mathematical component while studying computer technologies and utilization of modern computational methods guarantees a more competitive training in the field of the principal subject;
- *interpersonal* – discussing possible solutions with classmates, executing separate projects in mini-groups enhances communicative skills, ensuring interpersonal integration;
- *intrapersonal* – solving problematic tasks from the student’s zone of proximal development becomes a

personal achievement and a new stage of personal growth.

The contextual approach utilized in the model makes it possible to learn professional knowledge and functions during the training. The aforementioned process involves giving a professional context to the contents of an educational course. Content-based learning is used to intensify the educational process. First, studying interconnected subjects together allows one to show common patterns and opportunities. Second, it allows spreading the workload in the most efficient way. Finally, this way of learning becomes preferable for students who constantly deal with large volumes of information and are ready to absorb it.

### Conclusions

The analysis of scientific works and the observation of the learning process of bachelor students specializing in economics confirm the idea that interdisciplinary approaches are the most focused on modern education goals. In view of this, integrative models of education become the most relevant in professional education.

The proposed model of teaching mathematics to first-year bachelors specializing in economics can be expanded and generalized.

It is an indisputable fact that a modern professional not specializing in humanities should know mathematical tools and computer technologies. This is determined by the dynamic changes in modern society and the goals set for the higher education institutions by the government. To help university graduates to apply the acquired knowledge comprehensively, one needs new subjects that combine several fields of knowledge. We must reiterate that this does not mean excluding any subjects but reinforcing them by relevant resources.

We believe the following combination to be the most efficient: mathematics – the universal language of science, computer sciences – the means of utilizing this language in the most efficient way to search for necessary information and, most importantly, the reason for studying all of the above – the application to the student's future profession. This is why the generalized integrative model for teaching mathematics in the first year that utilizes the contextual approach and content-based learning, is designed as follows: the educational process is supplemented by a subject that allows using computer calculations, the content of this subject is

mathematics and professional applications work as context.

Our experience in the field of testing this model proves the efficiency of combining two modern activity-based aspects within the same model: the content-based education and the contextual approach. Each of them makes the educational process more efficient according to the current demand: the contextual approach enhances the vocational orientation and increases the students' motivation and the content-based education saturates and intensifies the educational process. All in all, the model meets modern students' dynamic needs and makes it possible to efficiently prepare specialists required by today's society. The utilization of the integrative model described above promotes the development of the triad currently necessary for an economic university graduate: professional knowledge, mathematical tools and computer technologies. They must be clear, and they must express the final balance of the research or the application of knowledge.

### Bibliographic references

- Al-Majed, A., Al-Kathiri, F., Al-Ajmi, S., Al-Hamlan, S. (2017). 21st Century Professional Skill Training Programs for Faculty Members— A Comparative Study between Virginia Tec University, American University & King Saud University. *Higher Education Studies*, 7(3).
- Artyuhina, M.S. (2018). Contextual model of professional education. In: *Innovative technologies in science, transport and education: a collection of articles of the international scientific and methodological Internet conference*. Moscow: Russian University of Transport (MIIT), 19–23. Retrieved September 20, 2019 from: <https://elibrary.ru/item.asp?id=36962457>
- Artyuhina, M.S., Artyuhin, O.I. (2018). Contextual technologies as a motivational component of mathematical education. *Continuum. Mathematics. Informatics. Education = Sontinum. Matematika. Informatika. Obrazovanie*, 3(11), 99–104. Retrieved September 20, 2019 from: <https://elibrary.ru/item.asp?id=36379533>
- Belyaeva, I.G., Samorodova, E.A., Voron, O.V., Zakirova, E.S. (2019). Analysis of Innovative Methods' Effectiveness in Teaching Foreign Languages for Special Purposes Used for the Formation of Future Specialists' Professional Competencies. *Education sciences*, 9(3), 171.
- Cheung, G., Wan, K., Chan, K. (2018). Efficient Use of Clickers: A Mixed-Method Inquiry with University Teachers. *Education science*, 8(1), 31.

- Climatic, I.I., Karpova, S.V., Kondrakhina, N.G. (2019). Theoretical and methodological approach to financial literacy through content and language integrated learning: monograph. Moscow: RUSAINS, 400.
- Dubinina, G.A. (2015). On the issue of providing professional orientation training in a foreign language. *Bulletin of the Moscow state linguistic University = Vestnik Moskovskogo gosudarstvennogo lingvisticheskogo universiteta*, 725, 178–187. Retrieved September 20, 2019 from: <http://libranet.linguanet.ru/prk/Vest/vest-725.pdf>
- Dvoryatkina, S.N., Dyakina, A.A., Rozanova, S.A. (2017). Synergy of humanitarian and mathematical knowledge as a pedagogical condition for solving interdisciplinary problems. *Education Integration = Integraciya obrazovaniya*, 21(1), 8–18.
- Förtsch, S., Förtsch, C., Von Kotzebue, L., Neuhaus, B. (2018). Effects of Teachers' Professional Knowledge and Their Use of Three-Dimensional Physical Models in Biology Lessons on Students' Achievement. *Education science*, 8(3), 118.
- Hsu, T., Chang, Sh., Hun, Y. (2018). How to learn and how to teach computational thinking: Suggestions based on a review of the literature. *Computers & Education*, 126, 296-310.
- Jacob, W.J. (2015). Interdisciplinary trends in higher education. *Palgrave communications*, 21(1), 1–5.
- Jacob, W.J., Xiong, W., Ye, H. (2015). Professional development programs at world-class universities. *Palgrave communications*, 1(2), 1–27.
- Jacob, W.J., Xiong, W., Ye, H., Wang, S., Wang, X. (2018). Strategic best practices of flagship university professional development centers. *Professional Development in Education*. DOI: <https://doi.org/10.1080/19415257.2018.1543722>
- Katsaounidou, A., Vrysis, L., Kotsakis, R., Dimoulas, C., Veglis, A. (2019). MATHe the Game: A Serious Game for Education and Training in News Verification. *Education science*, 9(2), 155.
- Klarin, M.V. (2016). Innovative Learning Models: A Study of World Experience. Moscow: Luch, 640. Retrieved September 20, 2019: [https://social.hse.ru/data/2017/07/17/1170756123/Кларин\\_ИнновацОбучение.pdf](https://social.hse.ru/data/2017/07/17/1170756123/Кларин_ИнновацОбучение.pdf)
- Konnova L.P., Rylov A.A., Stepanyan I.K. (2016). Integrative approach to basic mathematical training of economists. *Financial University Bulletin = Vestnik Finansovogo Universiteta*, 20(5), 158-166. Retrieved September 20, 2019: [http://old.fa.ru/dep/vestnik/Documents/VFU%2005\\_2016.pdf](http://old.fa.ru/dep/vestnik/Documents/VFU%2005_2016.pdf)
- Konnova L.P., Rylov A.P., Stepanyan I.K. (2018). The Context and Content Approaches to Teaching Mathematics at The Economic University. *The European Proceedings of Social & Behavioural Sciences*, 236-245.
- Konnova, L.P., Lipagina, L.V., Rylov, A.A., Stepanyan, I.K. (2019a). Early profiling in teaching mathematics to future economists and managers: a scientific monograph. Moscow: Prometej, 232.
- Konnova, L.P., Rylov, A.A., Stepanyan, I.K. (2018). Context approach as a way of early profilization discipline of high school. *Standarty i monitoring v obrazovanii*, 6(4), 15-20.
- Konnova, L.P., Rylov, A.A., Stepanyan, I.K. (2019b). Mathematical analysis: a practice-oriented course with case studies: a textbook for undergraduate study for 38.03.01 "Economics" and 38.03.02 "Management". Moscow: Prometej, 280.
- Lodatko, E.A. (2014). Typology of pedagogical models. *Vector science of Togliatti State University. Series: Pedagogy, Psychology = Vektor nauki Tol'yattinskogo gosudarstvennogo universiteta. Seriya: Pedagogika, psihologiya*, 1(16), 126–128. Retrieved September 20, 2019: <https://elibrary.ru/item.asp?id=21575522>
- Makarova, E.E. (2008). Maintenance and a structure of the integrative approach in higher professional education. *Integraciya obrazovaniya = Integration of education*, 3, 8–11. Retrieved September 20, 2019 from: <http://edumag.mrsu.ru/content/pdf/08-3.pdf>
- Mayes, R., Natividad, G., Spector, J.M. (2015). Challenges for Educational Technologists in the 21st Century. *Education science*, 5, 221–237.
- Mierdel, J., Bogner, F.X. (2019). Comparing the Use of Two Different Model Approaches on Students' Understanding of DNA Models. *Education science*, 9(2), 115.
- Nakakoji, Y., Wilson, R. (2018). First-Year Mathematics and Its Application to Science: Evidence of Transfer of Learning to Physics and Engineering. *Education science*, 8(1), 8.
- Nasonova, E.E., Batyukov, M.V., Grechushkin, V.A. (2017). Contextual approach to training future economists in continuing education. *Science and business: development paths = Nauka i biznes: puti razvitiya*, 5(72), 28–31. Retrieved September 20, 2019 from: <https://elibrary.ru/item.asp?id=29108697>
- Nikitin, O.D. (2017). The pedagogical model of creative development of pedagogical universities students: a monograph. Moscow: FGBNU «IHOiK RAO», 216. Retrieved September 20, 2019: <http://www.art->

- education.ru/sites/default/files/u40/nikitin\_pedagogicheskaya\_model\_kreativnogo\_razvitiya\_studentov\_pedagogicheskikh\_vuzov.pdf
- Nuriev, N.K., Starygina, S.D., Gibadullina, E.A. (2016). Didactic Engineering: Designing Next-Generation Learning Systems. *Education Integration = Integraciya obrazovaniya*, 20(3), 393–406.
- Panarina, S.S. (2017). The pedagogical model of organizing joint educational adult students activities in additional professional programs. *Siberian Pedagogical Journal = Sibirskij pedagogicheskij zhurnal*, 5, 62–69. Retrieved September 20, 2019: <https://elibrary.ru/item.asp?id=30488596>
- Rodionov, M.A., Fedoseev, V.M., Dedovec, Z.H., Shabanov, G.I., Akimova, I.V. (2018). Design features of the technological component of the integrated methodological system of mathematical training of future engineers. *Education Integration = Integraciya obrazovaniya*, 22(2), 383–400.
- Shadrikov, V.D. (2019). Personnel for an innovative economy: what is the real situation with their training? *Higher education today = Vysshee obrazovanie segodnya*, 6, 2–10.
- Shinysherova, G.B., Yessimov, B.K., Childibayev, J., Tuleubayev, Z., Ziyayeva, G.K., Alpysbaikyzy, M. (2018). Organizationally-Pedagogical Aspect of Preparation of Students to Professional Activity in the Process of Educational Practice. *Journal of Social Studies Education Research*, 9(1), 1-10. Retrieved September 2019 from: <https://dergipark.org.tr/download/article-file/496786>
- Somova, M.N. (2015). Model of mathematical competence of a bachelor - future economist. In: Actual problems of the quality of mathematical training of schoolchildren and students: methodological, theoretical and technological aspects: materials of the III All-Russian scientific-methodological conference. Krasnoyarsk, November 2–3. Retrieved September 20, 2019 from: <https://elibrary.ru/item.asp?id=24301348>
- 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.
- Verbitskiy, A.A. (2017). Theory and technologies of context education. Moscow: MPGU Publ., 266. Retrieved September 20, 2019 from: <http://www.iprbookshop.ru/72517.html>
- Voskoglou, M. (2019). Comparing Teaching Methods of Mathematics at University Level. *Education science*, 9(3), 204.
- Wood, L.N. (2011). Professional development for teaching in higher education. *International journal of mathematical education in science and technology*, 42(7), 997–1009.
- Xabier, S.I. (2018). Innovations and Challenges in CLIL Implementation in Europe. *Theory Pract*, 57, 185–195.
- Yadrovskaya, M.V. (2013). Models in pedagogy. *Bulletin of Tomsk State University = Vestnik Tomskogo gosudarstvennogo universiteta*, 366, 139–143. Retrieved September 20, 2019: [http://journals.tsu.ru/vestnik/&journal\\_page=archive&id=879&article\\_id=1228](http://journals.tsu.ru/vestnik/&journal_page=archive&id=879&article_id=1228)
- Yadrovskaya, M.V. (2014). Modeling professional training at a Technical University. *News of the Saratov University. New series. Philosophy. Psychology. Pedagogy = Izvestiya Saratovskogo universiteta. Novaya seriya. Filosofiya. Psihologiya. Pedagogika*, 14(4), 108–113. Retrieved September 20, 2019: <https://elibrary.ru/item.asp?id=22869498>
- Yanushchik, O.V., Dalinger, V.A. (2017). Contextual mathematical problems and the formation of basic competencies. *Higher education in Russia = Vysshee obrazovanie v Rossii*, 3(210), 151–154. Retrieved September 20, 2019 from: <https://elibrary.ru/item.asp?id=28863458>