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INTEGRATION OF MATHEMATICS AND INFORMATICS AS A BASE FOR TRAINING IN INFORMATION TECHNOLOGY

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ABSTRACT: *This paper develops a proposal for a joint Mathematics-Informatics course as a means of improving information technology skills. The structure of such a course should be based on common content line, thesaurus, organizational forms and education methods, and application and programming facilities between the two disciplines.*

KEYWORDS*:* Mathematics, Informatics, Training, Information Technology (IT), Education

INTRODUCTION

In modern-day higher education, there is an obvious and challenging problem for professional student preparation to handle efficiently information technology (IT) activities. One way to solve this problem is the creation and realization of a training course integrating the content of mathematics and informatics. In the standard curriculum, these two disciplines are considered to be different but interacting and complementing subject areas: On the one hand, the dynamic development of informatics (theoretical informatics, programming languages , information technologies, computer webs, artificial intelligence, quantum informatics, technical informatics, bioinformatics, social informatics, etc.) is being shaped by the mathematical advances of the 1930s (different forms of algorithm clarification, algorithmic insolvability, universal computable functions, analysis of algorithms' complexity, etc.). And, on the other hand, mathematics is advancing due to IT developments (parallel calculations, computer algebra, computer graphics, computer modeling, etc.).

THE BASICS FOR A JOINT COURSE

That is, the standard treatment of these two disciplines recognizes their mutual interaction only implicitly, but it is an interaction upon which an educational course may be based explicitly. Much more so when it is widely acclaimed that the success rate of informational and mathematical activities largely depends on the "informatics-to-math" balance of the study course preparing for such activities. We postulate that the **informational and mathematical activity** is one aiming at studying, analyzing, synthesizing, and researching informational objects and processes of different nature as well as at constructing informational models with the help of mathematical facilities and methods that can be realized by means of IT. Indeed, a similarity of mathematical and informational subject areas' thesaurus has been found lately to exist. Great many concepts like algorithm, discreteness, constructiveness, model, computability, data analysis, object, system, system analysis, process, classification, structure, tabular data, set, massive, formalization, result, connection, progression, finiteness, symbol, language, function, scheme, informational objects and processes, informational and communicational technologies, informational activity, informational interaction, etc. are equally important and frequently used in both disciplines.

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Based on the theory of methodical integration (Berulov M.N, Bezrukova V.S. and others), three are the levels of integrating mathematics and informatics:

- The level of similar methodological approaches to these two subject areas on the part of teachers;
- The level of similarity in thesaurus in mathematics and informatics; and
- The level of similar facilities of application and programming software, used as study object in informatics and as learning tool in mathematics.

The purpose of the integration of the two disciplines is to increase the efficiency of the theoretical background and practical training gained by the student as well as to shape students' cultural competences and capability to engage professionally in IT activities. It follows that the typical mathematical bachelor training in informatics needs to expand to include all those tenets which are common to these two disciplines. And, it should be done in line with the three integration levels just outlined: Similar thesaurus, similar organization forms, education methods, and activity instruments, similar approach to the professional duties that should be characterizing mathematics and informatics teachers, and similar application and programming software as a study object in informatics and learning tool in mathematics.

Capitalizing upon general integration theory in education (Berulov M.N., Bezrukova V.S. and others), on the discussions about the inner integration of the educational disciplines of the mathematical cycle (Gleizer G.D., Erdniev P.M. and others), on other work about the content of an integration of mathematics and informatics (Zhuravlev U.I., Semenov A.L. and others), and on analyses of the connections between mathematics and informatics (Kuznetsova L.G., Kuzmenko M.V. and others), we can identify the structure and content of an integrated "mathematical informatics" course as in Table 1. The structure goes like this:

- Content line;
- Thesaurus;
- Organizational forms and education methods;
- Application and programming facilities.

The *Content line* of the integrated course is composed of: number system and architecture of computer and computer systems; measurement and presentation methods of information; mathematical and informational modeling of objects and processes; algorithmization and programming; efficiency rate of algorithm; logic elements in informatics; discrete mathematics elements in informatics; mathematical basics of computational geometry, computer graphics; computational experiment.

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Table 1

	Mathematics	**Informatics**	**«Mathematical information» integrated course**
Content Line	Number system	Coding, presenting and measuring of information (machinery arithmetic)	Number system and architecture of computer and computer systems; methods of information sampling
	Mathematical modelling	Informational modelling	Mathematical and informational modelling of objects and processes
	Theory of algorithms, theory of computable functions	Theoretical basics of computing devices, programs and their types	Algorithm's efficiency rate, algorithmization and programming
	Elements of mathematical logic	Logic elements of computer, microprocessor, functional logic elements of computer devices, automated control systems (ACS)	Logic elements in informatics
	Elements of discrete mathematics	Informational processes and discrete systems, theory of automatic machines	Elements of discrete mathematics in informatics
	Elements of geometry	Computer graphics	Mathematical basics of computational geometry and computer graphics, computational experiment

The *Thesaurus* of this integrated course consists of: an algorithm, a discreteness, a constructiveness, a model, a computability, a data analysis, an object, a system, a system analysis, a process, a classification, a structure, tabular data, a set, a massive, a formalization, a result, a connection, a progression, a finite, a symbol, a language, a function, a scheme, informational objects and processes, informational and communicational technologies, an informational activity, an informational interaction, etc. And, as far as the *organizational forms and education methods*, and the *application and programming facilities* are concerned, they should derive from the plausibility of the need to deliver this integrated training course with optimal computer technology use and by distance perhaps learning. The main instrument of the course should be a computer with a specialized package of mathematical programs and actual use of programming languages as well as digital educational resources (DER), electronic educational facilities, etc.

DISCUSSION

From the point of view of learning psychology (Asmolova A.G., Galperina P.Y., and others),

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the course integration should be built in addition on a set of *universal educational activities* (UEA), which manage to attract the attention of and motivate students of different subject areas in a coordinated manner. With this in mind, delivering a "mathematical informatics" course to the student should be conditioned on the satisfaction of the following desiderata as well:

- The content and organization of the whole course should be targeting UEA formation on the part of the student;
- The learning outcome of such UAE formation should be framing in turn the informational and mathematical activities of the students in the desirable direction;
- UEA as well as their properties and qualities determine in general the efficiency of educational process; the whole scheme involves knowledge enhancement and skill development, it molds students' scientific image of the natural world and stcultural competencies;
- The success rate of students' UEA formation and development largely depends on informatics teacher's level of mathematical culture.

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