

## Experience of mathematics blended learning at the University University of Defence

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*The fact that - life long education is indispensable and demanding is fortunately realized by almost everyone, i.e. individuals, companies as well as most government representatives. The question is way how education could become available for everyone, anywhere and at any time. The authors develop multimedia study material designed for blended and distance learning in mathematics. The goal of the paper is to share the experience of a pilot test course where participating students were offered to use for their preparation both conventional printed materials and the multimedia CD. The authors focused on filling the material with a lot of solved and unsolved examples (they are provided with results), figures, illustrations, interactive tests and simulations. All this should facilitate students to understand the study material easier.*

It has been proven that a class consisting of adults is the least homogenous study group. Students differ from each other in their qualities of mental functions, life and work experience, age, motivation to study, aptitude, scope and depth of their entry knowledge and skills, and the ability to study continuously. This diversity necessitates taking a different pedagogical (instructional) approach to individual students in order to accommodate their different circumstances; for instance, through consultations, assigning voluntary activities or giving tasks with optional assignments.

The human aptitude for learning cannot generally be deduced from age. As for general dispositions to teach adults, evidence shows that many physical abilities can be maintained at a high level for a long time; moreover, systematic training can delay their deterioration. Analyses of intellectual learning abilities have even revealed that learning intensity increases commensurately with age.

Thus, age does not usually correspond to an adult's inability to learn something. Instead, this deficiency rather results from lacking abilities to acquire a specific goal, weak motivation or bad habits. Nevertheless, the age of students in a study group can indicate a lot of valuable information.

During the ages from 30 through 45 years, professional activities are stabilized. Learning is connected with our job position. We want to use what we learn to solve specific work tasks, which shows an apparent tendency to practicality.

Employed adults who enter a work-study program cope with a complicated socio-psychological situation, which is influenced by many external and internal factors. Therefore, they can encounter various blocks having a negative effect on their learning process such as psychological (poor motivation, weak endurance, deficiencies in intellectual abilities), pedagogical (weakened learning abilities, absence of entry knowledge, quality of education and ways of rating and testing) and organizational (insufficient information on study opportunities, lack of finance). The process of adult learning is most frequently hampered by previous experience, lack of self-confidence and motivation, fear of failure and change, and bad learning habits.

## 1. TEACHERS' ROLE AND PERSONALITY IN EDUCATION

The constant changes that our society goes through place high demands on all teachers; however, those who teach adults face specific challenges. In addition to meeting qualification criteria, they have to prove, in combination with appropriate personal characteristics, their didactic and managerial skills.

### 1.1. General Criteria for Teachers:

**High Level of Proficiency.** Teachers should have broad and deep knowledge of their profession. They should study continuously and keep pace with latest developments not only in their own but also in similar sciences. In addition to theoretical knowledge, they should develop solid practical skills, which is the only way to win the respect of students (particularly adult students).

**Didactic Skills.** The job of teachers is to effectively manage and coordinate the process of learning. They must be able to attract students' attention and motivate them to achieve the best study results. Knowledge and ability to apply various teaching methods is another criterion. Students expect to be advised on finding the most effective way of learning and comprehending the lesson. Teachers should adopt a creative approach in their job to avoid stereotypes in teaching.

**Personal Characteristics.** A responsible, honest and fair-minded teacher, who understands their students and is able to empathize with their situation, is not only an ideal requirement resulting from the pedagogical theory, but also a desired precondition for superior teaching. They are simultaneously expected to be impartial and highly objective with their students. Teachers should be well-balanced, able to control their emotions and critical not only of their students but especially of themselves. To complete the list of desired personal characteristics, they should display good expressive and writing skills, cultivated manners, and be able to solve unexpected problems.

Both full-time teachers and candidates who are prepared for this profession in a form of distance learning confirm that, in order to do their job at a high quality, they need:

- Broad and deep knowledge and skills in their profession and the ability to take an interdisciplinary approach.
- Suitable personal dispositions.
- Appropriate didactic, communicative and managerial skills.
- Motivation.

In the article *Managing Distance Education - Transition Involved in Implementing Innovation* Zdena Rosická quotes Benjamin Disraeli: “*Men govern with words*” and she adds:

“An interactive technology does not automatically make a teacher more interactive. Teaching and learning occur best in an encouraging and nurturing context both for students and for institute or faculty.”

Interpersonal communication, communication skills are required for any manager positions. But not only managers need this skill, it is very important for teachers as well. It is the teacher who manager the lesson, he can be able to manager the lesson, to deal with the mood of the students, to motivate them, and so on. Communications skills are very complex process; it is kind of art, often a source of misunderstanding and conflicts, which may be effectively prevented. A part of communication skills are

- Speech skills.
- Listening skills.
- Keep silence skills (estimate of situation, selectivity of communication...).

For reasons given above, it is obvious that a teacher’s role in the study groups of adult students is fundamentally challenging. Students of the combined or part-time study present questions more often than full-time students: “What is this for?”, “Why do we have to learn it?”, “What practical application does it have?” They not only ask these questions, but they also expect (or even require) their teacher to give them an insightful and comprehensive answer, as opposed to full-time students who often ask such questions to express their reluctance to learn anything, or just to provoke their teacher, without actually expecting an answer.

Inquiries of this kind and their answers in particular, result in higher demands on teachers’ qualifications and their acquaintance with interdisciplinary approaches to varied questions. Apart from the theory, they must include practical examples in the form of motivational and illustrative tasks in their classes.

## **1. 2. Tasks of teachers and students at the University of Defence**

The work of teachers within the bachelor-degree combined study at the University of Defence is even harder because their students have not voluntarily made the decision to continue their studies, for example, to increase or to pursue their eminent interest in a

particular field. These people are professionals who were forced to study due to circumstances. They are military officers whose average age is 31 and who have already reached a particular position within the army. However, reevaluation of the pay-scale and reassessment of the demands on officers' education have resulted in the requirement to have a bachelor or master degree in education for such positions where high school education concluded with a leaving examination used to be sufficient.

These people have really no personal desire for further education. The only motivation they have is that if they do not start their studies and do not finish them successfully approximately in 5 years, they will have to leave the position they care for.

This is also why most of the time they have a negative (many times justifiable) attitude at the beginning of their bachelor degree studies:

- They have to fulfill their work duties resulting from their position in unchanged amount along with their studies.
- There is a theoretical possibility to get educational leave in order to prepare for the exams; however, they will have to complete all the accumulated work after the leave ends.
- Most of them have families and family duties; therefore, they will have little time and silence for their study, plus their spare time for resting and relaxation itself will shorten significantly.

Such reasoning brings about stress and worries whether they will be able to manage all their work, family and study load and duties. This is the cause for their reluctance to study or attempt to study with minimal effort; not to learn new things on a long-term basis, to study just to pass an examination, to be satisfied with even worse study results than they would be able to get. To change their attitude towards their study and to bring about self-satisfaction from their education are conditions for a successful course of study.

### **1. 3. Students of combined study programs**

We have asked students of the combined form of study to answer the following short questionnaire, the aim of which is that the teachers get a better and concrete idea about the reasons that forced their students to come to the class again, the amount of time they can (or want to) spend on their learning and what parts of their study are the most difficult for them. The information obtained contributed to the preparation of the multimedia study survey quoted above and the improvement of the methodological work. The questionnaire was as follows:

- What age are you?
- What has given you the idea to educate yourself further?
- What do you expect from your studies as a whole?
- What do you expect to gain from studying math?
- How many hours a week do you spend studying?

- Which subject do you find as the most difficult and why?
- Have your studies limited your free-time activities?
- What does your family think about your studies?
- Does your employer give you educational leave without problems?
- If your previous answer was yes, is there anybody who completes your working duties, or do you have to do it yourself after your educational leave is finished?
- How do you prepare for math (do you learn the theory, do you count aloud, do you remember the content by heart, etc. ...)?
- When you study math, do you use your personal notes and a printed textbook only, or do you search for other sources, for example, private lessons, technical literature, internet, etc.?
- Which part of math in the first semester did you find
  - a) the easiest, b) the most difficult?
- If you successfully finish your bachelor degree study, do you have a reason to study further?

#### **1. 4. Some results of the questionnaire**

Question nr. 1: The average age of tested students was 31 years.

Question nr. 2: 90% - The main idea rised from the employer.  
10% - Other reasons.

Question nr. 3: The most frequent answer was: My studies should meet the employer's career requirements.

Question nr. 4: The most frequent answer was: I expect the subject Maths to be applied in technical subjects.

Question nr. 5: The average number of spend hours were 10, 2 per week.

Question nr. 6: Mathematics and Physics were mentioned in 80% of answers.

Question nr. 7: 20% greatly,  
20% yes,  
60% partially.

Question nr. 8: Families are usually helpful.

Question nr. 9: 100% yes – educational leave without problems.

Question nr. 10: 20% anybody else deals my duties,  
60% partially anybody do my duties, but some of them are left for me,  
20% nobody, I have to do my duties after coming back to my work.

Question nr.13: a) 80% ...matrices are the easiest part.  
b) 80%....integral calculus is the most difficult part.

Question nr.14: 40% yes, I would like to continue in my studies, 60% strictly no.

## 2. STUDY PROGRAMS AT THE UNIVERSITY OF DEFENCE

University of Defence consists of three faculties. Each faculty has its own study plan.

### 3. 1. Faculty of Economics and Military Management

#### 1. TERM

##### Course description

	Topic	L / E / LE
1.	Linear algebra	( 30 / 30 / 0 )
2.	Function of one variable	
3.	Differential calculus of one variable	
4.	Differential calculus of two variables	

#### 2. TERM

##### Course description

	Topics	L / E / LE
1.	Integral calculus	( 30 / 30 / 0 )
2.	Differential equations	
3.	Sequences and Series	

L ... lecture, E ... exercise, LE ...laboratory exercise

## 2. 2. Faculty of Military Technology

Here is mathematics taught in: Bachelor degree study, Master degree study, Post-graduate degree study. All degrees can be studied in daily and combined form of study. To be more specific we give a full course description about topics in bachelor form, specialization mechanical and electrical in the first term in daily and later on in combined study form.

### 1. TERM

#### Mathematics 1 bachelor mechanical and electrical

##### Learning outcomes

**To know** the basic parts of mathematical analysis and algebra which enable to study another discipline in a chosen study field.

**To be able to use** basic methods for solving examples from subject Math 1. To be able to use developed knowledge in a practice.

**Familiarise** students with the use of useful literature and with new mathematical methods used in technical and military practice.

##### Course description

	Topics	L / E / LE
1.	<u>Function of one variable, differential calculus</u> (56 hours) Function, elementary functions, polynomials, rational function, partial fractions, limit, continuity, derivative, applications of derivative, differential, behavior of a function, differential, Taylor polynomial.	( 28 / 26 / 2 )
2.	<u>Algebra</u> (24 hours) Determinants, matrices, rank, inverse matrix, systems of linear algebraic equations, Gaussian elimination, numerical methods.	( 12 / 10 / 2 )
3.	<u>Integral calculus</u> (40 hours) Definite integral, primitive function, indefinite integral, Newton-Leibniz formula, basic integration methods for indefinite and definite integral, integration of rational function and some irrational function, numerical integration, geometrical and physical application, improper integral.	( 20 / 18 / 2 )

## 2. TERM

### **Mathematics 2 *bachelor electrical***

#### **Course description**

	Topics	L / E / LE
1.	An. Geometry in space	( 8 / 8 / 0 )
2.	Function of two variables	( 8 / 0 / 0 )
3.	Differential equations	( 8 / 0 / 2 )
4.	Series	( 8 / 8 / 0 )
5.	Linear spaces	( 6 / 0 / 0 )
6.	Fourier series and Fourier transformations	( 6 / 0 / 0 )

### **Mathematics 2 *bachelor mechanical***

#### **Course description**

	Topics	L / E / LE
1-4.	The same as electrical specialization	
5.	Probability and statistics	( 12 / 0 / 0 )

## 1. TERM

### **Mathematics 1 *bachelor – combined study mechanical and electrical***

#### **Course description**

	Topics	L / E / LE
1.	Function of one variable	( 10 / 0 / 0 )
2.	Differential calculus	( 18 / 0 / 0 )
3.	Algebra – matrices, determinants	( 12 / 0 / 0 )
4.	Integral calculus	( 12 / 0 / 1 )

### 2. 3. Faculty of Military Medicine

No mathematics is taught here.

## 2. 4. Summary

By summing up what awaits the teachers at the University of Defence, we will get the following:

### **Entry**

- Students, most of whom did not decide to study “voluntarily”.

### **Exit**

- Bachelor degree or Master degree.

## **3. THE AIMS OF ADULT EDUCATION IN A COMPOSITE STUDY**

In these days, fortunately almost everybody - individuals, firms and government representatives of the majority of countries - is aware of the necessity and difficulty of constant life-long education. The essential question is not how to persuade somebody that life-long education is a necessity, but, rather, to determine how it is possible to provide the education so that it is available for everybody, anytime, anywhere.

When working on the didactic text of differential and integral calculus we had to consider a lot of standard pedagogical and didactical questions in order to achieve the best results for adult students of mathematics. Unfortunately, in the Czech Republic not enough attention is paid to the particular problems of adult education results of which could facilitate our work.

During our previous work on our multimedia CD, we gained a lot of experience in working with adult students and we would like to share this experience with other teachers of adult students; especially to alert teachers to certain problems that could arise:

We therefore asked a basic question.

*“What are the aims of adult education in a composite or extramural study of mathematics?”*

In agreement with other adult education experts, our experience suggests that the most important factor in the success of adult mathematics pedagogy is the further development of the personality of an adult student as an individual to whom the education offers a second chance. The primary focus of adult education is professional education, despite the disagreement of some pedagogical theoreticians. We can also relate to other opinions; opinions that hold that there are great differences between officially-stated perceptions about life-long adult education in the Czech Republic, and the real situation.

Our experience in teaching and observing adult students in mathematics suggests that it is necessary to develop their “personalities” in order to maximize their educational experience. Needless to say, the requisite development of the personalities of our adult students at mathematics study is not an easy process.

An opinion, we quote:

“Students themselves should realise that the contemporary level of their knowledge, skills and abilities needs to be improved so that not to stagnate but to be able to practise their work for their own satisfaction and also for satisfaction of others.” Unquote.

This quotation is unreasonably optimistic according to our experience with students of a *composite* study at *UO – University of Defence*

Nearer to reality is the opinion of a pedagogue Jaroslav Mužík who remembers decidedly more skeptical (cynical) statement by professor František Hyblík, the founder of the Department of Adult Education in *FF UK* in Prague. We quote:

„Adult education is in reality forcing people to some knowledge“. Unquote.

It is our opinion, in fact, that changing the mental attitude of adults is therefore the first and most important pre-condition for the successful education of the adult mathematics student. It has been our experience here at the University of Defence that it is therefore necessary to change the attitude of our adult students, whose goal of attaining a higher qualification in mathematics is not in most cases, their own ambition, but, rather a requirement imposed on them by their service regulations.

Our particular pedagogical challenge, therefore, is that our students do not long for obtaining knowledge of mathematics for their inner need; or, for the sake of “knowledge for the sake of knowledge”.

Most of them study mathematics only for its professional utility; learning for the sake of career-advantages.

This may be an understandable, if regrettable, motivation; so it is necessary to attempt to change their motivation into a more positive one. A desire to learn for the sake of intellectual curiosity to feel the joy of academic success; the will to achieve something. We find that this motivation is also intensified by a feeling of inner satisfaction.

In order to intensify their inner motivation, therefore, we try to give our students the opportunity to experience some of the more pleasant stimulations when working with our didactic text. We are also more sensitive to the knowledge that an adult appreciates what is expected from him/her, his/her education aim and the fact that his/her attitude to education is often a by-product of his/her strong-mindedness.

Cognition of rules in the process of adult education, which are in many ways different from rules of children education, is one of conditions in order to achieve success in educational process. It is known that an adult when learning uses his/her preceding experience and this is not always optimal in mathematics. Although learning is an individual process, there are certain common principles in learning:

- I listen and I forget.
- I watch and I remember.
- I do and I acquire.

In our considerations, an emotional influence on adult learning must not be omitted. In order to get an older person ready to learn, we have to affect his/her emotions positively. We can restore and develop abilities of adults to learn only by affecting their emotions. In this connection it is also good to remind the rule of relationship between teacher and studying adult. We must always treat him/her as a partner, we must not consider him/her to be only a learner.

If we need to restore and develop abilities to learn, we must learn about the range and depth of current knowledge and mathematics skills in the first place. Only after completing required information, restoration of skills and re-improvement of habits we can start learning process development. It is known not only from available literature but also from our teaching practice that if a student manages to evaluate his/her flaws and gaps in education and starts to learn voluntarily, he/she is on the best way to gain other knowledge more easily.

Our great problem that we have tried to solve also by a well-thought-out creation of our didactic texts consists in the very fact that a big part of students starts to learn with a feeling of a forced obligation. Moreover, a studying adult is afraid of making mistakes and of his/her failure more than a child. Therefore we have composed our textbook in a way, in which students gain their self-confidence from understanding simpler examples and, at the same time, worries of failure do not harm their study attitude. We have also tried to find examples and methods of solution supporting understanding of meaningfulness of mathematics and connecting the previous knowledge and experience of our students in the best way.

Feedback also improves quality and success of education. When a student finds out about his/her progress, he/she improves their inner motivation and motivated students are able to struggle through even more difficult parts of *curriculum*. Therefore, in order to check learnt knowledge, all parts of the textbook are abundantly interlarded with interactive tests, revision questions and selftests. Individual revisions with evaluation confirming students' success in learning, improve their activity and help them to get over the period of stagnation existing in every education and weakens their motivation.

#### **4. EDUCATIONAL MATERIALS OF UNIVERSITY OF DEFENCE AND EU GRANT**

During semester there is no possibility to explain and practise everything of educational schedule of a given subject due to various reasons. Some chapters are left for individual selfstudy and thus it is necessary to create a good quality educational support.

Nowadays the department of mathematics and physics has got its own textbooks for the whole course of mathematics for daily students. Moreover, students of the University of Defence have a great advantage because they get all required educational material for free.

There is still lack of specially formed literature for students of composite study and doctoral study. Thanks to cooperation of University of Defence with VŠB – TU Ostrava and thanks to ESF grant number CZ.04.1.03/3.2.15.1/0016 “Operational programme of Development of Human Resources – Educational Support with

Prevailling Distance Components for Subjects of Study on Theoretical Basis“ we managed to create also a textbook for both composite and distance education.

The aim of the grant of VŠTB-TU has been and still is a compilation of study materials of mathematics, descriptive geometry, physics and chemistry so that they can enable individual studies and thus minimalize the number of contact lessons with the teacher.

The compiled texts could be used by students of all sorts of study. Students of composite and distance types of study can use them for selfstudy, students in a daily type of study can through their help improve their learned knowledge.

Last but not least the aim of the project is enabling to improve qualifications of wide range of people who could not start their university studies immediatelly after school leaving exam because of various reasons.

For futher information about the project go to: <http://www.studopory.vsb.cz/> .

#### 4. 1. Interactive CD-ROM

In the frames of the project, the following materials were created by the staff of department of mathematics and physics, Faculty of Military Technology of University of Defence in Brno:

- standard didactic texts in printed form, composed for selfstudy,
- e-learning study material, accessible on the Internet,
- a bank of test exercises for individual subjects in which student can check up to which extent they mastered the problems done in the class.

This textbook covers basics of differencional and integral number of functions of one variable that are explained at the University of Defence in winter semester of the first year of bachelor type of study.

J. Kuben, P. Šarmanová:  
**Diferenciální počet funkcí jedné proměnné**  
 Š. Hošková, J. Kuben, P. Račková:  
**Integrální počet funkcí jedné proměnné**

**Instalace**

- Úvodní informace
- Systémové požadavky
- Instalace programů

**Interaktivní studium**

PDF Diferenciální počet  
 PDF Integrální počet  
 • Animace a testy

**Verze pro tisk**

PDF Diferenciální počet  
 PDF Integrální počet

**Externí odkazy**

- Evropský sociální fond
- Šárka Hošková
- Jaromír Kuben
- Pavlína Račková
- Petra Šarmanová



Svět, ve kterém žijeme, je v neustálém pohybu. Mění se roční doby, pohybují se planety, rostliny rostou, zvířata se rodí a umírají, šíří se nemoci. Pohyb je všude kolem nás. Některé druhy pohybu se zdají chaotické, ale většina má svůj řád a tak je lze zkoumat pomocí matematiky. Matematické nástroje jsou však ve své podstatě statické a pohyb nezahnují. Abychom jej mohli zkoumat, musíme nalézt způsob, jak pomocí statických nástrojů zachytit dynamický proces změny.

Trvalo to téměř 2000 let, než se lidstvu podařilo matematicky zachytit změnu a pohyb - výsledkem byl vznik diferenciálního a integrálního počtu v 17. století. Teprve od té doby bylo možno zkoumat proudění kapalin, létání, elektřinu, magnetismus a vše, co s pohybem souvisí. Jednalo se o jeden z největších mezníků ve vývoji lidstva.

Toto výukové CD vám nabízí možnost seznámit se se základy diferenciálního a integrálního počtu poutavou formou a díky mnoha historickým poznámkách pochopit, jakými cestami bylo třeba projít, než se dospělo k dnes používanému kalkulu.

**Interaktivní studium**

Jedná se o multimediální výukový text, obohacený o animace, interaktivní programy a testy. Vysvětlení dané problematiky je vždy následováno množstvím řešených příkladů, kontrolních otázek, neřešených příkladů a autotestů. Některé definice, věty, případně příklady jsou dynamicky ilustrovány pomocí animací. Samozřejmostí jsou hypertextové odkazy a rejstřík.

Aby bylo možno využít všech multimediálních možností, které výukové materiály nabízí, je nutné mít na počítači nainstalovány aktuální verze programů Adobe Reader (**min. verze 7.0.8**), Macromedia Flash Player, Java Runtime Environment (**min. verze 5.0**). Více informací naleznete v sekci **systémové požadavky**. Kliknutím na příslušný odkaz se otevře adresář s pdf souborem s interaktivní verzí výukového materiálu. Následně soubor otevřete přímo v prostředí Adobe Readeru, ne v okně v prohlížeči.

- Diferenciální počet funkcí jedné proměnné
- Integrální počet funkcí jedné proměnné

Všechny animace, interaktivní programy a testy, které jsou součástí výukových materiálů, si lze samostatně spustit ze stránky **animací a testů**.

**Verze pro tisk**

Texty jsou ve formátu PDF a jsou určeny pro černobílý tisk na papír formátu A4. Pro prohlížení a tisk je nutný Acrobat Reader (**min. verze 4.0**). Kliknutím na následující odkazy otevřete verze pro tisk:

- Diferenciální počet funkcí jedné proměnné
- Integrální počet funkcí jedné proměnné

Tyto studijní materiály byly vytvořeny v rámci projektu Operačního programu Rozvoje lidských zdrojů CZ.04.1.03/3.2.15.1/0016 Studijní opory s převažujícími distančními prvky pro předměty teoretického základu studia. Tento projekt je spolufinancován Evropským sociálním fondem a státním rozpočtem České republiky.

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Figure 1. Multimedia CD front page

## 4. 2. Teaching experience

Students in a composite study of a school year 2006/2007 were in the first lesson of mathematics informed about the opportunity to use a CD with above mentioned interactive form of textbook, except for regular printed textbooks (these textbooks are available for all our students free of charge). Teachers thoroughly explained the CD content to students, its installation and all possibilities it offered – i.e. especially the greater number of solved and unsolved examples, interactive tests and animation. Each student got his/her own CD free of charge. During the whole semester students were given homework from the CD and they were repeatedly informed about the possibilities of particular chapter in the electronic form of the textbook when encountered in the class. These students used the interactive CD which includes the above mentioned titles of didactic texts, as a study aid that completes and extends the material taught at ordinary lectures and traditionally supervised seminars.

The CD content with its well made visual and typographic sites suitably complemented the didactic texts and not always perfect notes from lectures and seminars. Students positively evaluated not only the synoptic text of both textbooks but also a lot of tests and pictures as well as interesting made animations. Unfortunately, nowadays their presentation is not always possible due to technical reasons.

## 2. 3. Examples

Test

V následujících integrálech, které lze řešit metodou per partes, zvolte funkce  $u(x)$ ,  $v'(x)$  při označení

$$\int u(x)v'(x)dx = u(x)v(x) - \int u'(x)v(x)dx.$$

Správné odpovědi vyberte z níže uvedených možností.

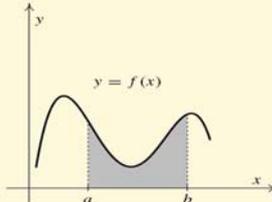
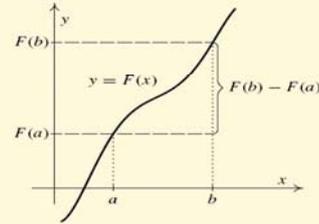
$\int \ln x dx :$	$u(x) =$ <input type="text"/>	$\int x \sin x dx :$	$u(x) =$ <input type="text"/>	<input type="button" value="1"/>	<input type="button" value="sin x"/>
	$v'(x) =$ <input type="text"/>		$v'(x) =$ <input type="text"/>	<input type="button" value="x"/>	<input type="button" value="arcsin x"/>
$\int x \ln x dx :$	$u(x) =$ <input type="text"/>	$\int \arcsin x dx :$	$u(x) =$ <input type="text"/>	<input type="button" value="x^2"/>	<input type="button" value="arccos x"/>
	$v'(x) =$ <input type="text"/>		$v'(x) =$ <input type="text"/>	<input type="button" value="x^3"/>	<input type="button" value="arctg x"/>
$\int x^2 \arctg x dx :$	$u(x) =$ <input type="text"/>	$\int \ln^2 x dx :$	$u(x) =$ <input type="text"/>	<input type="button" value="x^2-x"/>	<input type="button" value="arccotg x"/>
	$v'(x) =$ <input type="text"/>		$v'(x) =$ <input type="text"/>	<input type="button" value="e^{2x}"/>	<input type="button" value="ln x"/>
$\int x^2 e^{2x} dx :$	$u(x) =$ <input type="text"/>	$\int (x^2-x)e^{-x} dx :$	$u(x) =$ <input type="text"/>	<input type="button" value="e^{-x}"/>	<input type="button" value="ln^2 x"/>
	$v'(x) =$ <input type="text"/>		$v'(x) =$ <input type="text"/>		
$\int (x^2-x)\arccos x dx :$	$u(x) =$ <input type="text"/>	$\int x^3 \operatorname{arccotg} x dx :$	$u(x) =$ <input type="text"/>		
	$v'(x) =$ <input type="text"/>		$v'(x) =$ <input type="text"/>		

Figure 2. An interactive test

Učebnice - [up\_sbir.pdf]

Učební integrál 201

širším intervalu, než je  $(a, b)$ , jako je tomu např. v tomto případě). Všimněte si, že důsledkem toho, že v tomto případě je  $f(x)$  kladná, je, že primitivní funkce  $F(x)$  je rostoucí. Platí totiž  $F'(x) = f(x) > 0$  a z diferenciálního počtu víme, že kladná derivace na intervalu znamená, že funkce  $F(x)$  roste. To je ve shodě s názorem, který nám říká, že při zafixované dolní mezi  $a$  a zvětšující se horní mezi  $b$  se plocha pod grafem musí zvětšovat, tj.  $F(x)$  musí růst, aby se zvětšoval přírůstek  $F(b) - F(a)$ .

Obr. 3.13: Newtonova-Leibnizova formule

**Animace**

K lepšímu pochopení Newtonovy-Leibnizovy formule slouží následující [animace](#).

Obsah

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⏴ ⏵

Zavřít dokument

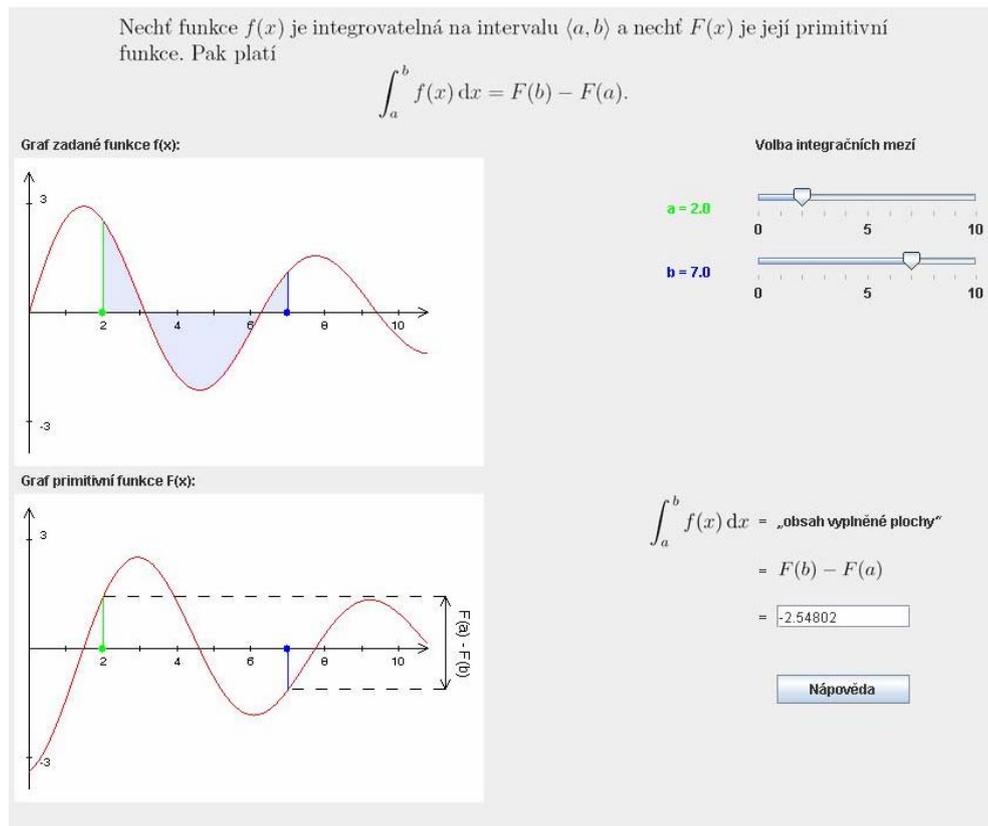
Konec

Celá obrazovka / Okno

V okně:

Zobrazit / Skryt ikony

Zobrazit / Skryt menu



**Figure 3. An explanation of Newton-Leibnitz formula is shown.**

## 5. SUMMARY

Continuous changes our society is experiencing nowadays, make high demands on teachers at every grade of education, particularly on college and university teachers. Proficiency requirements as well as teaching procedures, managerial skills, and last but not least personal profile qualities are rising. Current society asks teachers to show generally high competence, teaching skills and superior personal profile.

The number of students participating in the course is comparatively small for being able to watch better understanding of taught mathematics concepts. Limiting factor for an objective judgement of the course was a different level of skills and abilities of mathematics of individual students.

Better results were achieved by those students who actively worked with the electronical text because they got better idea and notion about given theme thanks to the pictures and animation. A lot of students also positively accepted checking tests and questions that had helped them to show the level and quality of learned knowledge.

Educational results of students who were included in pilot course of project Educational support with Prevailing Distance Components for Subjects of Study on Theoretical Basis where students were given a possibility of using the educational support “Differential calculus of one variable“ and “Integral calculus of one variable“ during the whole semester were not importantly changed in the first two monthes against results of students of last years who went through standard education of mathematics in

the subject Mathematics I and who did not have an opportunity during their preparation for lessons to use multimedial form of scripts. In this time the most of students has the greatest problems in a transition from secondary type lessons into university type lessons, students have to get used to a new system “lecture – exercise“, students meet new surrounding, new pedagogues. Then after this time there is a certain difference between students of pilot course and “ordinary“ students.

It can be said that the opportunity of multimedial CD using brought an improvement in understanding and in exercising of learned knowledge. Students used CD as an educational tool completing and enlarging knowledge gained during classical lessons and traditional exercises. CD content with its visual and typographic frame and with a well-qualified theme completed very well educational texts and also imperfect notes from lectures and exercises.

Students positively evaluated not only synoptic text of the both script titles but also a rage of tests and pictures and also animations made in a interesting way. The presentation of these anination is not sometimes possible to use in lessons because of technicals reasons. Limit factor for an objective evaluation of course was often very different level in mathematics abilities and knowledge of individual students.

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