

# Blended Learning in Tertiary Education: A Case Study

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## ABSTRACT

The paper starts with a quick overview of blended learning model in tertiary education systems. Model integration is illustrated on the example of Faculty of Technical Sciences in Čačak. It is supported by the results of the survey that was conducted in the period of November 2012 to January 2013 on specimen of 252 examinees. The significant achievement is that the model was well accepted in practice and that it could be successfully implemented with low costs and teachers dedication.

## Keywords

Blended Learning, Education, Practice.

## 1. INTRODUCTION

The traditional model of learning has recently been significantly influenced by information-communication technologies (ICT) and therefore it has reached its limits. The didactic rectangle from pedagogic theory [1] has evolved in a way that technology as a component (formerly just a bridge between teacher, student and content) now forms the essential part of the educational process. Modern technology has influenced the development of a new model of learning - e-learning. Sikora [2] states that college students are less satisfied with online courses as opposed to traditional ones. Blended learning, which presents the combination of traditional teaching and e-learning, integrates the models in order to exploit their advantages in the process of teaching. Rovai [3] states that "since students in the model of blended learning demonstrate the feelings of belonging to the community and diversity similar to the students of traditional model, it makes sense to upgrade the online course with a personal contact in order to avoid the feeling of isolation that students have in completely online courses".

Blended learning is by definition a combination of web and personal interaction between teachers and students, during which the advantages of both instructional approaches are used. Dziuban [4] observes the emergence of many potential advantages of blended learning, such as better access of information, pedagogic efficiency and better interaction. Faculty of Technical Sciences in Čačak introduced Learning Management System (LMS) in 2006 as a support for the blended learning in teaching practice. At the beginning the teachers used the System primarily for the

distribution of teaching materials, but they soon started using other available services. According to the data from December 2012, the System had 153 created courses and 2081 active users. In the period between 15/11/2012 and 18/1/2013 at the Faculty of Technical Sciences in Čačak an anonymous survey was conducted to discover the attitudes of students and teachers towards the model of blended learning, the influence on learning styles, the achievements and the technical support. The sample consisted of 238 students and 14 teaching staff.

## 2. MODELS OF BLENDED LEARNING

Learning is a process of gaining new knowledge, skills and habits. Mayes [5] divided the organization of theory of learning into three major groups: associative, cognitive and situated.

Associative model assumes that people learn by linking, initially through basic stimulus-response conditioning, and later through the capacity to integrate the concepts into thought or through linking the steps during the activities in order to create composite skill. Knowledge is considered as an organized set of skills and interconnections between them. Analyzing the model, Gagne [6] developed a system of instructional tasks of discrimination sequences, classification and responses. The model enables individualization of instruction so that each student actively solves a problem and immediately receives feedback (basis of the development of programmed learning). Instruction sequence allows students to study in small and logically arranged steps.

A cognitive model implies that people learn by the active construction of ideas and growing skills by exploring and experimenting, so according to the feedback they perform adequate adaptation. According to the theory, by improving the student's performances the basic skills become automatic, so that the cognitive attention is directed towards the strategic levels of information processing.

Situated model considers learning through the joint participation of people in practical activities, progress through observation, reflection and mentoring. Student learning outcomes are subject to influences from the social and cultural environment. In [7] is stated that there are two aspects of situational learning: "socio-psychological", which emphasizes the dependence of the context of the environment and "joint practice", which sees the individual relationship with the group in which the students are initially peripherally involved in the activities of the group and since they gain new knowledge and skills, their involvement becomes central.

Bloom's taxonomy [8] is used nowadays as a system for classification of learning outcomes. The main areas of cognitive competence are: knowledge, comprehension, application, analysis, synthesis and evaluation. Biggs [9] developed SOLO (Structure of the Observed Learning Outcome) taxonomy in

which he described the development of students' performance during the program implementation. Student outcomes have higher quantitative and qualitative structural complexity through acquisition of new knowledge.

New approaches to learning outcomes give greater emphasis to the development of employment skills and acquiring functional knowledge. These outcomes include analytical and flexible learning skills/qualities: confidence, self-discipline, communication, collaboration, reflection etc. They reflect the key role of the community and direct the attention to learning environment that provide the maximum opportunity for communication and collaboration, such as blended learning and e-learning systems.

Table 1 summarizes connections between the learning outcomes, models and environment.

**Table 1. Connection between learning model, outcome and environment**

Model	Outcome	Environment
Associative	<ul style="list-style-type: none"> <li>Task analysis</li> <li>Defining composite skill sequence and learning competence</li> </ul>	<ul style="list-style-type: none"> <li>Organized activity</li> <li>Clear goals</li> <li>Individualized routine</li> </ul>
Cognitive	<ul style="list-style-type: none"> <li>Conceptual development and principle understanding</li> <li>Encourage independent learning</li> </ul>	<ul style="list-style-type: none"> <li>Interactive environment</li> <li>Principle understanding</li> </ul>
Situated	<ul style="list-style-type: none"> <li>Collaborative learning and formulation with goal to solve real world problems</li> </ul>	<ul style="list-style-type: none"> <li>Participation in shared learning and practice</li> <li>Support the development of capable students</li> </ul>

In the last 15 years different research groups and authors proposed wide range of learning models and methods including blended learning as well.

Koschmann [10] suggests the CSCL method (Computer Supported Collaborative Learning) as the most effective, which focuses on a meaningful context of joint activities, supported by technology. The two critical elements are emphasized: collaborative learning and computer. Integrated approach to blended learning requires extra effort from the teacher while creating e-resources. Stahl [11] stated that working in small groups enables numerous models of social interaction, thereby improving group cognition. In CSCL context, group interaction among the members is performed in a computer environment.

Brooks [12] states that "IT infrastructure is the basis on which the knowledge is created through acquisition, transfer and the usage of information". In CSCL environment a problem of coordination of traditional and online communication in order to improve cooperation between teachers and students occurs. It is essential to synchronize the experiences of students which occurred in different time frames and contexts in order to integrate continuous learning process.

In practice, it is often the case that computer-mediated communication is completely trying to replace the traditional face-to-face interaction, which is a common model of distance learning. According to [13] traditional interaction can be viewed as a standard for evaluation of computer-mediated communication. This kind of researches try to improve computer-

mediated communication in order to meet the characteristics of traditional interaction, such as for example the introduction of cameras to convey gestures. However, according to blended learning, CSCL cannot completely replace traditional teaching practice. Some of the advantages of joint spatial location are difficult to replicate in online environment. The explicit use of online environment in the process of teaching cannot ensure the flow of learning since the students are requested to follow the individual structuring process. The ICT implementation in the process of teaching is often carried out with the aim of limiting students' options. Although it sounds negative, this can be a useful strategy since it reduces socio-cognitive burden learning imposition layout. Blended learning model, supported by CSCL offers many advantages, for example presentations such as models, simulations and visualization offers quality resources for productive conversation.

So & Bonk [14] have conducted a research by anonymous Delphi survey (with 38 questions) in order to collect the opinion of 32 experts in the field of blended learning in tertiary education. Respondents express the main advantages of blended learning model: communication, flexibility and time efficiency. Negative aspects are related to the need of synchronization of traditional and online components of the course. There is a clear consensus on the importance of proper design of the course in order to facilitate efficient CSCL support to blended learning. When asked to describe the module of blended learning in their lessons, the most frequent answers were related to collaborative writing, within which students do tasks in small groups and implement them via Wiki or online forum as the communication medium. They used traditional lessons for presentations or to continue to work on group tasks. In conclusion, when asked about the future projection, virtually all of them said that there will not come to the bipolar division of the online and offline learning method and 68% of respondents is of the opinion that the blended learning model will be the only one in the future.

Although there are many advantages of blended learning, it is rather complex. Teachers request additional training and they need the examples of cooperation, expert opinions, help with research resources and building competences for online communication. Students already use online discussions, podcast, blog, web sites and other different forms of online communication. This fact has already set up a problem for teachers of differentiation of traditional and online learning.

Staker & Horn [15] reduced the model and created their own taxonomy of blended learning. Taxonomy identifies four models (Fig 1): rotation, flexible, independent and virtual.

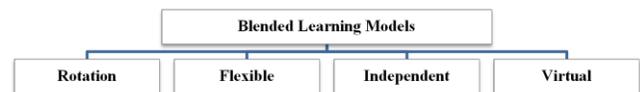


Figure 1. Blended Learning Model Taxonomy

In the *rotation model* the course content is overcome by alternate modalities (traditionally and online). The activities provide lectures to the entire student population or small groups of students, group projects, mentoring and writing assignments. Rotation of student activities is carried out by a fixed schedule determined by the teacher. *Flexible model* presents the students with the content primarily through the Internet. The teacher provides individual consultations, usually through activities such

as managing group projects and mentoring. *Independent model* describes the scenario in which the students perform the selection of one or more online courses in order to supplement the traditional teaching. Online courses can be implemented in computer laboratories or at home. Unlike the virtual model, students are left to choose between individual learning and traditional teaching and it involves only the realization of certain courses, not the entire teaching process. *Virtual model* is a model of the entire teaching based on the combining of the traditional teaching and online content that students take from their homes. It is usually implemented in everyday traditional classes, while the access to the online content is optional.

The quality of teaching is achieved by directing the process based on the real needs. The role of technology is primarily to complement traditional teaching. Bersin [16] offers two generalized approaches to blended learning:

1. *Program flow model* – introduced by sequential curriculum which integrates more media chronologically. New themes continue to previous ones (analogous to traditional course).
2. *Core and branching model* - is a fundamental teaching form supported by additional/complementary (optional or obligatory) materials, interactivity and resources.

The first approach creates the surrounding of deeper level of commitment and lower level of dropout. Students have the feeling of greater involvement in the process and they can plan learning. The teacher monitors the progress and eliminates potential problems. The approach can easily be adapted to specific needs of the students as well as the teachers.

In the second model students independently decide which additional material to use and they have no obligation to use synchronous implementation of the course. The course development is accelerated as additional material can be created during the implementation.

### **3. THE INTEGRATION OF THE BLENDED LEARNING MODEL IN TERTIARY EDUCATION**

According to [17] the success of integration of blended learning in educational institutions depends primarily on the degree of realization of three didactic questions: 1) What knowledge do the students acquire and in which pedagogical form? 2) What is the organization of the teaching process? 3) What kind of learning resources can be created?

The characteristic of tertiary educational institutions is a large number of students per teacher, which makes quality mentoring/individual teaching practically impossible. A particular problem is the heterogeneous time frame in which the students accomplish the subjects. By applying the blended learning model the efficiency of teaching process is improved and the stated problems are overcome. Less frequent physical contact with the teacher (and students mutually) presents a dissociating factor. However, the educational technology creates a new "communication bridge" between the actors in the teaching process. But, Clark [18] points out that the increase of the resource selection and the models of communication are not a guarantee of improvement of quality of education. The focus has to be on achieving outcomes, taking into account the characteristics of student population, learning curve, infrastructure

and development of quality resources. Defining the blended learning strategy primarily depends on the profile that tertiary institution educates. Faculty of Technical Sciences in Čačak educates electrical engineers, computer science, information technology, management and mechatronics engineers and teachers of technics and informatics.

These study programs highly relied on the increased use of technology compared to other disciplines. However, this does not imply the integration of IT into the process of learning. According to [19] "the introduction of blended model of learning in the classroom encourages the development of group work, motivation and better integration of contemporary technological solutions in everyday practice". Didactic model of group work, supported by computer, has been acclaimed by students and it contributes to better connection of theory and practice and to development of certain skills.

Management education in multidisciplinary field is characterized by high production of textual content. The study [20] shows that blended learning easily integrates the model of problem solving teaching into the process of learning in which students achieve outcomes on several levels simultaneously. The authors examined four different groups of students taught by the blended learning model within a semester on the subject of Information System Management. They conclude that using online resources teachers offer students a better quality of participation in the process of learning, and therefore the students in online environment can have better achieving outcomes on different levels.

Teacher education in technology field requires a specific methodical approach in achievement of ICT competences. In future practice, the teacher is required not only to use technology in the teaching process, but also to train other teachers to implement the same in their areas of teaching. Blended learning directly affects the development of knowledge and skills of future teachers through situational learning supported by hypermedia technology. [21] extracts three characteristic learning styles for future teachers supported in blended learning by: creating and applying the experience, studying theoretical resources and creating experience focusing on the range of resources.

Welker and Berardino [22] conducted a study on the outcomes of blended learning and they emphasize the quality improvement of task implementation and grades within courses. The study showed that although the model integration would relatively be simple, it comes to a certain loss in the dynamics of traditional teaching.

#### **3.1 Examples of good teaching practice**

All over the world there are a lot of Universities and educational institutions that intensively and fruitfully apply blended style of teaching. Some examples of good practice are mentioned in the subsection.

Norwegian Stord/Haugesund University (<http://www.hsh.no>) introduced in 2007 a blended learning model into master program of ICT in education. The teachers have introduced the use of LMS in order to distribute the material, online lectures and to improve student-teacher communication. Traditional teaching presents a relatively small part of the activity. Students had consultations in person or via synchronous/asynchronous communication on LMS. The results of the online questionnaire show a positive student attitude towards the course realization.

Department for Applied Informatics at Vytautas Magnus University in Lithuania (<http://www.vdu.lt>) has successfully been

using blended learning model for years. Mathematical Programming Course was created by PBL (Project Based Learning) methodology. Traditional teaching was combined with the problem teaching, within which students study theoretical basis while the discussions take place online.

Finnish University Jyväskylä (<https://www.jyu.fi/itp/>) has been using blended learning model since 2005 in Information sciences studies. Parallel to traditional teaching they developed online material and activities to support learning with the key idea that learning basic concepts of information systems can facilitate the use of online problem teaching. Students explore the concepts and resources by themselves. Problem solving makes 60% of the activities within the course.

Portuguese University of Porto ([www.fe.up.pt/](http://www.fe.up.pt/)) has introduced the model of blended learning in 2005 at the Faculty of Engineering sciences. The course of Physics of dynamic systems uses active learning supported by Moodle LMS. Since the model's implementation, the students' grades have greatly improved, while the pass rate rose from 43% to 94%.

According to [23] the implementation of blended learning model in P.R.C. was not successful. Although the students have a positive attitude towards the use of CMS, the teachers are not aware of its advantages. They were not convinced and motivated to use a new working model. Unlike China, the situation in South Korea is different. According to the data of their Ministry, 67% of university teaching is done by using blended learning model. The survey that was done during the last decade shows a positive attitude towards this model, but that there are certain aggravating factors such as inadequate material, the load on the students is too high and the methodological approach is insufficiently developed. According to the national survey in Japan in 2008, 51% of universities use some form of blended learning in their teaching, but only 20% of them recognize valid assessment at these courses. In [24] it is stated that Technological University in Nanjang in Singapore (<http://www.ntu.edu.sg>) has over 800 courses with blended learning model. The project started in 2002 and the results of the survey show that students point out discussion forums and video stream as efficient tools.

Murin and Watson [25] state that more than 50% of educational institutions in the state of Colorado offer some option of blended learning model and virtually 100% of institutions of high level of education. The results of the research are coexistent to similar studies throughout the USA. 84% of students are taught using the model and 79% of them use online content primarily as a complement to the course content. 59% of teaching staff had some kind of training for the implementation of the model.

Bubaš and Kermek [26] stated that at the Croatian Faculty of Organization and Informatics, Varaždin (<http://www.foi.unizg.hr/>) they had evaluated several created courses taught by blended learning model. After the study and practical experiences collected during a two year period, they point out that most of the students prefer this method and use it more than the traditional one. The model assumes that after the traditional lectures and exercises comes the mastering of online content and mandatory projects. Authors point out the need for significant efforts of academic institutions to increase the level of use of new technology and pedagogy.

### 3.2 The attitude of students and teachers towards the blended learning model

Even though there are great differences between the courses based on the blended learning model, student and teacher satisfaction with this model proved to be consistent. Majority of actors in the teaching process positively evaluate flexibility, convenience and the increase of the interaction level they have within the course. Enjelvin [27] stated that students also recognize the benefits of integration of traditional and blended approaches.

Nevertheless, the traditional form of teaching is applied at most of the universities [28]. 31% of tertiary educational institutions currently do not offer nor plan any other teaching model. 90% of institutions that offer some of the new teaching models use internet-based courses of asynchronous type. Usually they point out that traditional courses strengthen verbal skills, oral presentation and the abilities for solving problems in groups.

Researches that compare the student outcomes in traditional, blended and online courses give different results. For this purpose, two measurable outcomes achieved by students in course realization were chosen: a grade and frequency of interaction with the following online content.

Participation in discussions can be a success indicator of students in traditional and online environment. The parallel to classroom discussion, interactive online discussion is critical for successful studying [29]. Since online discussions enable the equal opportunity for the students' research, they can naturally lead to the higher level of participation, especially among the students who probably would not enter it. Apart from grade as the usual success indicator, the frequency of visiting online course makes an essential variable. The presence in traditional lessons cannot effectively determine the participation of students. Similarly, participation in online discussions is not a valid indicator of the quality of participation in lessons. The frequency of access to online content can provide a more complete picture for comparison of blended and online model.

In the period 15/9/2012 to 18/1/2013 at Faculty of Technical Sciences in Čačak a research was conducted by two anonymous surveys. The data on the attitudes of students and teachers towards the blended learning model, its impact on the style of learning, achievements and technical support were collected. The sample consisted of 238 students and 14 teaching staff.

The first electronic survey collected data on the sample of 199 students of the Faculty. The survey consisted of 12 questions whose structure will be used in the further discussion.

The results of answers to the question "How often do you access the System for e-learning?" are shown in the Figure 2.

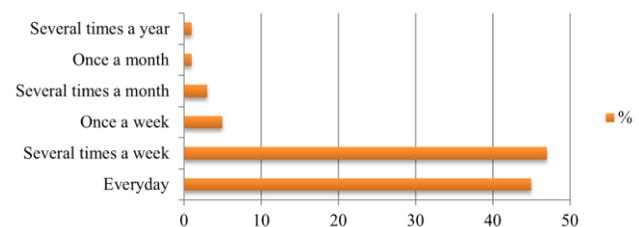


Figure 2. Frequency of accessing online content

From the students' answers it can be concluded that they used online content very frequently, 97% of respondents used additional material at least once a week, 31% of respondents enrolled to more than 5 courses, 59% to 2-5 courses, while 11% enrolled to only one course. This fact indicates the level of model support, since students on average have 5 courses per semester.

When students were asked to what extent the combination of traditional lessons and using online resources helps them in learning, 95% answers can be interpreted as positive. The percentage structure is shown in the Figure 3.

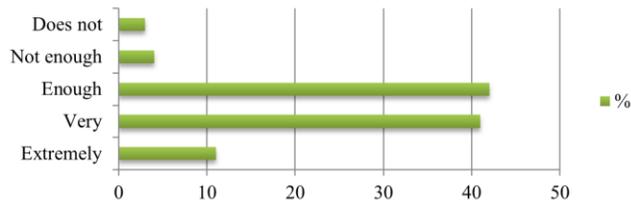


Figure 3. „Blended Learning helps me with learning“

Mezilevska in [30] concludes that students generally have positive attitude towards blended model of learning, noting that they still use traditional approach as the simplest for discussions on the content and for receiving feedback from the teacher.

When asked about the lack of resources, 38% of students expressed a desire for more multimedia content such as video material, while 22% of them were not satisfied with online communication with the teachers. 85% of students thought that 3 to 5 online resources were appropriate. 63% of the students point out discrepancy in the quality of the resources within different courses.

86% of the students study the additional teaching material offline, while 55% prefer reading the teaching material which was printed. 58% of students use the LMS to communicate with other users (students and teachers).

Students often report similar shortcomings of blended learning model as in [31]: insufficient level of two-way interaction between the students and the teaching staff, insufficient technical equipment, insufficient quality of the teaching material content, the process of learning does not encourage competitive spirit and it is not interesting and it often delays feedback to questions.

92% of teaching staff who were surveyed were satisfied with the use of this model and they think it allows better control of the teaching process and facilitates work.

The second written survey conducted on 18/1/2013 collected data on the sample of 39 students who attended the course Methodic of Technics in winter semester 2012/2013 year. The sample consisted of the students in 5<sup>th</sup> year of integrated academic studies. Of the total, 23 students realize the course entirely online and 16 students were taught by blended model. The survey consisted of 10 multiple choice questions in the form of scale ranging from 1 (“I completely disagree”) to 5 (“I completely agree”). The results of the survey are shown in Table 2.

The results show that the students taught by blended learning model point out the factor of personal contact, which can be interpreted in various ways: “the aspect of personal contact corresponds to the earlier learning habits of students”, “it is

possible that students get the answers during the lecture”, “the personal contact motivates them”.

Table 2. Written survey results

Question	Online	Blended	Avg.
1. Online environment helps me with course realization	4,21	3,89	4,05
2. Using the System is clear and simple	3,92	3,77	3,85
3. I can access the System from any location or device	4,81	4,45	4,63
4. Forum resource is simple to use	4,11	4,01	4,06
5. Personal contact with the teacher is an important learning factor	3,97	4,89	4,43
6. System resources meet my needs	3,26	4,38	3,82
7. Learning model is efficient	4,35	4,82	4,56
8. I'm bored when I'm learning online	3,35	3,88	3,62
9. I can learn in my own pace	3,93	2,15	3,04
10. Evaluation criteria is clear	4,80	4,86	4,83

The fact that students taught exclusively in the online environment clearly point out that they independently determined the pace of learning as a result of a lower level of teachers' control. Except the records of access and monitoring activities, the teacher is not able to adjust the process of learning to the group pace, which can be interpreted as a flaw.

The students taught in both models evaluate the teaching model as fairly efficient. It is obvious that the obstacle of independent use of modern technology does not exist, and that the process of adjusting to the new model of learning is effectively designed.

After examining the average number of monthly access rate of the students in the online model (82,9 times) and the blended learning model (77,2 times) it can be concluded that they do not differ significantly (7,4%). This conclusion is analogue to the research result [28] conducted over a much larger sample.

75% of the surveyed teaching staff use the System for e-learning at least once a week as a support to traditional teaching to set up the accompanying resources with the lectures and exercises, while 42% use the System to set additional tasks and communicate with students. Only 16% of respondents use electronic knowledge tests in the teaching process.

According to the proposed taxonomy [15] and after examining the teacher's work, it is clear that the rotation model stands out as the primary model at the Faculty.

90% of the surveyed students recognize the three most adequate e-resources as the support to traditional teaching: lessons, files (.doc, .pdf, .ppt) and knowledge tests. This fact implies that constructive approach to learning suits most students. According to [5], the activities within this approach have two main aspects: interaction with the system for resource distribution and interaction in which the students develop their own competencies.

However, when asked which e-resources should their ideal course contain, the students most frequent response was electronic knowledge tests, files, forums and e-lessons. This result shows that the situated approach sounded more attractive to them. The response structure is shown on the Figure 4.

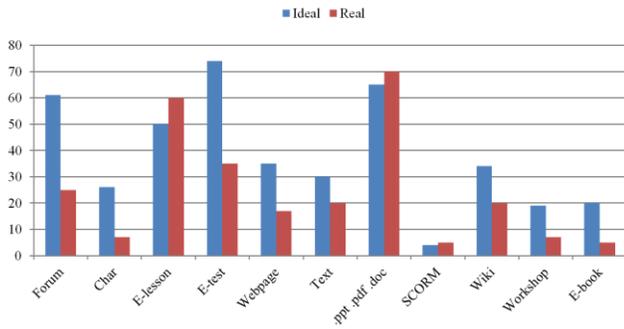


Figure 4. Course resources structure in percentage

The results are similar to the results of the study [28] which emphasizes different factors that influence the selection of resources within certain courses. The more the model is closer to the traditional one, the more online resources lose in their diversity and number. According to [32] the potential for using the course modality has more aspects. The students are not perceived as homogenous groups, but they should be given more resource choices in order to complete the learning experience.

### 3.3 Student achievements in blended learning

Evaluations of blended learning model which can show correlation between the student's achievements and the use of technology are relatively rare. This can be interpreted as the consequence of difficulties in extraction of unique variable in a complex dynamic system of education. Researches are mostly focused on the student's reactions to the new model and approach to learning, so they do not prove the connection between the model implementation and the level of competence of students. Kember [33] points out that the research is difficult to realize in the "natural" surroundings since creating valid control group is usually practically and ethically impossible.

Evaluation of the benefits of blended learning model through students achievements have been done during the winter semester of 2012/2013 year at Faculty of Technical Sciences in Čačak within the course Information Technology which is attended by all the students in the first year in all sections of the faculty. Since the blended learning model has been in the practice for several years, the experimental group consisted of 22 students who had traditional lessons and exercises. The control group consisted of 182 students. After conducting two tests, it was noticed that the average student achievements in the experimental group were lower (about 10%) than the average achievements of other students. Due to the impossibility of interrupting the process of teaching this fact cannot be considered absolute since the sample was relatively small and the lessons were realized using the alternative model in relatively short period of time.

The second survey conducted in January 2013 collected data on the achievements of the sample of 39 students who attended the course of Methodic of Technics. The assumption that there will be a significant difference between the achievements of the students taught by blended learning model and online was not entirely confirmed. It turned out that the students in online model have on average 3.6% better achievement than the students in the blended model (on average 61.8 to 58.2 points). Similar results were obtained in a study [28] in which the difference was a bit smaller.

Grades are traditionally efficient indicators of student achievements. Although it is widely believed that the students will

have better achievement in blended learning model rather than in the traditional and online environments, this claim is not absolute. Students taught by blended learning model have to adjust to learning in different forms which may lead to confusion about what is expected of them every week.

The effects of blended learning on the strategy and structure of student achievements could be measured by the two-dimensional Bloom's taxonomy [34] which has not yet been tried in practice.

The conclusion after the conducted survey is that the students taught by blended learning model point out individual feelings of easier studying and better experience in the process of teaching.

### 3.4 Technology base

LMS was set up to support the teaching process based on the platform Moodle 1.9.9+ that works under CentOS Linux distribution. In the last 4 years the average number of access was around 140.000 per month, with the maximum of 260.000 accesses at the end of winter semester and minimum of 10.000 during the summer holiday. Constant linear increase in the number of monthly accesses can be observed on the Figure 5, therefore it is expected to reach 300.000 during 2013. Bearing in mind that the System has more than 2000 users, it indicates that each one of them accesses it on average 2-3 times a day, which is interpreted as an indicator of success of the model's acceptance in practice.

The system requires relatively "modest" hardware, so the transition to more modern platform was made only after 5 years. System maintenance is performed by two administrators.

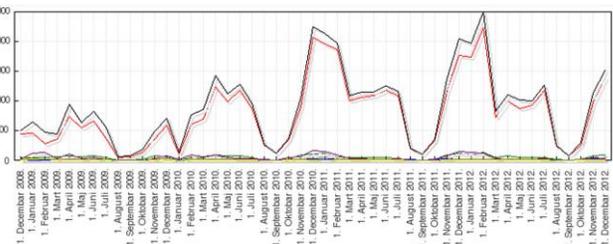


Figure 5. Average monthly LMS access in last 4 years

Survey also collected the data on the locations from which the students access the system. The structure of the responses is shown in the Figure 6.

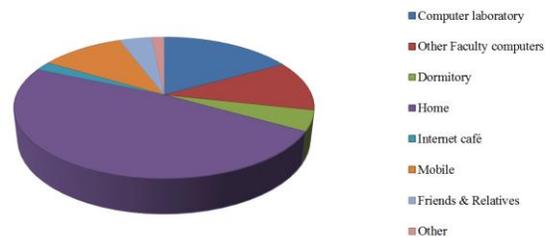


Figure 6. Locations for LMS access

A large number of students who access the System from their homes is the consequence of the Faculty's location as the regional center.

The year 2011 was the first in which the whole generation of freshmen owned their own computers with the Internet access.

This fact contributes the need to adjust the traditional teaching to new society demands and the surroundings by introducing blended learning model as the appropriate model in teaching.

The survey collected data on the types of the Internet access that the students own, which is shown in the Figure 7.



Figure 7. Types of Internet access

96% of the surveyed students were satisfied with the quality of technical support of the system. The structure of responses is shown in the Figure 8.

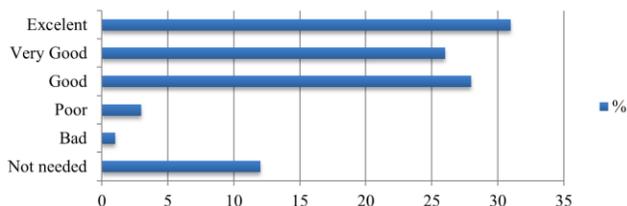


Figure 8. Student's satisfaction with technical support

#### 4. CONCLUSION

Blended learning model has proven as a highly successful in various examples of integration in tertiary educational systems. The traditional teaching has to be adjusted to the needs of the new "digitally literate" students. The practice confirms the thesis that the teachers acquire advantages relatively quickly and easily, thus indirectly they point out the principle of collaborative teaching in pedagogical work.

Various authors often state that the blended learning model can improve the outcomes of learning, increase student satisfaction and make subject more accessible to a wider range of students. Also there are different reactions to the development of the subjects realized by this model: the lack of support (technical and institutional), financial sustainability and the lack of empiric data which would sustain further development of the curriculum based on the blended learning model. Most common obstacle [35] is the lack of time for the development of teachers' competence, identification of new suitable technologies, development of cooperation etc.

According to Jukes [36] the students in contemporary education are used to graphic, entertainment, fantasy, the Internet, so the traditional model of teaching is extremely boring. In order to motivate the "digital" generation of students there has to be a change of the instructional design and the strategy of blended learning.

Creating taxonomy of blended learning [15] presents a step leading to the right direction. It enables future standardization and development of the model. Our results presented in this paper confirm the findings of other authors [28] [30] [31] [32] who dealt with similar themes. It turned out that the student's grade does not represent a valid indicator of the students success of the model's integration since it often does not include the complex body of competences, knowledge, skills and habits that student

receives. Clearly there are improvements compared to the traditional model, but there rises a question of the effects of learning on the strategy and the structure of the achievements which are not entirely gradable. The appropriate design of the assessment scheme based on two-dimensional Bloom's taxonomy, knowledge dimension and cognitive process of students could give a more realistic picture. The interaction frequency with the online content turned out to be valid. There is a direct connection between the frequency and achievements of students [28].

The result that the blended learning model achieved at Faculty of Technical Sciences is more than satisfactory. With its implementation the students' motivation has greatly improved and the teachers started to cooperate more intensively with the students. As a consequence of implementing the blended learning model, the average pass rate of students increased by about 20%, while the percentage of subject dropout was lowered to about 5%. Although it initially demanded extensive participation of teachers, the obvious advantages of this method implicate that the Faculty will continue with its application in the future with the aim of further modernization of the teaching process.

Blended learning has the potential to transform the traditional model if it introduces its accessibility and efficiency aggressively. Otherwise it will probably improve it, but not fundamentally change it.

The need for further research and pedagogical experiments should be emphasized in order to standardize the blended learning model and make it a mandatory component in the process of teaching in schools in the near future.

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