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## SCALE\_UP – an active learning cases modelling at Kaunas UAS

**Annotation**

The article reviews SCALE-UP (The Student-Centered Activities for Large Enrollment Undergraduate Programs) active learning environment and Cloud Computing technologies Enabled Active Learning know-how, the main requirements for a SCALE-UP type classroom and educational model. Transfer of this good practice of equipping two SCALE-UP classes at Kaunas University of Applied Sciences is discussed. This article presents the modelling case for Software Engineering, Data Management Technology, Business Economics and Management Courses. Each of those courses consists of lectures and practical activities. Three phases are underlined for each topic: 1) the problem based learning; 2) practical activities by tutoring; 3) collaborative learning. The lectures and practical work are combined and executed as a whole in the frame of SCALE-UP study plan and an active learning scenario. The classroom is equipped with a virtual workplace, cloud computing services, open resources on the Internet, e-libraries and subscribed databases. The study results considering the assessment of collaborative learning outcomes and the use of cloud computing technologies are discussed.

**Keywords**

Collaborative active learning, Cloud Computing technologies Enabled Learning, SCALE-UP learning environment

**1 Introduction**

The new approach to teaching and learning in higher education is no longer directly related to systematically organized studies. Teaching is viewed as the process which enables people to develop their knowledge, understanding, abilities, values, attitudes and experience. The implementation of this idea is concurrent with learning environments which put emphasis on equipping students with effective and interactive learning tools and devices that correspond to the student's learning habits and needs. The question is: what kind of technological and educational conditions and innovations will be needed to achieve that? What learning environments have to be created and what learning technologies need to be chosen in order to improve students' perception of conceptual (theoretical) subject-matter, their ability to solve problems, study results and motivation? Conventional lectures, when the study material is uploaded and easily available in the virtual environment, is becoming

less than effective method of teaching. At Kaunas University of Applied Sciences, the availability of study material in virtual learning environments has generated the need to modify conventional lectures by integrating active learning methods [1].

Active learning means the student's active participation in the learning process [4], the most advanced thinking skills such as analysing, synthesizing, and assessing [3], interactivity defined by the interaction between the student and the lecturer, between students, the student and the subject-matter, and the student and tools needed to accomplish the task [10]. In order to achieve such level of interaction and student activity it is necessary to appropriately reconstruct the physical space in relation to the virtual learning environment. Successful examples of such reconstruction are SCALE-UP (Student-Centered Activities for Large Enrollment Undergraduate Programs) and TEAL (The Technology Enabled Active Learning) projects [12, 13].

Since 2010 Kaunas University of Applied Sciences has been developing the environment of

active collaborative learning as based on the good practice of SCALE-UP and TEAL projects.

The article discusses the practice of developing the active collaborative learning environment by setting up studio-like SCALE-UP classrooms at Kaunas University of Applied Sciences while making use of the already existing e-learning infrastructure and MS Visual Studio software tools for visualization, simulation, experimentation and designing.

**The aim of research:** to analyse the case practice of active collaborative learning environment and cloud computing technologies enabled active learning while modelling the contents of the Software Engineering study subject.

**The subject of research:** SCALE-UP active collaborative learning environment.

**The methods of research:** analysis of scientific literature, case study, survey.

## 2 Good practice SCALE-UP and TEAL projects

SCALE-UP is a learning environment created to stimulate active collaborative learning in a studio-like classroom [6]. The requirements for such environment were shaped during the implementation of the SCALE-UP project at different universities including North Carolina State University (USA). The main achievements of the project: improved understanding of conceptual (theoretical) material; more positive approach to studies; increased motivation; improved study results and augmented problem solving abilities; decreased student wastage rates [2].

SCALE-UP classrooms are furnished with round tables for groups of nine students. Each student is equipped with an Intel i5 computer with a touchscreen. The lecturer uses a laptop with wireless Internet connection. There is a 47" Full HD screen for every student team. All screens are synchronized. The classroom equipment enables to display the picture from any computer in a classroom. Students have access to the Internet; they can carry out experiments using laboratory equipment and/or the computer, discuss in larger or smaller groups, and demonstrate the obtained results on a screen for a joint discussion. The classes follow an educational model based on student discussions and collaborative learning; student activity prevails over lecturing; there is individual instructing and joint discussing of activity results. One of the best known examples of SCALE-UP adaptation is the TEAL project for physics studies at Massachusetts Institute of Technology (MIT). The TEAL (The Technology Enabled Active Learning) model features: short lectures; visualization; process imitation/simulation; experimentation using laboratory devices and tools; collaborative learning. The studies at TEAL classrooms are notable for collaborative learning in

small groups, instructing, experimentation and data display on a computer screen, simulation of different physical processes, and the use of assessment tools for interactive study achievements. The distinctive features of the MIT TEAL project are the visualization and simulation of physical processes. Both animation and interactive JAVA based programs were used to implement the project [14]. Later on numerous interactive tools were prepared for teaching a mathematics course at a TEAL classroom [13]. SCALE-UP active learning environments are being adapted at many universities in the USA, the UK, Portugal, Sweden, Norway, France and other countries.

## 3 Setting up SCALE-UP classes at Kaunas University of Applied Sciences

The first SCALE-UP classroom at Kaunas University of Applied Sciences was set up in October 2010. There are four round tables of six computerized workplaces – for the total of 24 students and one computer-equipped workplace for the lecturer. There is a wireless Internet connection. Students can also use their personal computers. Students are able to perform individual or group tasks, demonstrate the results and discuss them in groups or together in the classroom; they can show the results from their workplace via the video projector. All the course material prepared by the lecturer is available in the virtual learning environment Moodle of Kaunas University of Applied Sciences. For group work, students can use the possibilities provided by Kaunas University of Applied Sciences Google Apps [15]. Students can also use other open study sources available on the Internet. The lecturer has a possibility to demonstrate the course material via the smart board or make use of the screens equipped in the room while providing explanations or tasks for separate student groups [1]. The SCALE-UP project at Kaunas University of Applied Sciences is being continued. In October 2014 the second SCALE-UP classroom was opened.

The classroom has 17 round tables of 6 workplaces with three laptops. Students can bring and use their own laptops or tablets. The classroom will seat 102 students; there is also a computer-smart board equipped workplace for the lecturer. There are six screens placed around the perimeter of the room. The lecturer can use his workplace to demonstrate the material via all screens; students can show their output on the nearest screen. Students are able to do individual or group tasks, demonstrate and discuss them in separate groups or as a whole class while displaying their output via screens. The classroom is equipped with wireless and wired Internet connection, MS Windows operating system that provides the possibility to

use virtual workplaces, cloud computing services, open resources on the Internet, subscribed e-libraries and databases. The SCALE-UP classroom enables the use of various visualization, process imitation, and computer design software packages.

#### **4 SCALE-UP Business Economics and Management case modelling**

##### 4.1 OUTCOMES OF STUDY SUBJECT

The course aims to introduce conception of business economics and management. The students introduced to: business efficiency, fields and forms of business organization, the influence of market law on a company, the dynamics of change of business environment and its macroeconomics indicators. The course introduces students to the: calculations of demand for material, financial and labour resources, financial accounting forms, basics of management, main categories of management, types of organizational structures of management, general management functions, human resource management, personnel motivation, communication process and conflict management. Knowledge and abilities are reinforced with the help of provided e-course material; students perform group and individual tasks.

##### 4.2 CASE MODEL OF STUDY SUBJECT

The course uses MS PowerPoint environment for theoretical lectures and student practical work presentation, MS Word environment for students works preparation and MS Excel environment for economic and business calculations. The studies integrate theoretical lectures and practical classes which are held in the SCALE-UP classroom which helps students to use open resources, software and internet for information search. Nevertheless, SCALE-UP classroom helps students to work in pairs or groups according to lecturer's tasks.

##### 4.3 AIM, STRUCTURE AND TOOLS OF SELF-STUDY WORK

The self-study work of Business Economics and Management course aims to help student master economics calculation by simulating a real project in IT field. Students have to develop fully project cost calculation based on the chosen project and prepare the project calculation documentation which consists of: hardware and software equipment prices and arguments for chosen supplier (few suppliers comparison); the hardware and software equipment estimate (assessing the quantity of hardware and software needed); project accomplishment duration; employees who will work in project gross wage, payroll cost calculation; total

estimate of the project (assessing the hardware and software prices, human resources salaries and administration costs); company description (it's structure, activity, company name, logo, size); project characteristic. Students are free to choose their project idea and discuss all detail with the lecturer. The documentation has to be prepared following the instructions provided by the lecturer.

Business Economics and Management self-study work is performed in small groups of free or four members. All allocated tasks of self-study work are being done by student group members and are being managed by all members of group. The project activities include seven stages: 1) grouping and finding/discussing the project idea, writing project characteristic, describing the company which will accomplish the project; 2) hardware and software equipment prices and arguments for chosen supplier; 3) hardware and software equipment estimate; 4) project accomplishment duration; 5) employees gross wage and payroll cost calculation; 6) total estimate of the project; 7) preparation for Business Economic and Management self-study work presentation and report. Students have two weeks for every stage with lecturer consulting to complete it. Students are presenting Business Economics and Management complete self-study work on the last term lecture in front of lecturer and classmates in the classroom.

##### 4.4 SOFTWARE USED FOR COURSE

The activity plan for Business Economics and Management self-study work in groups and Gantt chart are prepared using the business project management system MS Project. Students are using MS Excel (Pivot) for practical economics calculation and analyses.

#### **5 SCALE-UP Software Engineering case modelling**

##### 5.1 OUTCOMES OF STUDY SUBJECT

The course aims to introduce the object, paradigm and principles of software engineering; the conception of software engineering process, and its models; graphic design language UML, and management of software projects. The course introduces students to requirements engineering, the model of requirements process, methods of gathering requirements, and analysis of requirements, specification of requirements, document templates, and assessment of requirements. Students are taught software designing, software development, testing, maintenance, and configuration management. Knowledge and abilities are reinforced with the help of provided e-course material; students perform group and individual tasks.

## 5.2 CASE MODEL OF STUDY SUBJECT

The course uses MS Visual Studio environment for software designing, software development, testing, maintenance, and configuration. The studies integrate lectures and practical classes which are held according to the lecturer's plan and active learning scenario. The studies take place in the SCALE-UP classroom equipped with computerized workplaces, which enable students to use virtualization, cloud computing service, open resources, and software. Eight main topics are studied during the semester, each topic takes two weeks. Students spend three hours a week at the SCALE-UP classroom. The case model of Software Engineering lectures and practical classes at the SCALE-UP classroom:

- 1) There are three stages in the course of each study topic:
  - Introduction.
  - Learning based on problem solving.
  - Practical activity assisted by the lecturer.
  - Collaborative self-study in a group.
- 2) Study methods: discussion, work in pairs, group work, presenting problem solutions and answering questions.
- 3) Evaluation methods: participation in discussions, work in pairs, group work, presenting problem solutions and answering questions.
- 4) Cloud computing technologies.

## 5.3 AIM, STRUCTURE AND TOOLS OF SELF-STUDY WORK

The self-study work of Software Engineering course aims to help students master software engineering methods by implementing a real project. Students have to develop fully-functioning software based on the technical task and prepare the project documentation which consists of: the project plan; specification of requirements; designing document; testing plan; the system administrator and user manuals. Students are free to choose software tools to do the task. For project documentation, it is recommended to use the project management system MS Project and designing and programming system MS Visual Studio as well as a selected text editor. The documentation has to be prepared following the instructions provided by the lecturer.

## 5.4 PROCEDURE OF SELF-STUDY WORK

Self-study work is performed in small groups of three members. Each group member performs individually allocated tasks and is responsible for a certain stage of the project. The project activities include six stages: project planning, drafting requirements specification, designing, programming, testing, and preparing

documentation. During the first two weeks students have to divide into groups, assume responsibilities, choose the self-study task from the given list or present an idea and discuss all details with the lecturer. Students report on the completed work gradually according to the schedule. The assessment of self-study work is calculated individually for each group member, considering their roles, according to the formula.

## 5.5 SOFTWARE USED FOR COURSE

The activity plan for self-study work in groups and Gantt chart are prepared using the business project management system MS Project.

Requirements specification and designing document UML schemes are prepared using MS Visual Studio – the software designing and development, testing, maintenance, and configuration management system.

## 6 SCALE-UP Data Management Technology case modelling

### 6.1 OUTCOMES OF STUDY SUBJECT

The aims of course are to introduce conception of data management, the tools and equipment used to organize, secure, store and retrieve information.

The course introduces students to methods of database designing and development, process of normalization, testing, analyzing information.

Data management technology can use a wide range of techniques and database systems used for managing information and allocating access both within a business and between entities. Knowledge and abilities are reinforced with the help of provided e-course material; students perform group and individual tasks.

### 6.2 CASE MODEL OF STUDY SUBJECT

The course uses MS PowerPoint environment for theoretical lectures, SQL Server and SQL Server Management Studio for practical works. The studies integrate theoretical lectures and practical classes which are held in the SCALE-UP classroom which helps students to use open resources, software and web for information search. The duration of theoretical and practical lecture parts depends on students' comprehension and feedback.

### 6.3 AIM, STRUCTURE AND TOOLS OF SELF-STUDY WORK

The self-study work of Data Management Technology course aims to help students master the database structure design as a real project. Students have to analyse an information area and to develop an elements of database and interface

for using database. Strong focuses on using SSRS (SQL Server Report Service) for creating different reports from information's examination by various approaches. The documentation has to be prepared following the instructions provided by the lecturer.

6.4 PROCEDURE OF SELF-STUDY WORK

Data Management Technology self-study work is done in two ways. The first way - each student gives an individual task for two month. Another one – each group of three members give one task. Each member of group performs individually allocated tasks and is responsible for a certain stage of the project. Some solutions must be found by a group discussion. Group presents the solutions and gives feedback from another group and from lecturer. The assessment of Data Management Technology self-study work is calculated individually for each group member, considering their roles, according to the formula. One component of the formula is group's members' evaluation.

6.5 SOFTWARE USED FOR COURSE

As the basic software for studying Data Management Technology course can be various of existing relational database management systems – SQL Server (SQL Server Management Studio), MySQL etc.

Research on the assessment of collaborative learning outcomes

The research aims to find out how students rate the Software Engineering collaborative learning outcomes and cloud computing technologies in use. This is the first part of the ongoing research on students' attitude to active collaborative learning. The research involved second and third year Software Engineering, Business Economics and Management and Data Management Technology students, 184 people in total from Computer Network Administration, Automation Engineering and Infotronics (tables 1, 2).

The survey results revealed that students positively rate collaborative learning outcomes. When doing self-study work in groups, students prefer Google Docs, Office 365, Dropbox cloud

Table 1 Rating of collaborative learning outcomes

Outcomes	Average rating*
Helped to find information about the main Software Engineering concepts	2,9
Improved communication skills	2,4
Improved analysing skills	2,1
Improved ability to put into practice knowledge and skills gained during the practice	2,5
I understood the purpose and aim of Software Engineering subject	2,7
I found Software Engineering subject studies interesting	2,3
Group work experience	3

\*Maximum score is 5

Table 2 Cloud computing technologies in use

Title	
Google Drive	51%
OneDrive	16%
Dropbox	5%
ICloud	7%
Other	15%
Never used	6%
Group work experience	3

computing technologies.

7 Conclusions

The newly-equipped class at Kaunas University of Applied Sciences meets all major requirements for SCALE-UP infrastructure and potential to implement a SCALE-UP didactic model.

The classroom can be used to teach different exact and technology science subjects (general and specialized): mathematics, physics, information technology, programming, engineering, data management technology, business economics and management, process management and others.

Information technologies used in the classroom are easily integrated into the already existing e-learning infrastructure developed at Kaunas University of Applied Sciences and create additional possibilities for active learning and setting up of the student-oriented environment, as well as the development of lecturers' qualification by introducing them to the SCALE-UP didactic model and its implementation.

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