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Development of the course «Fundamentals of development and operations methodology» in the blended learning format

The paper considers the process of developing the course «Fundamentals of Development and Operations Methodology» in the format of blended learning. An analysis of the possibilities of presenting these materials in the format of blended learning was carried out. The application of various approaches for materials presentation in remote learning is considered.

Keywords: Development and Operations; blended learning; remote learning; Bloom's taxonomy; pedagogy wheel.

The Development and Operations methodology is a relatively new direction among software development approaches, which consists in designing a process of continuous development, deployment and support of software with feedback at all stages between the teams of development, testing, maintenance and support of the product environment. Currently, this methodology is in high demand both in large and medium companies, the purpose of which is to ensure the rapid and reliable release of new software versions.

Due to the high interest in this methodology in the field of software development, there is a demand for specialists familiar with this methodology and the main tools that are designed to support the practical implementation of this methodology. In the current situation, it is important to take into account the possibilities of learning in a blended format, since modern digital technologies make it possible to transform the traditional face-to-face learning format with the help of electronic resources and online communication available to students at any time. This allows you to create a more flexible learning path and increase the efficiency of learning the materials.

Within this paper a syllabus for the course «Fundamentals of Development and Operations methodology» is developed as well as teaching aids for lectures, formative and summative assessment measures and a series of tasks to complete by students throughout the course. The developed sequence for adapting this course to blended learning format is also presented.

The general structure of the developed course contains 2 main sections:

Section 1. Technologies of OS Linux.

The section forms basic ideas about the functioning of Linux operating system (OS), methods of working with Linux processes and subsystems, the structure of the file system, package managers, and data transmission networks.

This section is important in the context of Development and Operations methodology, because it is assumed that the Development and Operations (DevOps) specialist must have an understanding of how operating systems and individual OS components function.

Section 2. DevOps technologies.

The section forms the initial skills of using DevOps technologies in the context of Docker tools, CI/CD and databases. There are many resources for each section, from tutorials on OS Linux [7] and documentation on automation tools [1], to detailed instructions for deploying your own environments for continuous integration (CI) and continuous deployment (CD) of software [6].

The listed materials have been adapted into a single course, consistently covering all stages of using the Development and Operations methodology. In a short form, this course was used as a module of the discipline «Operating Systems» of the direction 09.03.01 «Informatics and Computer Engineering».

Lectures were given and laboratory work was carried out in the traditional face-to-face format, except some of the materials which were presented for self-study.

As a result, elements of educational materials were identified that require improvement in the form of presentation, and assumptions were made about the possibility of using elements of blended learning within this course when it is introduced into the educational process. As part of the work carried out, a study was conducted on the application of blended and distance learning opportunities to the Development and Operations course being developed. Blended learning, also known as technology-mediated instruction, web-enhanced instruction, or mixed-mode instruction, is an approach to education that combines online educational materials and opportunities for interaction online with physical place-based classroom methods.

In the process of analyzing the applicability of individual elements of blended learning, various types of activities were considered, such as «Watch a video and discuss», «Submit essay», «Quiz», «Discussion», «Field trip» and many others. Given the specifics of the course, many of the activities typical of blended learning turned out to be inapplicable. However, part of considered activities such as «Watch a video and discuss», «Multiple choice test», «Project work», «Lab Exercises», «Guest lecturer», «Demonstrations», «Assessments, Tests and Surveys» are enough universal. They are suitable for the Development and Operations course in the traditional face-to-face learning mode as well as in distant and blended formats, but with some modifications, e.g. guest lecturer will require different preparations and different types of equipment.

Bloom's taxonomy was also applied as a part of the course analysis. Benjamin Bloom with collaborators published a framework for categorizing educational goals in 1956. This framework was named Taxonomy of Educational Objectives [8]. Familiarly known as Bloom's Taxonomy, this framework has been applied by generations of teachers and college instructors in their teaching. In 2001 a revised version of this framework was published.

The updated framework consists of six major categories: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. The categories after Knowledge are presented as «skills and abilities». It should be noticed that knowledge is the necessary precondition for putting these skills and abilities into practice.

From the point of view of Bloom's taxonomy, it is possible to distinguish levels suitable for full-time education and for online education. So, most of the activities associated with the Remember level can be taken online (reading and remembering information, repetition, studying definitions, etc.). At this level,

video lectures and video materials, electronic text learning materials, online tests are suitable. This also correlates with the concept of advanced learning of materials and the concept of a flipped classroom, which consists in independent study of the material by students, and the time of face-to-face classes is distributed for individual consultations and practical tasks.

Most of the next levels – Understand, Apply, Analyze – require face-to-face communication with the teacher (or at least video communication). Everything related to the performance of laboratory and independent work, in one form or another, depends on observation by the teacher. First of all, students can demonstrate the acquired knowledge. Secondly, they can apply this knowledge in practice. Thirdly, they can discuss the possibilities of considered tools and algorithms in real tasks.

Within the framework of the course, it is difficult to find a place for activities related to the last 2 levels – Evaluate and Create. These levels assume a deep understanding of the material and are not well suited for a basic course, but may be useful in development of course projects disciplines related to Development and Operations.

With the Pedagogy Wheel Model [4], teachers have an at-hand reference that ties apps to specific learning outcomes directly connected to modern pedagogies and theories. They can easily sit with the wheel during lesson planning time to find tools that will best aid their students or use it during class time to extend or deepen learning towards a specific 21st century skill or content area. The Pedagogy Wheel follows a similar model to Bloom's taxonomy, divided into 6 areas of learning activity, adding more activities and applications that can be useful for the successful completion of these activities.

Given the specifics of the Development and Operations course, only a few applications can be used in the learning process (tools for working with documents such as Google Docs and Word, tools for information searching (Google), and others), but most of the activities will be related to more course-specific programs, such as Oracle VM VirtualBox virtualization tool, Docker container manager, Jenkins and GitLab CI/CD management tools.

An example of a separate lesson was formulated in general form taking into account the knowledge gained in the study of Bloom's taxonomy and The Pedagogy Wheel.

Session title: Docker containerization system, Docker Compose container management.

Learning Outcomes for the session:

Obtaining the skills of independent study of the material on the topic of the session;

Obtaining practical skills in organizing and managing containers.

Tasks for the session in accordance with Learning Outcomes.

- 1) learn how containerization systems work;
- 2) review practical examples of running containers in Docker and managing containers in Docker Compose;
- 3) build your own container-based client-server architecture that works with requests from the user and returns a result;

Instruments from the Pedagogy Wheel to deliver the tasks within the Learning Outcomes:

Task 1 is connected with «Understand» and «Remember» parts of Pedagogy Wheel. This task requires such activities as: read materials, define main ideas and tools of container systems, explain concepts of these systems, search appropriate tools and methods for practical tasks.

Task 2 is connected with «Understand» and «Analyse» parts of Pedagogy Wheel. This task requires such activities as: compare practical examples, make relations between examples and theoretical materials, classify programming methods by the areas of their use, be able to repeat practical examples on virtual machine.

Task 3 is connected with «Analyse» and «Apply» parts of Pedagogy Wheel. This task requires such activities as: estimate task that must be solved, determine necessary methods, construct new containers, run these containers and evaluate their correspondence with initial task.

Such a description of classes helps to identify gaps in educational materials and methods of their presentation as well as helps to assess the degree of student involvement in each stage of the lesson and the total amount of knowledge and activities presented. Examples of blended courses presented by the University of Waterloo [9] were considered and analyzed; such advantages of blended courses as Increased flexibility in the design of teaching and Increased access to course materials were highlighted. The out-of-class activities considered in the examples (Field trips, Independent or group projects, Community engagement projects) were analyzed, but these activities are not applicable within the area of the Development and Operations course. As a better option for out-of-class activities in the developed course company tour can be organized (for companies that are interested in Development and Operations specialists).

Based on the studied materials [3, 5, 10], the possibilities of separating online activities within the course were analyzed, and a general scheme was formulated that reflects the plan for conducting classes in the Development and Operations course. The scheme is shown in fig. 1.

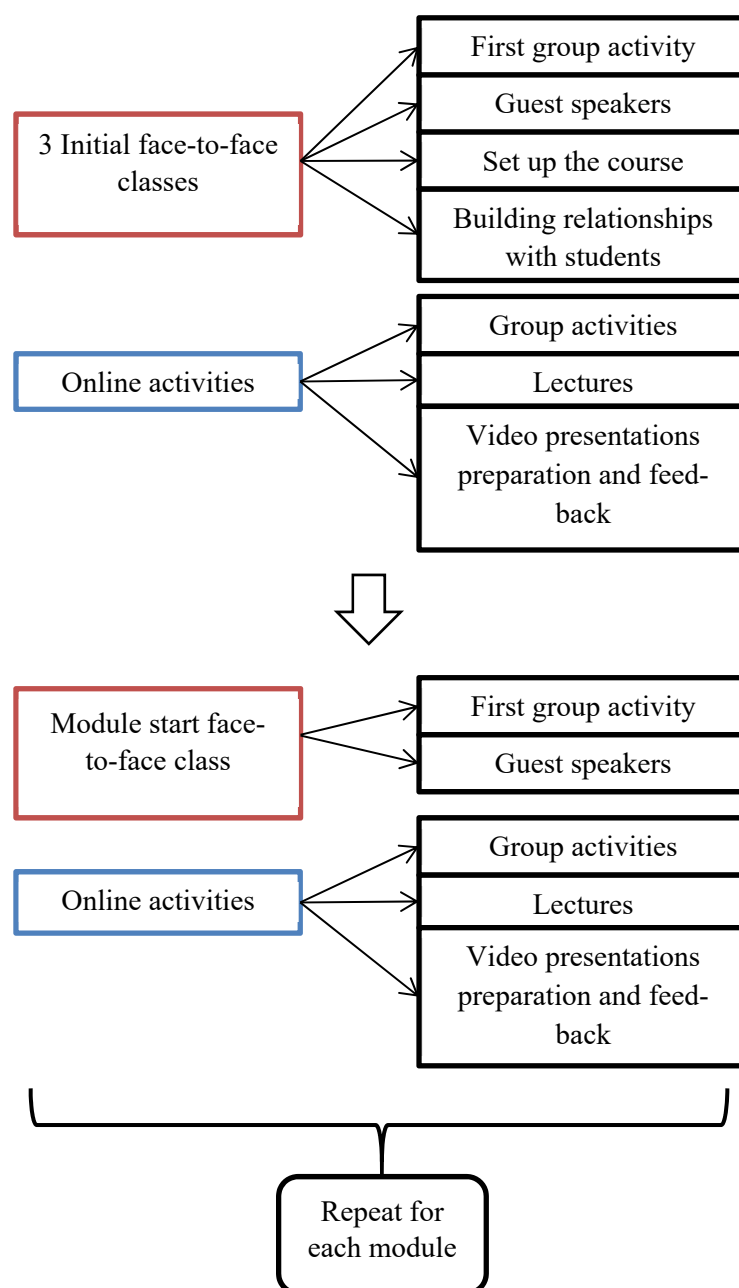


Fig. 1. Scheme of blended learning course

In fig. 1, face-to-face classes are highlighted in red, online classes are highlighted in blue, and the individual activities planned for them are presented. Initially, 3 face-to-face classes are planned, during which initial relationships with students are built, a general description of the course and the first introductory lectures are given. After first 3 face-to-face lectures work with students goes to online part of course. Group and individual consultations are held by video conferencing, and students independently study the materials of the electronic course at their own pace, then take online tests for self-control and perform laboratory work. Face-to-face classes are held again as soon as

students' laboratory works are done. At these classes laboratory works are defended and general information is given on the topic of the next laboratory work, with the possible involvement of a guest speaker.

After consideration of the features of blended and distance learning [8], recommendations for students on organizing a workspace for distance learning were investigated and aggregated. A few examples of workspace organization:

Clear workspace; relaxing music; warm coffee; healthy snacks.

Small clean desk; things that associates with learning; comfortable workspace.

Distraction notepad for writing extraneous thoughts; bottle of water; schedule app for schedule study and breaks periods; plants around workspace.

Maintain a daily routine; use the right tools and equipment for different tasks. A lot pieces of advice can be applied by students (e.g. clean workspace, bottle of water), but some advices are very situational or person-dependable (e.g. relaxing music or warm coffee).

A syllabus for the course «Fundamentals of Development and Operations methodology», teaching aids for lectures, formative and summative assessment measures and a series of tasks for students throughout the course were developed within this paper. The developed sequence for adapting Development and Operations course to blended learning format was presented.

The materials in this paper will be used for training students of specialties 09.03.01 «Informatics and Computer Engineering» and 09.03.04 «Software engineering» as a course «Fundamentals of Development and Operations methodology».

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Диагностическое исследование как средство совершенствования педагогической компетенции преподавателя вуза

В статье представлен опыт использования диагностического исследования в формате практико-исследовательских проектов для совершенствования педагогической компетенции слушателей программ повышения квалификации Ресурсного центра языковой и методической подготовки Отделения иностранных языков Школы общественных наук ТПУ.

Ключевые слова: диагностическое исследование; практико-исследовательский проект; научно-педагогические работники; педагогическая компетенция; система повышения квалификации.

Совершенствование педагогической компетенции научно-педагогических работников университета является одним из ключевых направлений обновленной системы повышения квалификации, пилотирование которой состоялось на базе Ресурсного центра языковой и методической подготовки Отделения иностранных языков Школы общественных наук ТПУ в 2023–2024 учебном году. Формирование и совершенствование педагогической компетенции сотрудников в рамках новой системы реализуется в программах повышения квалификации направления Педагогическое мастерство Академического трека [3, 4].