

Accelerating Western Balkans University Modernization by Incorporating Virtual Technologies

VTech@WBUUni

WP2.2 - Activity 2.3.2, 2.3.3 and 2.3.4 Report

Enabling Virtual Technology teaching and learning methodologies

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1. Introduction

The scope of Work package 2.3, is Integrating Virtual Technologies in teaching and learning to foster the modernization of WB universities. The WP's goal is to implement virtual technologies in the teaching and learning process as the best user experience in educational content consumption, which requires consideration of usability and user experience guidelines. This document emphasizes the pilot courses at each HEI that will use Vtech technologies.

Several meetings have been held to discuss Vtech courses with all project partners. Most of the meetings organized by UP regarding the Vtech courses have been done online due to the pandemic.

Meetings have been organized on weekly basis, for three months (06.01.2022 – 31.03.2022). On meetings are discussed the achievements that each project partner has reached on respective Vtech courses.

2. Selection of pilot courses at each HEI that will use VTech

The development of the courses is based on the development of the methodology, which will remain in force for use by Higher Education Institutions (HEIs) after the completion of the project. Such development will further contribute to increasing the modernization of HEIs and the introduction of new technologies.

developed VR courses will be available to students to ensure the quality of teaching and enhance student performance.

In each project partner, several meetings with academic staff were conducted. In each meeting, is discussed about the most suitable courses in which virtual technologies could be implemented. Faculty staff members gave valuable inputs in proposing and elaborating the reasons for proposed courses that can implement VR technology and that will directly impact the teaching and learning process in selected fields.

After a period of discussions within the consortium, each partner proposed at least three selected courses offered at bachelor and/or master level studies that can implement VR technology.

- **University of Prishtina**, seven courses for implementing VR technologies, four in bachelor and three in the master level program (master thesis).
- **Polis University**, three courses, one in bachelor, one in integrated master, and one in the master course.
- **European University of Tirana**, four courses are most suitable for implementing these technologies, two in bachelor and two in the master program.
- **Mother Tereza University**, two courses, one in bachelor and one in master level studies.
- **EPOKA University**, three courses, two in bachelor and one in the master program.
- **Aleksander Moisiu University**, eight courses that are suitable for implementing virtual technologies, five in bachelor and three in master studies.
- **South East European University**, three courses, two in bachelor and one in master studies

- **University for Business and Technology**, ten courses, five in bachelor and five in master program.

There are 40 courses in total at both study levels (bachelor and master) where virtual technologies have been developed and implemented together by professors and students.

3. Developing and delivering VTech supported courses

There were conducted several online meetings with all project partners on weekly basis for discussions on approaches and strategies for implementing VR technologies in learning and teaching process.

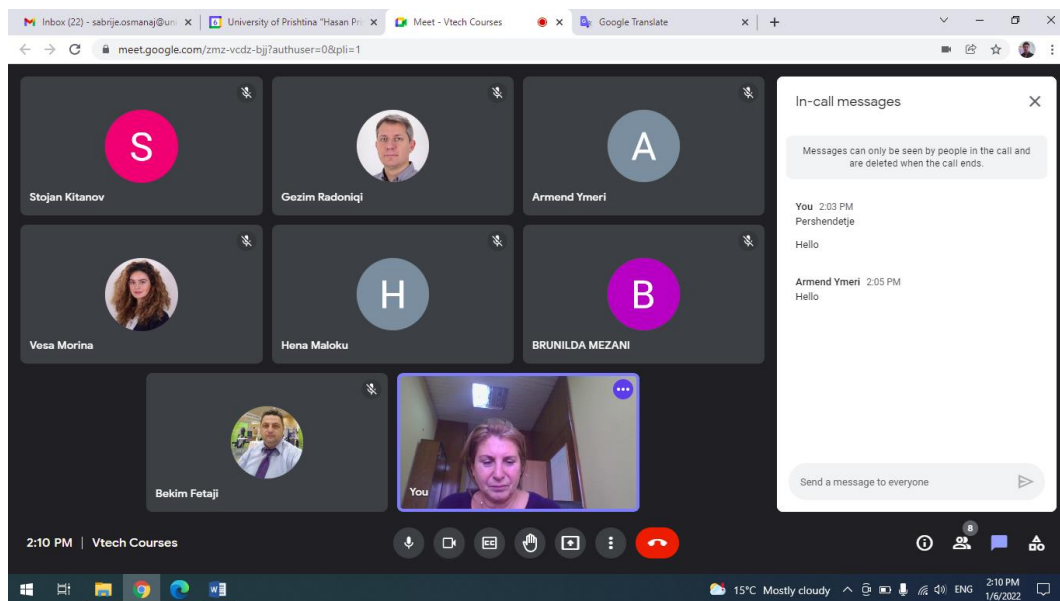


Figure 1 Discussions related to me and the experience of partners around the development of VR courses

All HEIs representatives presented their achievements regarding the implementation of these technologies in selected courses.

The selected courses from each partner are presented below:

- **Aleksander Moisiu University (UAMD)**
 - Fundamentals of Electrical Engineering
 - Data structures

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- Operating Systems
- Image processing
- Integrating Marketing Communications
- Multimedia Laboratory
- Advanced Multimedia Technologies
- Data Mining

- **European University of Tirana (UET)**
 - Anatomy
 - Human biology
 - Techniques and tools in diagnosing in Imagery and Radiotherapy
 - Architecture

- **University of Prishtina (UP)**
 - Fundamentals of Electrical Engineering
 - Digital electronics
 - Bio-medicinal electronics
 - Multimedia Communications
 - Animation and virtual reality
 - 3D animation
 - Master thesis

- **South East European University (SEEU)**
 - Game programming
 - Capstone Projects
 - Master Thesis

- **Polis University (U_Polis)**
 - Computer based Arts
 - Interactive Design
 - Computational aided design

- **Epoka University (EPOKA)**
 - Data Structures
 - Circuit Theory
 - Digital Image Processing

- **Mother Teresa University (MTU)**
 - Computer Architecture
 - Game Programming

- **University for Business and Technology - UBT**
 - Fundamentals of Mechanical Engineering
 - Game Programming
 - Introduction to System multimedia
 - Lab Course ½
 - Web Multimedia
 - Elotronika digjitale dhe sinjalet
 - CAD and Computational Structural Analysis
 - Dizajnimi dhe Modelimi i Softuerit
 - Modelimi i Sistemeve Softuerike Komplekse
 - Power electronics in smart grids
 - 3D Modeling
 - Hoising
 - Studio Design 3

Each university has built modern laboratories where VR courses are implemented. Following is presented some summarized reports provided by each HEI regarding the courses implemented by the respective HEIs:

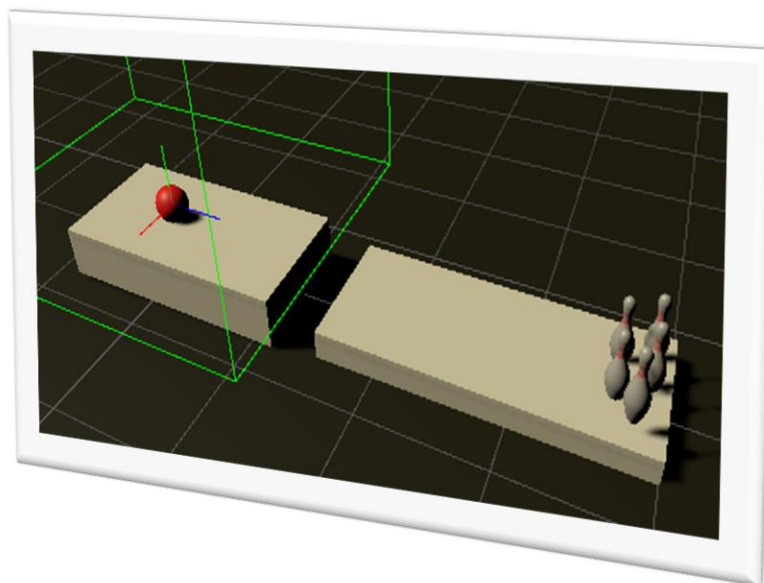
1. Report on the implementation of the some of the VTech courses in UP:

Within the framework of the Erasmus+ VTECH project, the Faculty of Electrical and Computer Engineering (FECE) is implementing the inclusion of virtual technologies (AR / VR) in the teaching and learning process at UP.



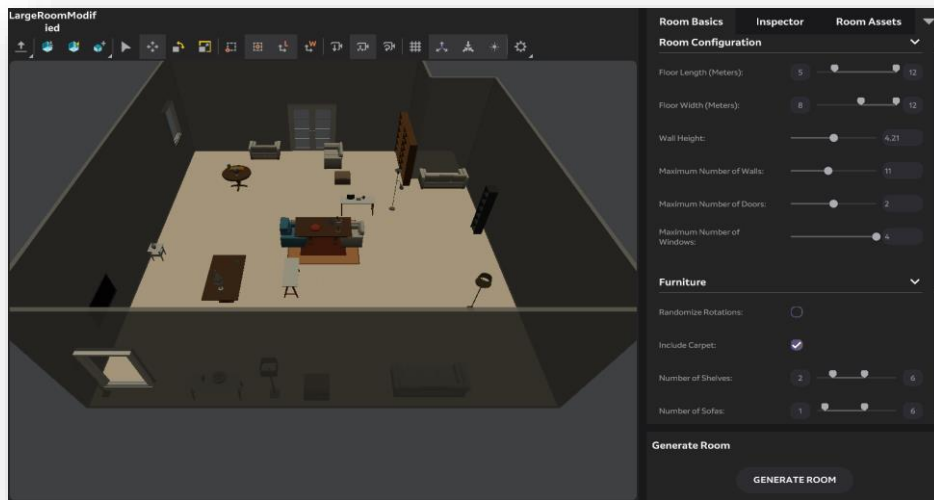
The pilot VR Lab was introduced as an additional instructional tool for the BSc and MSc courses during the Fall 2022 semester, and Spring 2022 semester. Over 50 students were enrolled in the VR section during last semester.

In addition to the regular lectures, students attended one hour per week in the VR lab, but were granted access 24/7 to the space. During the instruction lab period, students worked in teams of two or three, and at the end of the laboratory session, they completed a project of the type presented below.

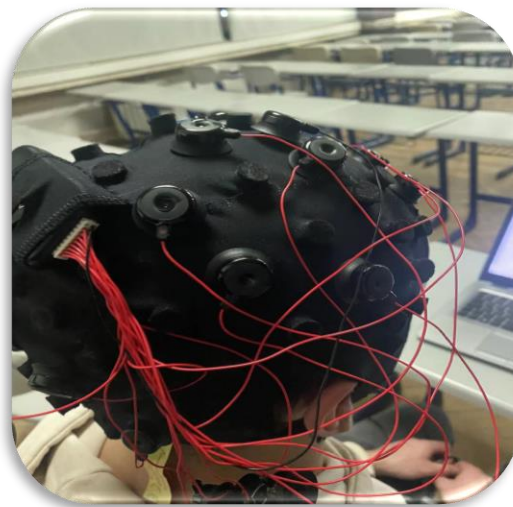


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Bowling game developed with Unity



Magic Leap Stimulation – Virtual Room



Students also realized a project with Emotiv Pro for reading the human brain data metrics

One master thesis "Assisted living supported by smart home and AR technology" is delivered using VR/AR technologies

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Master thesis – defense

2. Report on the implementation of the v-tech project in EPOKA:

- Data Structures

For the Data Structures course, the following topics are implemented:

- Sorting,
- Stack,
- Queue and
- Recursion.

We will also implement the arrays and linked list.

A small group of students has experienced the topics implemented with VR
Virtual Class Design: The classroom we have designed is a simple one, as we can find in different schools. It will contain 2 windows to have better lighting, a green board for the teacher to write on it, tables and chairs, a bookshelf and also a projector which makes the teaching and learning experience quite

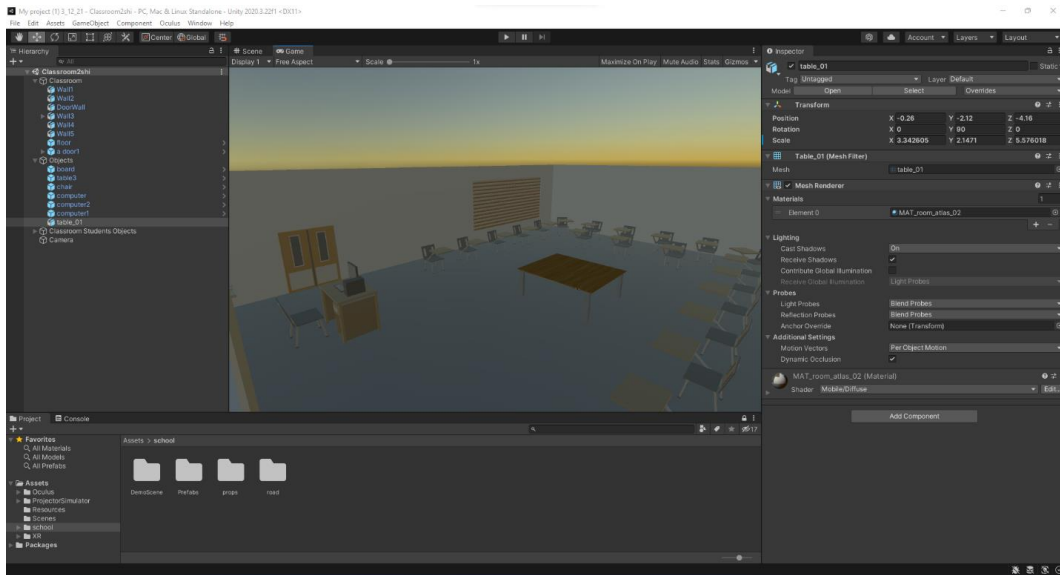
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impressive. Every student will be prepared with a personal laptop located at the desk.



Virtual Class

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Virtual Class

Image Processing Course

- In the Digital Image Processing course, we have implemented filtering in order for the students to understand it better. The convolution of images with different filters is implemented and the observe the outputs.
- Examples of filters are the following:
- $A = \begin{bmatrix} 1 & -1 \\ 1 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 1 \\ -1 & 1 \end{bmatrix}$ to detect vertical lines. These were implemented on curved features to let the students understand the deficiency of the above two filters to detect correctly. Then the Laplace filter is implemented on the same images and the superiority of the latter filter over the previous filters is shown.
- Designing a virtual classroom did not stray much from designing a real classroom. We have included all the necessary tools needed in a classroom such as: a blackboard, desks and chairs, a clock, lights (which should turn on/off), cupboards etc.

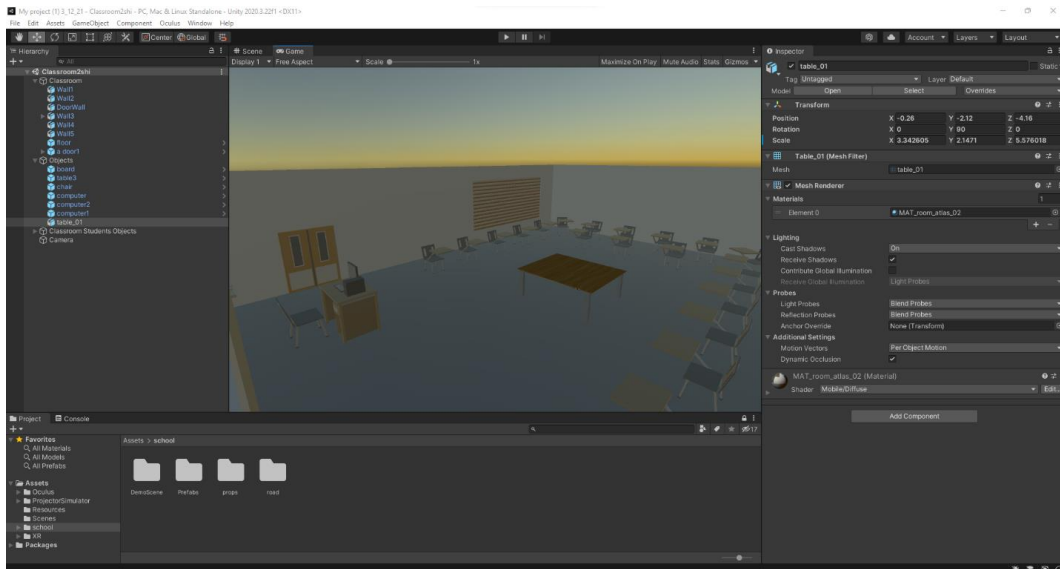
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Virtual Class

Circuit Theory Course

- The design and implementation of the virtual classroom is complete.
- Topics to be explained using the virtual classroom are being implemented.
- We will complete the implementation of the evaluation of the voltage across the circuit that has different circuit components like: resistors, capacitors and inductors.



Virtual Class

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- The Laboratory is established and is actively used by students and staff as well.
- During Fall 2021-2022 semester 20 students did their professional practice at V-TECH Lab
- During Spring 2021-2022 semester 4 students are doing their Bachelor thesis at V-TECH Lab
- 5 Student clubs use the lab every week



3. Report on the implementation of the v-tech project in POLIS:

Bachelor in Art and Design, 3rd year of the program, 2nd semester

VR/AR technology is being demonstrated during this course as a new tool that will challenge the traditional ways of perceiving and using materiality in product design or interior design.

Integrated Master of Science in Architecture and Urban Design, 4th year of the program, 2nd semester

VR/AR technology is used as a tool for allowing the control of advanced construction structures. The technology is being tested in order to design construction techniques where not highly skilled construction workers can manufacture advanced structures by following visual instructions, given through AR technology.

Professional Master in Digital Architecture, 2nd year of the program, 1st semester

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The VR/AR technology was used during this course as a way to demonstrate the new possibilities that the introduction of new media can open to Game Design. Students dealt with the case study of a game developed in the AR environment and they explored all the phases of developing a game and an interactive environment in AR.

Master of Science in Applied Design, 1st year of the program, 1st semester, and 2nd semester

The VR/AR technology is used during this year-long course as one of the environments inside which the students are asked to model their projects. In this course, students are taught how to model geometries that can be rendered in virtual reality or can be paired with the existing object in order to allow the use of augmented reality.

4. Report on the implementation of the V-TECH project in UET:

Semester I /Academic Year 2021-2022

	Anatomy 1 / Efs	Human Biology /FSHMT	Physiology /Efs	Total
Number of students	70	140	60	270
Impact on the students immediately after the implementation for the first time	Positive/ want to go on with this 3D technology	Positive/ want to go on with this 3D technology	Positive/ want to go on with this 3D technology	

- **Results:** At the end of the implementation in the subject Anatomy 1, Physiology students were asked some questions about the importance of using 3D technology, in relation to the topic of the subject in which the project was implemented. The impact on the implementation of the Vtech project is taken from the feedback immediately after using the 3D technology.
- Students express the demand and importance of continuing teaching through this virtual, 3D technology.
- **The Vtech project will continue to be implemented in the second-semester subjects: Anatomy 2 / EFS, BA, and Diagnostic Equipment in Imaging and Radiology / MSH and Histology.**

Human Biology			
	Implemented on 2 groups respectively: IFM 105 and FIZ 101	Still to be implemented on 6 (six) groups out of 8 (eight) that are in total, namely: IMZH 101; IMZH 102; IFM 101; IFM 102; IFM 103; IFM 104 (six teaching hours)	Total
Number of students	38	140	178

	Neuroradiology	Basic Radiological Techniques	Total
Number of students	36	27	63
Impact of the Students immediately after the implementation for the first time	Positive/ want to go on with this 3D technology	Positive/ want to go on with this 3D technology	

- Using VR and AR programs for anatomy, I explained the positioning of CT and MRI scan plans for the anatomical region of the brain.

Meantime, on the subject of Radiological Techniques I is explained the radiographic projections for the **osteoarticular system**. **In both the above cases it is applied in a single session.**

- **Result:** At the end of the implementation in a subject such as **Neuroradiology** students were asked some questions about **the importance of using 3D technology**, in relation to the topic of the subject in which the project was implemented. The impact on the implementation of the Vtech project is taken from the feedback immediately after using the 3D technology.

Students express the demand and importance of continuing teaching through this virtual, 3D technology.

They asked for more applications similar to the anatomy system and also asked if was possible to create 3D forms of radiology equipment to learn techniques and their function.

- Total number of students trained with VR / AR technology: 371

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- Total number of students in the process to be trained with VR / AR technology: 140
- Implemented in 5 courses: Anatomy 1/Efs, Physiology/Efs, Human Biology, Neuroradiology, Basic Radiological Techniques.
- To be implemented in other 3 courses: Diagnostic Equipment in Imaging and Radiology, Anatomy 2, and Histology.
- General feedback from students: Positive.

5. Report on the implementation of the V-TECH project in UAMD:

Basics of Electrical Engineering course VR implementation phases:

- The workspace modeled in Blender (**3D modeling**) is the environment where students will have the resistors with different values, batteries with different voltages, and an oscilloscope to experiment with the circuit:
 - the connection of the electrical components (circuit composition),
 - measuring the values of the voltage and current to understand the Ohms Law
- The 3D model is exported to Unity to create the interactivity of the VR content.
- After the VR content is finished, students will have the possibility to test the content.
- Survey results

Data Structure course VR implementation phases

- The workspace modeled in Blender (3D modeling) is the environment where students:
 - Have to create “objects” related to Linked List and operate with ADD and DELETE functions
 - Sorting a list of numbers (boxes) with Insertion Sort, Quick Sort, and Bubble Sort
 - Starts with the initial node of the graph then goes deeper until it finds the goal node 1
 - The 3D model is exported to Unity to create the interactivity of the VR content.
 - After the VR content is finished, students will have the possibility to test the content
 - Survey results

Operating System course VR implementation phases

- The workspace modeled in Blender (3D modeling) is the environment where students:
 - Have to create “objects” related to Scheduling Algorithms (First In First Out, Round-Robin, Short Job First, Priority) like Processes and Sportels.
 - Build the logic and scenarios of how the selection will work.
- The 3D model is exported to Unity to create the interactivity of the VR content.
- After the VR content is finished, students will have the possibility to test the content.
- Survey results

Advanced Multimedia Technologies VR implementation phases

- The workspace modeled in Blender (3D modeling) is the environment/ room where students will experience using all the different devices and technologies back in time
 - Creation of stereoscope, Cinerama, Sword of Damocles
 - Adding texture and movement
- The 3D model is exported to Unity to create the interactivity of the VR content.
- After the VR content is finished, students will have the possibility to test the content.
- Survey results

4. Student performance assessment in virtual technologies courses

After all planned activities for all courses have been completed, all partners have been asked to conduct an end-of-year survey to gather student feedback regarding Vtech courses. The questionnaire to collect student feedback on VTech supported courses were developed by the project partners.

The questionnaires have been distributed to the students of each HEI, and the results have been processed by the quality assurance units and will be used for further improvement of the subjects and delivery methods.

Conclusion

This document presented the reports of the meetings that took place within the framework of WP2.3 in the field of courses, related to VR content. The purpose of the document is to provide guidelines for courses developed by all partners that use VR technologies within the Erasmus+ Vtech project.