MetUni
Software Requirements Specification

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History of changes in document

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1   Introduction

1.1 Purpose

This document defines the functional and non-functional requirements for the "MetUni" VR Learning Platform. The platform aims to enhance student learning and engagement by providing immersive, interactive VR environments such as virtual classrooms, labs, and campus tours.

1.2 Document Conventions

- Use cases are formatted with ID, name, actors, scenarios.
- Non-functional requirements are listed by ISO/IEC 25010 categories.

Tracking changes in the document:

History of approved document is presented on 4 page of the document.

Description of actors:

Characteristic of particular actor presented in chapter 3.1

ID:	**<identifier>**
Name:	**<name of actor>**
Description:	
<description of actor>	

Business object:

Characteristic of particular business object described in chapter 3.2

Name:	**<Name of business object>**
Description:	
<Description of business object>	

Use cases:

To describe use cases it is used tables below

ID:	**<identifier>**	
Name:	**<name of business case>**	
Main actors:	<list of actors>	
Additional actors:	<list of actors>	
Level: <Business, User, sub function>		**Priority:** <High, Medium, Low>
Description:		
<Description of use case>		
Trigger:		
1. <List of triggers that causes starting use case>		
Preconditions:		

1. <List of conditions that runs this use case>
Postconditions:
1. <list of conditions that should be fulfill after this use>
Main scenario:
1. <Most typical scenario to achieve >
Alternative scenarios and extensions:
<Alternative scenarios to achieve>
Exceptions:
<Description of exceptional situations and their>
Additional requirements:
<Additional requirement concerning use>

2 Overall description

The proposed MetUni VR Learning Platform directly addresses the key challenges faced in remote and hybrid education by providing an immersive and interactive environment that goes beyond traditional e-learning tools. Through the use of virtual classrooms, practical lab simulations, and interactive mentoring spaces, the platform enhances student engagement, improves concept retention, and enables real-world skill development. Additionally, features like immersive campus tours and social hubs help first-year students orient themselves within the university and foster a sense of community. By integrating gamified learning and collaborative scenarios, the solution promotes deeper learning and combats student isolation, ultimately increasing academic performance and satisfaction.

3 Business process model

3.1 Actors and user characteristics

[Briefly describe all the actors that were identified.]

ID: **A_01**
Name: **Student**
Description:
Primary user, attends courses, explores campus, uses social and learning tools.

ID: **A_02**
Name: **Lecturer**
Description:
Teaches courses, manages content and sessions.

ID: **A_03**
Name: **Admin**
Description:
Maintains system and moderates content.

ID: **A_04**

Name: **System**
Description:
Delivers VR content and manages interactions.

3.2 Domain objects

[Describe the most important domain objects, which will be referred to in the next sections of this document. Domain objects are the entities, which appear in the problem that is going to be solved.]

Name: **User**
Description:
Represents a person using the platform, such as a student, mentor, or administrator. Contains basic identity details, login credentials, user role (e.g., student, staff), avatar initials, and current online status.

Name: **Lecture**
Description:
A scheduled or on-demand VR class session. Each lecture includes metadata such as its title, subject, time schedule, and current state (Live, Upcoming, Completed).

Name: **Lab**
Description:
An interactive virtual environment for performing scientific or technical experiments. Labs may include progress tracking and access status.

Name: **CampusLocation**
Description:
A virtual representation of a location on the university campus (e.g., Library, Main Hall, Lab Building). The system tracks user visit progress.

Name: **SocialSpace**
Description:
A shared virtual environment for informal interactions between students, such as a VR study café or gaming lounge. Shows current users online.

Name: **MentoringSession**
Description:
A one-on-one or group meeting scheduled with a mentor or academic advisor. Includes session topic, assigned mentor, and scheduled date/time.

Name: **OrientationTask**
Description:
Represents an individual onboarding activity that a user must complete during the initial usage of the platform. Each task contributes to orientation progress.

Name: **Progress**

Description:

Tracks the user's overall advancement within various parts of the VR education platform, such as lecture attendance, lab activities, campus exploration, and orientation tasks.

Name:	**AuthenticationSession**

Description:

Records a login session for a user. Stores login time, logout time, session validity, and status (active/expired), supporting audit and security management.

3.3 Business processes

ID:	**ID_01**
Name:	**Join virtual lecture**

Main actors:	Student, Lecturer	
Additional actors:	System	
Level:	User	**Priority:** High

Description:

Allows students to attend scheduled university lectures in a virtual environment simulating a classroom, including real-time interaction with lecturers.

Trigger:

1. Student selects scheduled lecture from dashboard.

Preconditions:

1. Student has valid login credentials.
2. Lecture session is scheduled in the system.
3. VR-compatible device or 2D fallback is available.

Postconditions:

1. Attendance is recorded.
2. Student completes or exits the session.
3. Feedback is optionally submitted.

Main scenario:

1. Student logs into the Metaverse platform.
2. Student selects a lecture session.
3. System loads virtual lecture hall and positions avatar.
4. Attendance is recorded.
5. Lecturer begins teaching using whiteboard and media.
6. Student interacts via voice or gestures.
7. Lecture ends, feedback form appears.

Alternative scenarios and extensions:

3.A. Late join – Avatar joins silently; time of entry logged.
5.A. Pre-recorded lecture – Video is shown in VR space; user controls playback.

Exceptions:

2.A. No session found – User is redirected to calendar.
3.A. VR unsupported – Fall back to 2D interface.
6.A. Connection loss – Attempts reconnect; session marked incomplete if fails.

Additional requirements:

Lecture materials must be accessible post-session.

ID:	**ID_02**
Name:	**Perform virtual lab experiment**

Main actors:	Student		
Additional actors:	System, Lecturer		
Level:	User	**Priority:**	High

Description:
Enables students to complete hands-on lab assignments in a virtual environment with simulated tools and real-time feedback.

Trigger:
1. Student selects lab assignment.

Preconditions:
1. Student is enrolled in a course with lab access.
2. Lab module is available and unlocked.

Postconditions:
1. Student's actions and results are logged.
2. Grade or feedback is assigned.

Main scenario:
1. Student logs in and selects lab module.
2. System loads virtual lab scene with tools.
3. Student follows step-by-step simulation instructions.
4. System validates actions and tracks progress.
5. Upon completion, results are stored.
6. Feedback or grade is issued automatically or by tutor.

Alternative scenarios and extensions:
3.A. Free Mode – Student chooses exploratory mode without instruction steps.
5.A. Instructor Review – Manual grading available for open-ended tasks.

Exceptions:
2.A. Lab environment fails to load – Student receives error with retry.
4.A. Student makes repeated critical mistakes – Hint system activates.

Additional requirements:
Progress must be saved at checkpoints.

ID:	**ID_03**
Name:	**Explore campus**

Main actors:	Student		
Additional actors:	System		
Level:	User	**Priority:**	Medium

Description:
Lets students explore a virtual representation of the university campus to familiarize themselves with locations and services.

Trigger:
1. Student selects "Explore Campus" option from menu.

Preconditions:
1. Student has access to the system.
2. Campus map and hotspots are loaded.

Postconditions:
1. Visited locations are marked.

2. Optional badge or score is updated.

Main scenario:
1. Student enters the VR platform and launches campus mode.
2. System positions avatar near main entrance.
3. Student navigates freely using controller/gestures.
4. Interactive hotspots provide info about buildings.
5. System tracks progress and marks visited locations.

Alternative scenarios and extensions:
4.A. Enable guided tour – Avatar is led along predefined route with narration.
5.A. Checklist for gamification – Student unlocks achievements per building.

Exceptions:
3.A. Motion sickness setting enabled – Switches to teleport movement.
4.A. Student attempts restricted area – Message appears with redirection.

Additional requirements:
Include narration and accessibility settings for new users.

ID:	**ID_04**
Name:	**Join social VR space**

Main actors:	Student		
Additional actors:	Admin		
Level:	User	**Priority:**	Medium

Description:
Allows students to meet and interact informally with peers in a shared virtual space, encouraging social bonding and community building.

Trigger:
1. Student selects social zone from dashboard.

Preconditions:
1. User is logged in.
2. Social space is available.

Postconditions:
1. Interactions are logged.
2. User returns to dashboard or logs out.

Main scenario:
1. Student enters shared social environment (e.g., VR café).
2. Avatar is placed among others in real-time.
3. System activates audio chat in proximity mode.
4. Student may engage in voice chat, emoji reactions, or gestures.
5. Optional games or quizzes are accessible.

Alternative scenarios and extensions:
3.A. Enable private voice rooms – Student invites friends to join group chat.
5.A. Scheduled student events – Admin adds DJ nights, open mic, etc.

Exceptions:
3.A. Voice issues – System defaults to text chat.
4.A. Abusive behavior – Moderation tools allow reporting/muting.

Additional requirements:
All users must agree to a code of conduct.

ID:	**ID_05**
Name:	**Attend mentoring session**

Main actors: Student, Lecturer

Additional actors: System

Level: User   **Priority:**   High

Description:
Supports 1:1 or group mentoring between students and lecturers in a private or scheduled virtual meeting room.

Trigger:
   1.   Student schedules mentoring session.

Preconditions:
   1.   Session is scheduled and confirmed.
   2.   Participants are notified.

Postconditions:
   1.   Notes or materials are shared.
   2.   Attendance is recorded.

Main scenario:
   1.   Student uses calendar to request 1:1 or group mentoring.
   2.   Lecturer approves time; system sends notification.
   3.   Student joins VR room at scheduled time.
   4.   Interactive whiteboard, file sharing, and screen sharing are available.
   5.   Discussion occurs in real-time; notes can be saved.

Alternative scenarios and extensions:
   3.A. Group session – Multiple students join; breakout areas possible.
   5.A. Anonymous mode – Student can ask questions with masked identity.

Exceptions:
   1.A. Scheduling conflict – System suggests alternative slots.
   4.A. Technical failure – Session is moved to fallback platform (e.g., MS Teams).

Additional requirements:
   Sessions should be optionally recorded for reference.

ID:	**ID_06**
Name:	**Use interactive whiteboard**

Main actors: Students, Lecturer

Additional actors: -

Level: User   **Priority:**   High

Description:
Provides a shared visual space where lecturers and optionally students can draw, annotate, or present material during a VR session.

Trigger:
   1.   Lecture or mentoring session begins.

Preconditions:
   1.   Session has started.
   2.   Lecturer opens the whiteboard.

Postconditions:
   1.   Whiteboard state is saved/exported.

Main scenario:

1.	Lecturer opens interactive whiteboard in VR.
2.	Lecturer writes, draws or uploads slides.
3.	Students see changes live.
4.	Whiteboard state is autosaved.
5.	Lecturer clears, exports or shares final board.

Alternative scenarios and extensions:

2.A. Use laser pointer – Highlight specific content in slides.

3.A. Collaborative mode – Students gain permission to draw.

Exceptions:

1.A. File format unsupported – Upload rejected with suggestion.

4.A. Whiteboard unsaved due to crash – Recovery available on re-entry.

Additional requirements:

Allow file uploads in supported formats (PDF, PNG).

ID:	**ID_07**
Name:	**Track orientation progress**

Main actors:	Student		
Additional actors:	System		
Level:	User	**Priority:**	Medium

Description:

Enables new students to complete orientation tasks in a gamified VR checklist format to ensure proper onboarding.

Trigger:

1. Student starts orientation module.

Preconditions:

1. Orientation module is active.

Postconditions:

1. Student receives badge or completion token.
2. Admin dashboard is updated with progress.

Main scenario:

1. Student opens "My Orientation" checklist.
2. Tasks include visiting key buildings, joining student group, attending intro session.
3. System updates progress as student completes each action.
4. Progress bar and "next step" appear.
5. Upon completion, student unlocks digital badge.

Alternative scenarios and extensions:

2.A. Link to calendar – Orientation events are synchronized.

5.A. Bonus content unlocked – Tips for navigating university life.

Exceptions:

3.A. Task not recognized – Manual override with justification request.

4.A. Badge not issued – Student can request admin review.

Additional requirements:

Option to repeat tasks or view progress history.

3.4 Business rules

ID:	BR_01
Contents:	User Authentication
Additional Description:	Users must provide a valid email or student ID along with a password to access the platform. Authentication tokens expire after 30 minutes of inactivity.

ID:	BR_02
Contents:	Unique User Identity
Additional Description:	Each user must have a unique identifier (e.g., email or student ID). Duplicate accounts are not allowed.

ID:	BR_03
Contents:	Session Access Rules
Additional Description:	Only enrolled students can join scheduled lectures and labs. Unauthorized access should be blocked at the server level.

ID:	BR_04
Contents:	Orientation Requirement
Additional Description:	Users must complete tutorial before gaining full access to advanced modules like mentoring or labs.

ID:	BR_05
Contents:	Campus Visit Tracking
Additional Description:	Progress in campus exploration is based on distinct locations visited. Each location is counted only once per user.

ID:	BR_06
Contents:	Mentoring Session Limit
Additional Description:	A student can schedule a maximum of 2 active mentoring sessions per week. Cancellations must be made at least 12 hours in advance.

ID:	BR_07
Contents:	Lecture Attendance Logging
Additional Description:	Joining a lecture marks a user as "present." Attendance is recorded with a timestamp and session ID.

ID:	BR_08
Contents:	Lab Progress Persistence
Additional Description:	User progress in virtual labs must be auto-saved every 2 minutes to avoid data loss during unexpected disconnections.

ID:	BR_09
Contents:	Online Status Accuracy
Additional Description:	A user marked as "Online" must have an active session within the last 15 minutes. Otherwise, status is changed to "Away."

ID:	BR_10
Contents:	Badge Unlocking
Additional Description:	Digital orientation badges are granted only after completing 100% of orientation tasks and visiting all required campus locations.

4   Functional Requirements

[Divide functionality into functional modules. The structure can be organized either by actor (each module represents goals of a certain actor) or by feature (a group of related functions).]

4.1 Authentication Module

FR_1.1: The system shall allow users to log in using a valid student ID or email and password.
FR_1.2: The system shall validate credentials and start an authenticated session upon success.
FR_1.3: The system shall display an error message on invalid login attempts.
FR_1.4: The system shall store login sessions and expire them after a period of inactivity.

4.2 User Profile & Status

FR_2.1: The system shall display the user's name, role, study year, and avatar initials on the dashboard.
FR_2.2: The system shall indicate the current user status (Online, Away).
FR_2.3: The system shall allow users to update their personal details (in future versions).

4.3 Virtual Lectures

FR_3.1: The system shall list upcoming, ongoing (LIVE), and completed lectures.
FR_3.2: The user shall be able to open lecture details or join if the session is LIVE.
FR_3.3: The system shall record lecture attendance with timestamp and session ID.

4.4 Virtual Labs

FR_4.1: The system shall allow users to start or continue lab simulations.
FR_4.2: The system shall track lab progress and auto-save every 2 minutes.
FR_4.3: The user shall see a progress indicator (%) per lab session.

4.5 Campus Exploration

FR_5.1: The system shall display a progress bar for campus exploration.
FR_5.2: Each campus location visited shall increment the user's exploration count.
FR_5.3: The system shall prevent double-counting of visited locations.

4.6 Social VR Spaces

FR_6.1: The system shall show a list of available social spaces and online users.
FR_6.2: The user shall be able to join social spaces for group interaction.

4.7 Mentoring Sessions

FR_7.1: The system shall list upcoming mentoring sessions scheduled for the user.

FR_7.2: The system shall allow users to request/schedule new mentoring sessions.
FR_7.3: A student may not have more than 2 active sessions per week.

4.8 Orientation Progress
FR_8.1: The system shall show orientation progress as a visual percentage bar.
FR_8.2: Completing tasks or locations shall increment orientation completion rate.
FR_8.3: The system shall notify users when orientation is complete and grant a digital badge.

5 Interface characteristics

5.1 User interfaces

ID	Requirement	Priority
UI_01	The login screen shall include fields for Student ID/Email and Password.	High
UI_02	The dashboard shall display the user's name, avatar, role, and online status.	High
UI_03	The system shall display feature cards (e.g., Lectures, Labs, Campus, etc.).	High
UI_04	The user interface shall visually differentiate between LIVE, Upcoming, and Completed sessions.	Medium
UI_05	Orientation progress and explore progress shall be shown using progress bars.	Medium
UI_06	Social space cards shall include user count and a join button.	Medium
UI_07	The UI shall be responsive and accessible on both desktop and mobile devices.	High
UI_08	The system shall support dark/light mode toggle (future feature).	Low

5.2 External interfaces

5.2.1 Hardware Interfaces

- The system shall support standard VR headsets (e.g., Meta Quest, HTC Vive) for full immersion.

- The platform must also support mouse/keyboard input for non-VR desktop use.

- Mobile access (optional) must support touchscreen interaction.

5.2.2 Software Interfaces

- The frontend is implemented using HTML/CSS/JavaScript and integrates with a backend (e.g., Node.js, Django, or similar).

- The platform shall interact with:

  o Authentication API (OAuth2 or custom login backend)

    o   Lecture/Lab scheduling services

    o   Progress tracking database

5.2.3 Communication Interfaces

- The platform shall use HTTPS for all web communications to ensure data security.

- Real-time components (e.g., live sessions, social spaces) shall use WebSocket or WebRTC.

- Backend communication shall rely on RESTful APIs with JSON responses.

- VR streaming may use RTSP or proprietary VR communication protocols.

6   Non-functional requirements

ID:	NFR_01
Contents:	**Scene loading time < 10 seconds**
Priority:	High
Additional Description:	The system should render and make available any environment scene within 10 seconds to ensure smooth transitions and maintain user immersion.

ID:	NFR_02
Contents:	**Voice delay < 150 ms**
Priority:	High
Additional Description:	Communication latency in real-time audio chat should not exceed 150 milliseconds to maintain natural dialogue.

ID:	NFR_03
Contents:	**Min. 100 users per VR server instance without FPS drop < 30**
Priority:	High
Additional Description:	The platform must be able to host at least 100 simultaneous users without the frame rate dropping below 30 FPS.

ID:	NFR_04
Contents:	**Dynamic scaling of VR instances**
Priority:	Medium
Additional Description:	The backend architecture should support automated instance scaling based on user demand.

ID:	NFR_05
Contents:	**Support multiple simultaneous sessions**
Priority:	Medium
Additional	System must handle multiple course sessions or labs at once across separate VR environments.

Description:	

ID:	NFR_06
Contents:	GDPR compliance
Priority:	High
Additional Description:	All personal data must be handled and stored according to GDPR guidelines, including user consent and right to be forgotten.

ID:	NFR_07
Contents:	TLS 1.2+ encryption for connections
Priority:	High
Additional Description:	All client-server communications must be secured using TLS 1.2 or higher.

ID:	NFR_08
Contents:	Ability to report abuse and block users
Priority:	High
Additional Description:	Users must be able to report others and mute/block interactions; moderators receive alerts.

ID:	NFR_09
Contents:	Availability >= 99% annually
Priority:	High
Additional Description:	The system must have an uptime of 99.5% or more per year, excluding scheduled maintenance.

ID:	NFR_10
Contents:	Failover to backup instance within 30 seconds
Priority:	High
Additional Description:	In case of system failure, users should be automatically redirected to a backup server in under 30 seconds.

ID:	NFR_11
Contents:	Intuitive UI, onboarding time < 15 minutes
Priority:	High
Additional Description:	A new user should be able to complete orientation and basic navigation within 15 minutes.

ID:	NFR_12
Contents:	User manual accessible from main menu
Priority:	Medium
Additional	An accessible help menu and tutorial guide should be available within the VR interface.

Description:	

ID:	NFR_13
Contents:	**Accessibility support for visually and hearing impaired users**
Priority:	High
Additional Description:	The system must support screen readers, subtitles, and colorblind modes.

ID:	NFR_14
Contents:	**Support for VR devices: Quest 2+, HTC Vive, WMR**
Priority:	High
Additional Description:	The platform must be operable on Oculus Quest 2+, HTC Vive, and Windows Mixed Reality headsets.

ID:	NFR_15
Contents:	**2D version compatible with Chrome, Firefox, Edge**
Priority:	Medium
Additional Description:	A 2D fallback must work seamlessly in Chrome, Firefox, and Edge browsers.

ID:	NFR_16
Contents:	**Error logging and admin monitoring**
Priority:	High
Additional Description:	All system errors should be logged centrally and viewable by admins via a dashboard.

ID:	NFR_17
Contents:	**Session recovery after unexpected crash**
Priority:	High
Additional Description:	In the event of a crash, users must have the option to resume their last session.

ID:	NFR_18
Contents:	**No data loss after system updates**
Priority:	High
Additional Description:	No user data may be lost or corrupted during maintenance or system updates.

ID:	NFR_19
Contents:	**All updates tested in staging before production**
Priority:	High
Additional	All updates must pass functional and security tests in a staging environment before deployment.

Description:	

7   Other requirements

Appendix A: Glossary

Term	Definition
VR	Virtual Reality — immersive digital environment simulated through 3D interaction.
Session	A scheduled event (e.g., lecture, lab, mentoring) that a user can attend or interact with.
Dashboard	Main screen showing personalized information, progress, and access to modules.
Metaverse	Shared virtual space where students interact in real-time (via avatars).
Orientation	Onboarding tasks and exploration to help new users learn how to use the platform.
Progress Bar	Visual element showing user advancement in a specific task or module.
Campus Tour	Virtual exploration of university spaces and facilities.
Avatar	Visual or textual representation of a user in the virtual environment.
Mentoring	One-on-one or group guidance sessions with academic staff.
LMS	Learning Management System — platform for managing educational content (e.g., Moodle).
GDPR	General Data Protection Regulation — European privacy law governing user data handling.

Appendix B: Data dictionary

Entity	Attribute	Type	Description
User	userId	String (UUID)	Unique identifier for each user
	email	String	User's login email
	passwordHash	String	Hashed password
	name	String	Full name of the user
	role	String	e.g., Student, Mentor
	avatarInitials	String	First letters of user name
Session	sessionId	String (UUID)	Unique session identifier
	title	String	Session title (e.g., "Advanced Algorithms")
	type	Enum	Lecture, Lab, Mentoring
	status	Enum	Upcoming, Live, Completed
	startTime / endTime	DateTime	Session timing
Progress	userId	String	Foreign key to User
	taskId	String	Task identifier (e.g., "Explore Campus")
	completed	Boolean	Task completion flag
CampusLocation	locationId	String	Virtual location ID
	name	String	Name of campus building
	visited	Boolean	Whether the user visited the location

Appendix C: Analysis models

[In this section, you can attach additional diagrams and other outcomes of the requirements analysis.]

Appendix D: Issues list

ID	Issue	Status	Comment
ISS_01	How will the VR platform integrate with the university's LMS?	Open	Integration probably needed
ISS_02	Should mentoring sessions support video conferencing or VR only?	Open	Awaiting stakeholder decision
ISS_03	Is offline access to labs or lectures required?	Closed	Decided to support online-only
ISS_04	What data is stored for user progress and for how long?	Open	Needs alignment
ISS_05	Should guest (non-student) users be allowed access to campus?	Deferred	To be handled in Phase 2