Alliance4XR

Innovation alliance to infuse Extended Reality skills into Higher education and Vocational Training

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1. DRAFT XR TAXONOMY

The term “body of knowledge” (BoK) often refers to a set of concepts, terms and activities that make up a professional domain, as defined by the relevant learned society or professional association. In many cases, this type of knowledge representations is organised in domain ontologies and may be formally described using semantic web standards such as OWL (Web Ontology Language).

However, for the time being, no suitable BoK related to XR technologies has been found, which could support the project in describing the knowledge and skills gaps. As a result, a hierarchical taxonomy has been created as a substitute for a full-fledged BoK, where the most important topics (concepts and terms) in the XR domain are identified.

Table 1: Concepts and terms of the draft XR taxonomy

1st level topics	2nd level topics	3rd level topics
1 Fundamentals of XR	**1.1 XR Definitions**	**1.1.1 Virtual Reality (VR)**
		1.1.2 MR, AR and AV
		1.1.3 XR
	1.2 Concepts and founding technologies	**1.2.1 Perceptive and cognitive concepts**
		1.2.2 Simulation modelling
		1.2.3 Computer science technologies
	1.3 XR equipment	
2 Tracking technologies		
3. 3D visualisation		
4. 3D Audio		
5. Kinematics		
6. Haptic senses		
7. Mixed reality	**7.1 MR equipment**	
	7.2 MR calibration	

	7.3 Image alignment	
8. Multimodal interactions in immersive environments		
9. Virtual navigations techniques		
10. Human factors and ergonomics in XR	**10.1 User centred design**	
	10.2 Dimensions in XR applications	
	10.3 Criteria on XR application ergonomics	
	10.4 Ergonomic evaluation	
	10.5 Evaluation based on questionnaires	
	10.6 Evaluation of usability	
	10.7 User-centric evaluation methods	
11. XR for business development		
12. XR in process and product development		
13. XR usage		

2. SUPPLY OF XR COURSES

The supply side is investigated by two different studies, one desk study of course syllabi being published, and one questionnaire submitted to teachers in XR technologies.

Based on the results of the supply and demand analysis, the following topics of high priority for further development are

1. **Basic Principles of XR:** Respondents overwhelmingly agree on the necessity of understanding the foundational concepts of XR. This indicates a need for comprehensive introductory courses that cover the basics of virtual reality (VR), augmented reality (AR), and mixed reality (MR).

2. **Advanced Technologies for Mixed Reality:** This topic reflects the growing interest in cutting-edge XR technologies. Curriculum development may include modules on the latest advancements in MR technologies, such as holography and advanced display systems.
3. **Usage of XR technologies in various industrial sectors:** There is a clear need for additional training tools such as simulators and response to various scenarios. More efficient development tools are needed to reduce the costs associated with the development of applications and products for XR usage.
4. **Virtual Navigation Techniques:** Effective navigation is key to creating immersive and intuitive XR experiences. Courses and learning material should cover the principles of spatial awareness, user orientation, and wayfinding in virtual environments. Hands-on projects involving navigation challenges will build practical skills.
5. **Tracking Technologies:** The strong support for this topic suggests that understanding how XR systems track user movements and interactions is crucial. It may be beneficial to include practical workshops or labs that allow students to work with various tracking technologies.
6. **3D Visualization and 3D Audio:** The emphasis on these areas indicates that immersive experiences are essential for XR applications. Educational programs should incorporate projects that involve creating and manipulating 3D models and integrating spatial audio to enhance realism.
7. **Applying XR technologies in process and product development:** Such emphasis suggests that XR can streamline workflows and enhance productivity. Training programs should include simulations and project-based learning that allow students to apply XR technologies to real-world process challenges and product developments.

8. **The role of XR for business development:** The responses of the questionnaires indicate a strong belief in the role of XR technologies for business development in various industrial sectors. This suggests a need for case studies and real-world applications to be included in the curriculum, focusing on how XR can improve processes, training, and customer engagement in various industries and provide value to the organisation.

The main conclusions of this study may be summarised as follows

- The findings highlight the growing importance of incorporating XR technologies into educational programs to meet the evolving needs of the industry, in topics such as "Basic Principles of XR", “Advanced Technologies for Mixed Reality”, “Usage of XR Technologies”, "3D Visualisation," and "Virtual Navigation Techniques".
- Within the VET sector, there is a need for low-cost solutions aiming to guide the learner in performing operational tasks and making real-world decisions. Simple simulators and gaming applications may be one way forward.

- As the XR industry continues to expand, the importance of integrating practical applications and emerging trends into HEI educational programs is likely to grow.