METAVERSE ACADEMY

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D2.4 **Skills Analysis Report and Practical Guidelines**
T2.3 Need Analysis of Students
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Glossary

Abbreviation	Definition
VR	Virtual Reality
AR	Augmented Reality
XR	Extended Reality
MR	Mixed reality
STEM	Science, Technology, Engineering, Mathematics
T	Task
D	Deliverable
MOOCs	Massive Open Online Courses

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Executive Summary

The document presents a comprehensive analysis of the current landscape in XR (Extended Reality) technologies based on responses from over 2,000 students across 10 countries. The report explores students' awareness, use, and perceptions of AR/VR/XR technologies, focusing on how these technologies could be better integrated into education to meet industry demands and student needs.

Introduction: The report is part of the Metaverse Academy project's Work Package 2 (WP2), which focuses on industrial analysis and skill mapping. It aims to identify the gaps in knowledge and skills needed by students to succeed in the XR industry. The focus is on understanding students' perceptions, expectations, and preparedness for immersive technologies such as Augmented Reality (AR), Virtual Reality (VR), and XR.

Methodology: Surveys were conducted between May and October 2024 across 13 partner institutions in 10 countries, including Türkiye, Romania, Spain, South Africa, and others. 2,039 student responses were collected, ensuring a broad and diverse data set. The survey examined various aspects such as demographic data, educational background, familiarity with XR, and self-assessed competencies in XR-related skills.

Findings: The findings reveal substantial disparities in awareness and use of XR technologies. Many students, particularly in Türkiye and Spain, were aware of XR but had never used it. Only a tiny percentage of students actively used XR technologies in their studies, suggesting that, despite widespread interest, XR technologies are not yet fully integrated into academic programmes. Students expressed a strong belief in the potential benefits of XR, both in enhancing their learning experience and its broader societal applications.

Key Challenges: Several barriers were identified in adopting XR technologies. These include technical issues, a lack of practical training, and the high cost of XR equipment. Access to stable internet connections and electricity, particularly in countries like South Africa, also poses significant challenges. The analysis highlights the need for educational institutions to provide more hands-on training and to address the technological and infrastructural limitations that hinder XR adoption.

Competency Gaps: The report identified a gap between the perceived importance of competencies like creativity, technical literacy, and safety awareness and students' self-assessed abilities in these areas. For example, countries like Greece and Slovakia showed significant gaps in skills such as adaptability to new interfaces and understanding the ethics surrounding XR technologies. These findings suggest the need for targeted educational interventions to bridge these competency gaps.

Recommendations: The report offers several recommendations to help integrate XR technologies into education. These include:

1. **Raising Awareness and Training:** Introducing workshops and basic courses to familiarise students with XR technologies and their applications.

2. **Practical Experience:** Establishing XR labs and providing opportunities for students to engage with XR technologies through practical, hands-on experiences.
3. **Cross-Disciplinary Learning:** Developing XR-based learning modules tailored to different academic fields, from humanities to STEM.
4. **Infrastructure Improvement:** Addressing the infrastructural challenges, particularly in regions with limited access to technology, by collaborating with local institutions and providing affordable solutions for XR adoption.

Conclusion: The report concludes that while significant challenges remain in terms of infrastructure and accessibility, the interest and positive perception of XR technologies among students are strong. By addressing these barriers and aligning educational content with industry needs, the Metaverse Academy can play a pivotal role in preparing students for the growing demand for XR-related skills in the workforce.

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1. Introduction

Work Package 2 (WP2) of the Metaverse Academy project, titled "Industrial Analysis and Skill Mapping," is a collaborative effort designed to comprehensively understand the target beneficiaries. These include students, industrial stakeholders, working professionals, youth, and unemployed graduates, with a specific focus on their familiarity with AR/VR/XR technologies, the opportunities within the sector, and their expectations for course structures. Your participation in this project is crucial. This package will play a crucial role in shaping the subsequent work packages (WP3, WP4, and WP5) by generating essential data through qualitative and quantitative research methods.

However, this report concentrates explicitly on T2.3: Need Analysis of Students. In this task, the primary goal is to assess the students' perceptions and understanding of immersive technologies (AR/VR/XR), their awareness of the opportunities within this emerging field, and their expectations regarding the structure of courses. By focusing on the needs and expectations of students, this task aims to identify the knowledge gaps and required skills that will enable students to thrive in industries where immersive technologies play a crucial role. This analysis will be vital for tailoring educational content and course delivery in future work packages, ensuring that the Metaverse Academy meets the specific needs of its student cohort.

This report, therefore, will provide in-depth insights into the students' perspectives, guiding the design of future learning frameworks and course content to align with industry demands and student aspirations.

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2. Methodology

In this section on *Methodology*, we present the approach used to carry out the student needs analysis under WP2 of the Metaverse Academy project, explicitly focusing on **T2.3: Need Analysis of Students**. The methodology is divided into two essential parts.

The first part, *Research Design*, outlines the scope of the investigation, including the countries and partners involved, as well as the period during data collection. Partners participated in the data collection process, ensuring a broad and representative sample of students. The collaboration involved key institutions who worked together to design and execute the data collection phase. Data collection was carried out over May and October 2024, during which surveys were conducted to ensure comprehensive coverage of the target student population.

The second part, *Measurement of Variables*, focuses on the questionnaire used to assess student needs and expectations. The questionnaire was carefully structured into several sections, each aimed at gathering specific insights into students' familiarity with AR/VR/XR technologies, their understanding of industry opportunities, and their expectations from the courses provided by the Metaverse Academy.

2.1. Research Design

The research design for **T2.3: Need Analysis of Students** in the Metaverse Academy project was carefully structured to ensure comprehensive data collection across a wide range of countries and partner institutions. The surveys were conducted between May and October 2024, involving a broad network of partners to capture insights from diverse student populations regarding their perceptions and expectations of AR/VR/XR technologies.

Data collection was carried out in 13 different partner organisations across various countries, ensuring a representative and international sample. The participation and roles of each organisation, along with the number of responses collected, are detailed below:

- **Türkiye (TR)**:
    - *Bursa Eskisehir Bilecik Kalkinma Ajansi* acted as the **Coordinator**, collecting 101 responses.
    - *Sabanci Universitesi*, a **Partner** institution, gathered many responses, with 296 students participating.
    - *Eyesoft Bilisim Egitim Yayincilik Iletisim ve Danismanlik Atri*, also a **Partner**, contributed with 52 responses.
- **Romania (RO)**:
    - *Universitatea Babes Bolyai*, a key **Partner**, conducted the surveys in Romania and collected 310 responses.
- **Spain (ES)**:

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  - *Universitat Jaume I de Castellón*, as a **Partner**, gathered the highest number of responses across all participating countries, with 470 students participating in the survey.
- **South Africa (ZA)**:
  - *Vaal University of Technology*, a **Partner** institution, collected 323 responses.
  - *Centre for Digital Transformation and Innovation Africa (Pty)*, also a **Partner**, contributed with 103 responses.
- **Bulgaria-Romania (BG)**:
  - *Bulgarian-Romanian Chamber of Commerce and Industry* collected 103 responses as a **Partner**.
- **Germany (DE)**:
  - *Forschungsinstitut für innovative Arbeitsgestaltung und Prävention* acted as a **Partner**, gathering 31 responses.
- **Greece (EL)**:
  - *Instituto Anaptixis Epicheirimatikotitas Astiki Etairia* contributed as a **Partner**, collecting 103 responses.
- **Sweden (SE)**:
  - *EON Development AB*, a **Partner** from Sweden, gathered 40 responses.
- **Slovakia (SK)**:
  - *Pedal Consulting SRO* participated as a **Partner** and collected 45 responses.
- **Israel (IL)**:
  - *Twinnovation*, as a **Partner**, contributed with 62 responses.

Two thousand thirty-nine (2,039) student responses were collected across all participating countries and partners. This international collaboration provided a rich and diverse dataset, allowing for a comprehensive analysis of students' needs, expectations, and knowledge regarding AR/VR/XR technologies. This broad geographical spread ensured that the findings could be generalised across different educational and cultural contexts, thus enhancing the relevance of the research for the development of the Metaverse Academy's future course offerings.

This carefully coordinated approach allowed each partner to contribute meaningfully to the project, ensuring that the needs analysis was comprehensive and reflective of the diverse student body targeted by the Metaverse Academy.

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2.2. Measurement of Variables

The student survey utilised for **T2.3: Need Analysis of Students** in the Metaverse Academy project was designed to gather comprehensive data on student demographics, experiences with immersive technologies, and their expectations regarding AR/VR/XR technologies in education. The survey was structured into several distinct sections, each aimed at collecting specific types of information:

1. **Demographic Data**:
    - This section captures basic demographic information such as gender, country of study, field of study (e.g. humanities, social sciences, natural sciences, etc.), and level of education (Bachelor's, Master's, Ph.D.).
    - It also includes a question about how long students have been enrolled in their respective educational programmes, offering insights into their academic experience.
2. **Experience and Perceptions Regarding XR Technologies**:
    - This part assesses the students' familiarity with XR technologies (AR/VR/MR) and previous experiences using them.
    - The questions are designed to determine the level of exposure to XR technologies, ranging from those who have never heard of it to those who actively use it for leisure or professional purposes.
    - Students are also asked whether they have encountered XR technologies in their country and if they believe these technologies could benefit their country.
3. **Interest in XR Technologies**:
    - A vital survey section asks students about their interest in using XR technologies within their field of study. The responses are gathered using a Likert scale (1 to 5), allowing participants to express varying degrees of interest, from "strongly disagree" to "strongly agree."
    - Another question explores how frequently XR technologies are used in their current study programmes, helping to identify how integrated these technologies already are within their educational experience.
4. **Experience and Perceptions Regarding MOOCs**:
    - This section inquires about students' previous participation in Massive Open Online Courses (MOOCs) such as Coursera, EdX, or Udemy. It also asks them to rate the relevance of MOOCs in providing opportunities for acquiring new skills pertinent to their academic goals.
5. **Added Value of XR Technologies**:

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- Students are asked to rate how much they agree with statements regarding XR technologies' value in enhancing theoretical and practical learning experiences. Again, They are asked whether they believe XR technologies can improve learning outcomes using a Likert scale.

6. **Competencies Related to XR Technologies**:
    - This part evaluates students' perceptions of the competencies they believe are relevant for using XR technologies effectively, such as creativity, technical literacy, adaptability to new interfaces, and safety awareness.
    - Following this, students are asked to self-assess their current competency levels in these areas, providing a clear picture of both perceived and actual readiness to use XR technologies in their studies.
7. **Challenges and Barriers**:
    - Students are asked to identify potential challenges they face in using XR technologies for learning. Multiple options are provided, including technical issues, lack of training, time constraints, high costs, and accessibility problems (e.g., stable internet connection or access to devices).
8. **Country-Specific Questions**:
    - This section is tailored for specific countries, like South Africa, where questions about infrastructure and access to technologies are addressed. For example, students are asked whether they have a stable internet connection, access to a mobile device, or other technology necessary to use XR tools.
9. **Additional Comments**:
    - The final section allows students to provide open-ended feedback regarding their experiences with XR technologies in education and suggestions for improving XR-related courses within the Metaverse Academy.

The comprehensive structure of the survey ensures that all critical aspects of student needs, experiences, and expectations related to XR technologies are captured. These insights will be instrumental in shaping future course content and ensuring that the Metaverse Academy's educational offerings are aligned with student demands and industry trends.

Link to the survey in English:

https://docs.google.com/forms/d/e/1FAIpQLScepvsmQcye1-YWBeWoh05gP3d18Wi8RvzqgSju-yApSZIUNQ/viewform

The database with information for all countries can be found at the following link:

https://docs.google.com/spreadsheets/d/1BUdiaCQEFy1jTPUmGH-TQG-I9yWpumFB/edit?usp=drive_link&ouid=113221944521471187461&rtpof=true&sd=true

In the following sections, the results from each country will be analysed in detail, addressing each part of the questionnaire separately. This approach will allow for a thorough examination of the data collected from each participating country, ensuring that we capture both individual and regional perspectives on XR technologies. After analysing the data country-by-country, a comprehensive global analysis will be conducted, providing a consolidated overview of the findings across all countries involved in the study. This final analysis will offer broader insights into the overall trends and patterns identified throughout the research.

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3. Demographic data

3.1. Gender

Table 3.1 presents the percentage distribution of an unspecified category across three gender groups—Male, Female, and Diverse—across ten countries. Here is a detailed breakdown:

- **Türkiye**: 41.7% Male, 57.8% Female, 0.4% Diverse
- **Romania**: 38.7% Male, 60.3% Female, 1.0% Diverse
- **Spain**: 37.5% Male, 61.8% Female, 0.7% Diverse
- **South Africa**: 46.1% Male, 53.2% Female, 0.7% Diverse
- **Bulgaria**: 44.7% Male, 54.4% Female, 1.0% Diverse
- **Germany**: 41.9% Male, 58.1% Female, 0.0% Diverse
- **Greece**: 38.8% Male, 60.2% Female, 1.0% Diverse
- **Sweden**: 67.5% Male, 30.0% Female, 2.5% Diverse
- **Slovakia**: 36.4% Male, 63.6% Female, 0.0% Diverse
- **Israel**: 37.1% Male, 56.5% Female, 6.5% Diverse

This data provides insights into gender distribution within the specified category across these countries.

Table 3.1. Gender

	Male	**Female**	**Diverse**
Türkiye	42.0%	58.0%	-
Romania	38.7%	60.3%	1.0%
Spain	37.5%	61.8%	0.7%
South Africa	46.1%	53.2%	0.7%
Bulgaria	44.7%	54.4%	1.0%
Germany	41.9%	58.1%	--
Greece	38.8%	60.2%	1.0%
Sweden	67.5%	30.0%	2.5%
Slovakia	36.4%	63.6%	--
Israel	37.1%	56.5%	6.5%

3.2. Educational profile

Table 3.2 provides an overview of the educational profiles of university students across various countries participating in the Metaverse Academy study. This table categorises students into different fields of study, such as Arts, Law, Health Sciences, Natural Sciences, Social Sciences, Education, Technical/Engineering, Humanities, Business/Management, and other specialised areas. The data is presented as valid percentages, reflecting the distribution of students in each educational profile within their respective countries. This information is crucial for understanding the diverse academic backgrounds of students and tailoring XR-based educational content to meet their specific needs and preferences.

Table 3.2. Educational profile

	Türkiye	Romania	Spain	South Africa	Bulgaria	Germany	Greece	Sweden	Slovakia	Israel
Arts	1.6%	0.6%	0.9%	2.6%	1.9%		11.7%	5.0%	2.3%	6.5%
Law	0.7%	1.3%	8.5%	1.0%	1.9%	6.5%	1.0%			8.1%
Health Sciences	2.2%	4.5%	2.2%	2.1%	2.9%	12.9%	9.7%	2.5%	4.7%	11.3%
Natural Sciences	6.1%	3.5%	0.2%	3.3%	4.9%	6.5%	7.8%	7.5%	9.3%	6.5%
Social Sciences	9.7%	18.7%	15.0%	1.9%	7.8%	16.1%	14.6%		18.6%	6.5%
Education	50.3%	6.1%	1.7%	12.8%	9.7%	12.9%	6.8%		16.3%	14.5%
Technical/Engineering	20.0%	15.8%	4.6%	37.8%	10.6%	25.8%	11.7%	82.5%	16.3%	16.1%
Humanities	0.9%	13.9%	2.2%	10.5%	20.3%	12.9%	16.5%	2.5%	16.3%	11.3%
Business/Management	3.1%	31.6%	61.8%	9.0%	34.0%	6.5%	19.4%		16.3%	19.4%
Accounting Sciences				0.4%						
Analytical Chemistry				0.7%						
Applied and Computer Science				1.1%						
Applied Science				0.3%						
Bachelor Science (Mathematical Science)				0.3%						
BSc in mathematical science				0.3%						
BSc molecular and life sciences				0.6%						
Business and Law			1.6%							
Chemistry				0.5%						
Communication		0.3%								
Computer Science		0.3%								
Computer Science				0.4%						
Computer Systems Engineering				0.4%						
Design				0.3%						
Economic Informatics		0.6%								
Economics		0.9%								

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	Türkiye	Romania	Spain	South Africa	Bulgaria	Germany	Greece	Sweden	Slovakia	Israel
Economics & Business & Technology/Engineering			0.2%							
Electrical Engineering				0.3%						
Engineering				1.2%						
Financial Management				0.3%						
Graphic Design				0.3%						
Human Science				0.6%						
Information Communication Technology				0.5%						
Information Technology				4.0%						
Insurance Business					1.0%					
Internal Auditing				0.3%						
International Relations and European Studies		0.9%								
IT				0.7%	1.0%					
IT business analysis and IT security				0.3%						
Linguistics					2.0%					
Management Science				0.4%						
Mathematical and Computer Science				1.4%						
Mathematics				0.3%			1.0%			
Mathematics and Computer Science		0.3%								
National senior certificate				0.7%						
Otros	5.4%									
Photography				0.4%						
Political Science of Communication and Public Relations		0.3%								
Public Administration		0.3%								
Science				0.5%						
Sciences and Agriculture				0.7%						
Sport Management				0.2%						
Technology				0.3%						
Tourism			1.1%		1.0%					
Trade					1.0%					
Veterinary Medicine				0.3%						

3.3. Level of education

Table 3.3 provides an overview of the educational attainment levels among university students across various countries participating in the Metaverse study. The table categorises students into three primary levels of education: Bachelor's degree, Master's degree, and Doctorate/Ph.D., along with an additional category for other types of education. This classification allows for a comprehensive understanding of the distribution of educational qualifications within the student population, highlighting the diversity in academic backgrounds and the varying emphasis on different levels of higher education across countries. This information is crucial for tailoring educational content and strategies to meet student's specific needs and preferences in the context of XR technologies.

Tabla 3.3. Level of education

	Bachelor's degree	Master's degree	Doctorate/Ph.D.	Other
Türkiye	64.7%	23.5%	9.4%	2.4%
Romania	74.5%	21.0%	2.9%	1.6%
Spain	82.0%	15.2%	2.8%	0.0%
South Africa	44.6%	31.5%	0.7%	23.2%
Bulgaria	67.6%	26.5%	5.9%	0.0%
Germany	50.0%	13.3%	6.7%	30.00%
Greece	46.5%	43.6%	9.9%	0.0%
Sweden	20.0%	72.5%	2.5%	5.0%
Slovakia	48.8%	41.5%	4.9%	4.8%
Israel	58.1%	29.0%	12.9%	0.0%

3.4. Years in the programme

Table 3.4 provides an overview of the duration students have been enrolled in their respective programmes across various countries. The table categorises the duration into four groups: 1-2 years, 3-4 years, 5 years or more, and less than one year. This classification allows for a comprehensive understanding of the distribution of students' tenure in their programmes, highlighting the diversity in the length of time students have been engaged in their studies. This information is crucial for analysing students' progression and retention rates within different educational systems. It can help tailor support services to meet the specific needs of students at various stages of their academic journey.

Table 3.4. Years in the programme

	1-2 years	3-4 years	5 years or more	Less than one year
Türkiye	15.6%	24.1%	29.2%	31.0%
Romania	31.6%	12.9%	6.5%	49.0%
Spain	35.8%	20.0%	4.8%	39.5%
South Africa	25.2%	41.1%	3.1%	30.6%
Bulgaria	22.3%	43.7%	28.2%	5.8%
Germany	25.8%	38.7%	22.6%	12.9%
Greece	37.9%	27.2%	17.5%	17.5%

Sweden	30.0%	20.0%	22.5%	27.5%
Slovakia	15.6%	20.0%	42.2%	22.2%
Israel	24.6%	39.3%	23.0%	13.1%

4. Experience and Perceptions Regarding XR

4.1. Experience with XR Technologies by Country

Table 4.1 presents the distribution of respondents' experiences with XR technologies across ten countries: Türkiye, Romania, Spain, South Africa, Bulgaria, Germany, Greece, Sweden, Slovakia, and Israel. It categorises the respondents' familiarity and usage of XR technologies, ranging from those who have never heard of it to those with extensive experience using it for leisure and/or professional activities. The data provides insights into varying levels of awareness, exposure, and usage of XR technologies in different regions, highlighting the frequency of use and the extent of experience among students in each country.

Table 4.1. Experience with XR Technologies by Country

	I have never heard of it.	**I have heard of it but never used it**	**I have seen demonstrations but never used it**	**I have used it a few times**	**I use it often but only because I have to**	**I have a lot of experience using it for leisure and/or professional activities**
Türkiye	25.7%	30.8%	22.8%	15.4%	1.1%	4.2%
Romania	15.5%	31.3%	22.6%	27.4%	0.6%	2.6%
Spain	37.8%	23.9%	18.3%	17.0%	1.5%	1.5%
South Africa	44.4%	36.2%	11.6%	5.2%	1.2%	1.4%
Bulgaria	10.7%	35.9%	16.5%	22.3%	2.9%	11.7%
Germany	19.4%	29.0%	22.6%	22.6%	0.0%	6.5%
Greece	13.6%	46.6%	17.5%	15.5%	3.9%	2.9%
Sweden	12.8%	12.8%	7.7%	53.8%	0.0%	12.8%
Slovakia	31.1%	33.3%	13.3%	22.2%	0.0%	0.0%
Israel	27.4%	33.9%	14.5%	9.7%	8.1%	6.5%

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4.1.1. Comparative Analysis of XR Technology Experience Across Countries

Integrating Extended Reality (XR) technologies in educational settings has garnered significant interest worldwide, particularly as institutions seek innovative methods to enhance student engagement and learning outcomes. This analysis compares students' experiences across eight countries—Türkiye, Romania, Spain, South Africa, Bulgaria, Germany, Greece, Sweden, Slovakia, and Israel—regarding their familiarity and usage of XR technologies. By examining the distinct patterns of awareness, practical experience, and engagement, we can understand how cultural, economic, and educational factors shape students' interactions with XR technologies.

Awareness of XR Technologies

The data reveals varying levels of awareness of XR technologies among students from different countries. Türkiye shows the highest percentage of students (25.7%) who have never heard of XR technologies, which suggests a significant knowledge gap in a country that is making strides in digital innovation. In contrast, Bulgaria has the lowest percentage of students (10.7%) reporting that they have never heard of XR technologies, indicating a relatively higher level of awareness. This disparity can be attributed to various factors, such as the availability of educational resources, the promotion of technological innovations in academic contexts, and the integration of XR technologies into the national curriculum. Romania also presents considerable unawareness, with 15.5% of students indicating they have never heard of XR, highlighting the need for targeted educational campaigns to promote XR technologies.

Interestingly, Israel and South Africa both report relatively high awareness levels, with 27.4% and 44.4% of students claiming to have never heard of XR technologies. This raises questions about the effectiveness of educational initiatives in these regions and the extent to which institutions prioritise technology education. In Israel, known for its technological advancements, the finding may point to a disconnect between the high-tech industry and educational institutions, suggesting a need for greater collaboration to foster awareness and integration of XR technologies.

Familiarity and Usage of XR Technologies

The familiarity with XR technologies shows a pronounced divergence among the countries. Slovakia reports that 31.1% of students have heard of XR but have never used it, while Israel follows closely with 33.9% in the same category. This trend reflects a significant gap between awareness and practical experience across these nations, indicating a need for more accessible XR experiences in educational contexts. On the other hand, Bulgaria's 35.9% of students who have heard of XR but never used it suggest that while there is some awareness, the practical implementation of these technologies is lacking, further emphasising the need for increased access to XR tools.

When examining those who have seen demonstrations of XR technologies but have never used them, Slovakia stands out with 13.3%, suggesting that while exposure is present,

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actual engagement remains minimal. Comparatively, South Africa reports a mere 11.6%, which could indicate that demonstrations may need to be more effective, leading to hands-on experiences. The data from Germany and Greece also shows similar patterns, with both countries having a significant portion of students (22.6% and 17.5%, respectively) who have seen demonstrations without subsequent usage. This highlights a potential shortfall in providing students with opportunities to engage directly with XR technologies, underscoring the need for educational frameworks that promote hands-on learning experiences.

Regular and Frequent Use of XR Technologies

In terms of regular usage, South Africa demonstrates a unique trend, with only 5.2% of students reporting that they have used XR a few times, while 1.2% claim to use it often but only because they have to. This low engagement may reflect limited access to XR technologies or a lack of integration into the curriculum. Similarly, Türkiye shows that only 15.4% of students use XR a few times, which raises concerns about how these technologies are being adopted in educational settings.

On the other hand, Spain presents a mixed picture, with 17.0% of students using XR technologies a few times and 1.5% using them often but only out of necessity. This suggests that while some students can access XR, it needs to be leveraged to its full potential. The situation in Greece is also noteworthy, with 15.5% of students indicating they have used XR technologies a few times, highlighting moderate engagement.

Bulgaria stands out in terms of regular and voluntary use for leisure or professional activities, with 11.7% of students reporting significant experience in this domain, which can indicate cultural factors that encourage the exploration of new technologies. Conversely, countries like Sweden and Slovakia report 0.0% for frequent use out of necessity or leisure, indicating that XR technologies may still need to be perceived as essential learning or personal development tools.

Insights on Engagement and Motivation

An essential aspect of this analysis is understanding the motivation behind students' engagement with XR technologies. The data suggests that intrinsic motivation is crucial in determining the extent of usage. Countries where a higher percentage of students report using XR often out of necessity, such as South Africa and Spain, may indicate that educational institutions are not effectively communicating the value of these technologies.

Conversely, Bulgaria's higher level of voluntary engagement suggests that students may perceive XR as a beneficial tool for enhancing their educational experience. This highlights the importance of fostering an environment where students view XR as a valuable asset rather than an obligation. Academic institutions should strive to create engaging curricula that showcase the practical applications of XR technologies, thus fostering a culture of exploration and innovation.

Cultural and Educational Context

The differences in XR technology experiences across these countries may also stem from broader cultural and educational contexts. Countries like Israel and Germany, recognised for their technological prowess, demonstrate varying levels of engagement with XR technologies, indicating that awareness only sometimes translates into practical application. In contrast, Bulgaria and Slovakia present a landscape where awareness and usage diverge significantly, suggesting that educational institutions may need to rethink their approaches to technology integration.

Furthermore, the disparity in XR technology experiences across countries may reflect variations in educational policies, access to technology, and investment in educational innovation. Countries with more robust educational policies that emphasise technology integration, such as Germany and Sweden, may see higher engagement levels compared to countries with less developed such policies.

This comparative analysis of student experiences with XR technologies across Türkiye, Romania, Spain, South Africa, Bulgaria, Germany, Greece, Sweden, Slovakia, and Israel reveals a complex interplay of awareness, familiarity, and engagement. While some countries demonstrate higher levels of awareness, others need help with practical usage and motivation. The findings underscore that educational institutions need to enhance their integration of XR technologies in curricula, promote understanding, and foster a culture of engagement among students. By leveraging each country's unique strengths and addressing the existing gaps in knowledge and experience, stakeholders can work towards creating a future where XR technologies play an integral role in educational environments, ultimately preparing students for a rapidly evolving digital landscape.

4.1.2. Türkiye

The data from Türkiye reveals several key points regarding the distribution of responses. First, 25.7% of the respondents said they had never heard of XR technologies. This figure suggests that over a quarter of the surveyed students have no exposure to or understanding XR. Given that XR encompasses a wide range of immersive digital experiences, from virtual reality (VR) to augmented reality (AR) and mixed reality (MR), this lack of awareness represents a significant barrier to entry for these technologies in the Turkish context. The fact that such a high percentage of respondents have never even heard of XR may indicate gaps in digital literacy or the educational system's focus on emerging technologies. It also raises questions about whether there is sufficient public or institutional promotion of these technologies within Türkiye's academic institutions.

Moving on to the next group of respondents, 30.8% stated that they had heard of XR technologies but had never used them. This is the largest group in the dataset, suggesting a considerable level of theoretical awareness without practical application. For more than 30% of students to have heard of XR but not had any hands-on experience indicates a disconnect between awareness and accessibility. There may be several reasons for this gap, including limited access to the necessary equipment, such as VR headsets or AR-capable devices, or a lack of curricular integration that would allow students to experiment with and learn from XR technologies. This group of students represents a key demographic for initiatives aimed at expanding XR technology use, as they already possess a basic understanding but require

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opportunities to gain practical experience. If these students had more access to XR technology, the percentage of users could grow significantly.

The next category, those who have seen demonstrations of XR technologies but never used them, comprises 22.8% of Turkish respondents. This group represents students exposed to XR technology's capabilities through demonstrations but have yet to take the next step to interact with the technology themselves. Demonstrations can be impactful, providing a visual and experiential understanding of what the technology can do. However, the fact that nearly a quarter of respondents have yet to progress beyond passive observation implies a potential shortfall in opportunities for interactive learning or a lack of encouragement for students to engage more deeply with the technology. While positive in building awareness, this passive engagement may translate into something other than skill development or greater competency in using XR technologies for academic or professional purposes. More interactive experiences, integrated into classroom learning or available through extracurricular activities, could help bridge this gap.

The next group, which represents students who have used XR technologies a few times, makes up 15.4% of respondents. This group is relatively small compared to those who have only heard of or seen demonstrations of XR technologies. The fact that just over 15% of students have had hands-on experience with XR suggests that while there is some usage level, it still needs to be improved. The reasons for this could be multifaceted. Limited access to technology in academic settings, high costs associated with personal ownership of XR devices, or even a lack of awareness regarding XR's educational or professional benefits could all be contributing factors. Nevertheless, this group has already taken the step from passive to active interaction with XR technology, a promising indicator of future growth. If students who have only used XR a few times are encouraged to explore these technologies further, the country could see a rise in the number of skilled users.

The next group comprises students who report using XR technologies often but only because they have to, accounting for just 1.1% of respondents. This is the smallest group in the dataset and indicates that very few students must use XR technologies in their academic or professional activities. The fact that so few students fall into this category may indicate a limited integration of XR technologies within Türkiye's educational institutions. In contexts where XR technologies are integrated into course curricula or specific projects, we would expect to see a higher percentage of students using XR out of necessity. The low percentage suggests that for most Turkish students, XR is not yet a significant component of their educational experience. This may change as educational institutions adopt more immersive learning technologies. Still, for now, the data indicates that XR technologies are not a regular part of academic life for most students.

Finally, the group of students with a lot of experience using XR technologies for leisure and/or professional activities comprises 4.2% of respondents. This group represents those with the highest expertise and experience with XR technologies in Türkiye. While this percentage is small, it is nonetheless significant, as these students have already incorporated XR into their daily lives for entertainment or more advanced professional uses. This could include gaming, virtual collaboration, design work, or other applications of XR that are becoming increasingly important in various industries. The presence of this group,

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though limited in size, shows that there is already a foundation of XR expertise within Türkiye. These students will likely be the early adopters and innovators who can drive the future growth of XR technology use in academic and professional settings.

The data on Türkiye presents a mixed picture regarding students' use and awareness of XR technologies. While a significant portion of students have either never heard of XR or have only an essential understanding of it, there is also a small but growing group of students with hands-on experience. The gap between awareness and practical application suggests room for growth, particularly in providing more opportunities for students to engage with XR technologies in educational settings. Limited access to equipment and a lack of curricular integration may be critical factors contributing to the relatively low usage rates. However, the presence of a small group of experienced users indicates that there is potential for XR technologies to become more widely adopted in Türkiye as awareness and access increase. By addressing the current barriers and promoting the educational benefits of XR, Türkiye could see a substantial rise in the number of students who actively engage with and benefit from these emerging technologies.

4.1.3. Romania

The analysis of Romania's data on experience with XR technologies offers essential insights into students' current awareness and usage of these technologies. The data highlights a variety of stages in familiarity and engagement with XR technologies, which range from complete unfamiliarity to extensive usage for both leisure and professional activities. Understanding these dynamics can help inform strategies for increasing access, usage, and integration of XR technologies within Romania's educational system.

The first key observation from the data is that 15.5% of respondents from Romania stated that they had never heard of XR technologies. This figure, while not the highest compared to other countries, indicates that a significant minority of Romanian students still lack essential awareness of these technologies. In a world where XR is increasingly seen as a vital tool for enhancing educational experiences, XR's potential benefits to students need more understanding. However, it is worth noting that Romania has a smaller percentage of students in this category than countries like Spain (37.8%) or South Africa (44.4%), indicating that the general level of awareness may be slightly higher in Romania. This suggests that initiatives to raise awareness and promote XR technologies may have succeeded. However, there is still room for improvement in ensuring that all students have a basic understanding of XR.

The largest group in Romania's data comprises 31.3% of students who have heard of XR technologies but never used them. This figure indicates that while awareness of XR is relatively widespread, many students have not had the opportunity or access to these technologies. This group is vital for bridging the gap between theoretical knowledge and practical experience. Many students may understand the potential of XR but lack the resources or opportunities to engage with the technology firsthand. The reasons for this could include the high cost of XR equipment, such as VR headsets or AR-capable devices, or the limited availability of these tools in academic institutions. This suggests a need for more

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significant investment in infrastructure that would allow students to interact with XR technologies more readily. This demographic represents a crucial target for educational and policy initiatives that aim to increase the accessibility of XR, as they already possess the interest but not the practical experience.

A significant portion of students, 22.6%, reported that they have seen demonstrations of XR technologies but have never used them. This category reflects a somewhat passive level of engagement, where students are familiar with what XR technologies can do but have yet to have the chance to interact directly with them. Demonstrations can provide valuable insight into the capabilities and applications of XR. Still, they do not necessarily translate into hands-on experience, which is essential for developing skills and confidence in technology use. The relatively high percentage of students in this category suggests that while demonstrations of XR technology are taking place, there may be barriers that prevent students from moving beyond observation to active usage. These barriers could include the lack of available devices for student use or a lack of curriculum integration where students are encouraged to experiment with XR technologies in their academic work. For Romania, moving students from this passive engagement to active use could significantly enhance their educational experience and prepare them for future professional environments where XR technologies are becoming increasingly important.

A notable 27.4% of respondents in Romania reported that they had used XR technologies a few times. This is a relatively high figure compared to other countries, indicating that most Romanian students have had at least some hands-on experience with XR. This group represents a promising segment of the student population who have already started interacting with these technologies and may be more inclined to explore further applications in their academic and personal lives. The fact that nearly a third of students have used XR technologies at least occasionally suggests that access to these tools, while not universal, is available. However, this occasional use may also indicate a need for more consistent integration of XR technologies in the curriculum. If students only use these tools sporadically, they may need to gain the full range of benefits that XR can offer. Regular, structured use of XR technologies, particularly in subjects where immersive learning could enhance understanding, could help ensure students develop more advanced skills and familiarity with these tools.

The next category, those who use XR technologies often but only because they have to, accounts for just 0.6% of Romanian respondents. This tiny percentage indicates that very few students must use XR technologies in their academic or professional activities. The fact that so few students fall into this category may suggest that XR technologies are not yet widely integrated into Romania's educational system as mandatory tools for learning. In countries or institutions where XR is a central part of the curriculum, we expect a higher percentage of students using the technology out of necessity. The low figure indicates that XR is likely being used more voluntarily or for specific projects or courses rather than as an essential tool across different disciplines. Increasing the curricular integration of XR technologies could help boost this percentage, ensuring that more students are exposed to regular, structured use of these tools.

Finally, the group of students with a lot of experience using XR technologies for leisure and/or professional activities is relatively small, comprising 2.6% of respondents. This group represents those with the highest familiarity and competence with XR technologies in Romania. While this percentage is low, it is expected given that XR is still an emerging technology, and many students may need to explore it extensively. The fact that this group exists, albeit in small numbers, suggests that there is already a foundation of XR knowledge and expertise within the student population. These students will likely be the early adopters who have recognised the potential of XR technologies for entertainment and professional use. As XR becomes more integrated into everyday life, particularly in gaming, design, architecture, and virtual collaboration, this group of experienced users could serve as a valuable resource for expanding XR use across the student body. Encouraging peer-to-peer learning, where more experienced users can share their knowledge and skills with their peers, could be one way to increase the overall level of XR competence among students.

Romania's data presents a nuanced picture of the current state of XR technology usage among students. While many students have at least heard of XR technologies, the gap between awareness and practical use remains significant. The data suggests a relatively high level of passive engagement, with many students having seen demonstrations but not using the technology themselves. However, a promising portion of students have had some hands-on experience, indicating that access to XR technology, while not universal, is available to a degree. The challenge moving forward will be to increase opportunities for regular, structured use of XR technologies in educational settings, ensuring that more students can move from passive observation to active, consistent engagement. By addressing the barriers to access and promoting the academic benefits of XR, Romania could see a substantial increase in the number of students familiar with and proficient in these emerging technologies.

4.1.4. Spain

Spain's data on experience with XR technologies paints a fascinating picture of the diverse levels of engagement among students with these emerging tools. The data presents a spectrum that ranges from complete unfamiliarity to a moderate level of experience, providing valuable insight into the current state of XR technology integration within the Spanish education system. Analysing this data reveals the challenges Spain faces in adopting XR technologies and the opportunities for increasing student engagement and proficiency in these tools.

The most striking statistic in Spain's data is the high percentage of students—37.8%—who have never heard of XR technologies. This figure is among the highest among the surveyed countries and suggests that many Spanish students remain unaware of these technologies. Given that XR encompasses a range of transformative tools, including virtual reality (VR), augmented reality (AR), and mixed reality (MR), this lack of awareness is a significant barrier to the widespread adoption of XR technologies in education. This figure may reflect gaps in educational outreach or insufficient emphasis on emerging technologies within the curriculum. The high number of students who have not encountered XR technologies indicates that more must be done to introduce and promote these tools at earlier stages in the educational system. Raising awareness about the potential of XR, particularly in how it can enhance learning by providing immersive and interactive experiences, could help reduce this percentage over time.

The next largest group in Spain's data comprises 23.9% of students who have heard of XR technologies but have never used them. This figure suggests that while many students are aware of XR, they have not had the opportunity or access to experience it firsthand. This is a critical group when considering efforts to increase the practical use of XR in education. Students in this category may understand the theoretical value of XR but have not engaged with it, perhaps due to a lack of resources, such as VR headsets or AR-enabled devices, or the absence of XR integration in their courses. This disconnect between awareness and usage highlights a need for better infrastructure and access to XR tools in schools and universities. Introducing more hands-on experiences and ensuring that XR devices are more widely available could help move these students from awareness to active engagement. Additionally, providing training and workshops on using XR in educational settings could empower students to leap from theoretical knowledge to practical application.

A smaller portion of students, 18.3%, reported that they have seen demonstrations of XR technologies but have never used them. This group represents a form of passive engagement, where students are familiar with XR's potential and capabilities but have not had the chance to experiment with it directly. Demonstrations can be an essential first step in exposing students to XR, but without hands-on experience, students may not fully grasp the transformative potential of these technologies. The presence of this group suggests that while demonstrations of XR are taking place in educational settings, students need to have opportunities to engage actively with the technology. This could involve creating more interactive classroom environments where students can use XR tools rather than just observing their use. Increasing the number of labs, workshops, or courses that require students to use XR technologies would also help bridge the gap between observation and application.

The percentage of students who have used XR technologies a few times is 17%. This figure indicates that a significant portion of students in Spain have had at least some hands-on experience with XR, which is promising. These students will likely better understand how XR can be used in both educational and professional contexts. However, the fact that this group makes up less than a fifth of the student population suggests a long way to go before XR technologies are widely adopted and used regularly in the Spanish educational system. Students who have used XR a few times may have done so as part of isolated projects or specific courses but not consistently. The challenge for educators and institutions will be to increase the frequency and depth of XR usage, moving beyond occasional exposure to more sustained and integrated use across various subjects and disciplines. By doing so, students can develop more advanced skills and become more comfortable using XR as a tool for learning and problem-solving.

One notable observation is that a tiny percentage of students—1.5%—reported using XR technologies often, but only because they have to. This suggests that there are few instances in Spain where students must use XR technologies as part of their academic work. The fact that this percentage is so low implies that XR technologies are not yet embedded in

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the curriculum as essential tools for learning. In educational systems where XR is seen as a core component of teaching and learning, we expect more students to use technology regularly, even if unnecessary. The low figure in Spain suggests that XR is likely being used on a more optional or exploratory basis rather than as a mandatory part of the educational experience. To increase the adoption of XR technologies, more efforts should be made to integrate them into the core curriculum, ensuring that students have access to these tools and are required to use them in meaningful and structured ways.

Lastly, 1.5% of students in Spain reported that they have a lot of experience using XR technologies for leisure and/or professional activities. This figure represents the students most familiar with XR technologies and likely explored their applications beyond the classroom. These students may have used XR for gaming, virtual collaboration, or other professional or personal purposes. While small, this group represents an essential subset of the student population who could serve as early adopters and advocates for XR technology. These students could play a crucial role in spreading awareness and encouraging their peers to explore the potential of XR technologies. Peer-to-peer learning could be a valuable strategy in Spain’s educational system, where students with more experience could help guide others less familiar with XR. By leveraging the knowledge and skills of these early adopters, educators could help create a more inclusive environment where all students can engage with and benefit from XR technologies.

Spain’s data on experience with XR technologies reveals a mixed picture of awareness and usage. While a large percentage of students are still unfamiliar with XR technologies, a promising portion of the student population has had some experience with these tools. The critical challenges for Spain will be reducing the number of students who have never heard of XR and increasing opportunities for hands-on engagement among those who are aware of the technology but have not yet used it. Ensuring that XR technologies are more widely available and integrated into the curriculum could help bridge the gap between awareness and usage, allowing more students to benefit from XR's immersive and interactive learning experiences. By doing so, Spain could position itself as a leader in adopting and integrating XR technologies in education, helping prepare students for the future of work and learning in an increasingly digital world.

4.1.5. South Africa

South Africa's data on the experience with XR technologies presents a unique case within the spectrum of countries surveyed. The data suggests that a large portion of the student population in South Africa needs to become more familiar with these technologies, with relatively low levels of usage compared to other countries. The analysis of this data provides insight into South Africa's challenges regarding access to XR technologies and the potential for growth in adopting these tools in the educational sector.

The most prominent statistic from South Africa’s data is the extremely high percentage of students—44.4%—who have never heard of XR technologies. This figure is the highest among the countries surveyed and indicates a significant lack of awareness or exposure to XR technologies within the South African educational system. This could be due to several

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factors, including insufficient access to digital infrastructure, a lack of emphasis on technological literacy in the curriculum, or economic disparities that limit students' access to the internet and digital devices. XR technologies, which include virtual reality (VR), augmented reality (AR), and mixed reality (MR), have the potential to revolutionise education by offering immersive and interactive learning experiences. Still, this potential cannot be realised if students are unaware of their existence. The high percentage of students who have never heard of XR technologies indicates a pressing need for greater educational outreach and more significant investment in raising awareness about these tools in South Africa. Without this foundation of knowledge, it will be difficult for the country to integrate XR technologies into the mainstream of education.

The second largest group in South Africa's data consists of the 36.2% of students who have heard of XR technologies but have never used them. This figure, while slightly lower than the number of students who have never heard of XR, still represents a substantial portion of the student population. This group suggests that while XR technologies may be discussed or introduced in theoretical terms within educational settings, students are not given opportunities to use or experiment with them in practice. The gap between awareness and usage is a critical issue, as it indicates that students understand XR technologies' potential but are not given the tools or access necessary to engage with them. One possible reason for this is the cost associated with XR devices, such as VR headsets or AR-enabled smartphones, which may be prohibitively expensive for many students or schools in South Africa. Additionally, educators may lack technical support or training, which would prevent them from incorporating XR technologies into their teaching. For South Africa to bridge this gap, efforts must be made to provide students with more hands-on experiences and ensure that the necessary infrastructure is in place to support XR technologies in schools and universities.

The percentage of students who have seen demonstrations of XR technologies but have never used them stands at 11.6%. This group represents a smaller portion of the student population and suggests that demonstrations of XR technologies are occurring, albeit on a limited basis. Demonstrations can be a valuable first step in introducing students to XR technologies, allowing them to observe how these tools can be applied in real-world scenarios. However, without the opportunity to engage with the technology themselves, students may not fully grasp the potential of XR or develop the skills necessary to use it effectively. The presence of this group in South Africa's data indicates that while there is some exposure to XR technologies, it is not being followed up with practical, hands-on experiences. More interactive demonstrations and workshops should be introduced to enhance student's understanding and proficiency with XR, where students can experiment with the technology and learn by doing. By increasing the number of opportunities for active participation, South Africa can help ensure that students move from passive observers to active users of XR technologies.

Only 5.2% of students in South Africa reported that they had used XR technologies a few times. This figure is relatively low compared to other countries. It suggests limited access to XR tools and opportunities for students to engage with them practically. The low percentage of students who have used XR technologies even occasionally highlights South Africa's

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challenges in integrating these tools into the education system. In countries where XR technologies are more widely adopted, we expect to see a higher percentage of students with at least some experience with these tools. The fact that this group is so small in South Africa suggests that more efforts must be made to provide students with opportunities to use XR technologies, whether through dedicated courses, labs, or extracurricular activities. Increasing the availability of XR devices and ensuring that students have regular opportunities to use them would foster a more technologically literate student body, preparing them for future careers in industries where XR technologies are likely to play a significant role.

A similarly small percentage of students—1.2%—reported using XR technologies often, but only because they have to. This figure suggests that South Africa rarely requires XR technologies for academic coursework or other educational activities. The low percentage of students who use XR technologies out of necessity indicates that these tools are not yet seen as essential components of the academic experience in South Africa. In educational systems where XR technologies are integrated into the curriculum, we expect to see a higher percentage of students using these tools regularly, even if only because they are required. The fact that this percentage is so low in South Africa suggests that XR technologies are still viewed as optional or supplementary rather than as core educational tools. To become more widely adopted, XR technologies must be seen as indispensable components of the learning process, with clear links to academic outcomes and career preparation. By embedding XR technologies more deeply into the curriculum and making their use a requirement in specific courses or projects, South Africa could help students develop the skills they need to succeed in a rapidly evolving digital world.

Lastly, 1.4% of students in South Africa reported that they have a lot of experience using XR technologies for leisure and/or professional activities. This figure is also relatively low, indicating that very few students in South Africa have had extensive experience with XR technologies outside of the classroom. This group likely includes students accessing XR technologies for personal or professional use through gaming, virtual collaboration, or other activities. While small, this group represents an essential subset of the student population who could serve as early adopters and advocates for XR technology. These students may have valuable insights into how XR technologies can be used in various contexts and could help spread awareness of the potential of XR among their peers. Encouraging these students to share their experiences and mentor others could effectively increase XR adoption in South Africa. By leveraging the knowledge and enthusiasm of these early adopters, educators and institutions could help create a more inclusive and engaged learning environment where all students can explore and benefit from XR technologies.

South Africa's data on experience with XR technologies highlights significant challenges in terms of awareness, access, and usage. Many of the student population remain unfamiliar with these tools, and relatively few students have had the opportunity to engage with them meaningfully. The critical challenges for South Africa will be raising awareness about XR technologies and increasing access to the devices and infrastructure necessary to support their use. South Africa can help prepare its students for the future of work and learning in an increasingly digital world by providing more opportunities for hands-on engagement and

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ensuring that XR technologies are integrated into the curriculum. The potential for growth in adopting XR technologies in South Africa is immense, but concerted efforts from educators, institutions, and policymakers are required to make this a reality. With suitable investments in technology, training, and infrastructure, South Africa could position itself as a leader in using XR technologies in education, helping bridge the digital divide and create more equitable access to transformative learning experiences.

4.1.6. Bulgaria

Bulgaria's data on the experience with XR technologies provides a distinctive overview of how students in the country engage with these emerging digital tools. The distribution of responses reveals a diverse range of familiarity and usage patterns, indicating that while some students have embraced XR technologies significantly, others remain in the very early stages of awareness and usage. Bulgaria stands out as a country with a moderate level of experience compared to other nations in the dataset, and a deeper analysis of the data highlights both the potential for growth and the barriers that may need to be addressed to integrate XR technologies into educational settings fully.

The most striking feature of the data is that only 10.7% of Bulgarian students reported that they had never heard of XR technologies. This is a relatively low percentage compared to other countries, suggesting a reasonably high level of general awareness about these technologies among students. This indicates that XR technologies have made their way into educational discourse in Bulgaria through formal education channels, media exposure, or word of mouth. The fact that over 89% of students have at least heard of XR technologies suggests that efforts to introduce these concepts to students are succeeding to some extent, and the foundation for further engagement with these tools is already in place. However, mere awareness does not necessarily translate into understanding or usage; this is where the data reveals more complexity.

A significant portion of Bulgarian students—35.9%—reported having heard of XR technologies but never using them. This figure points to a gap between theoretical knowledge and practical experience. While students may be aware of the existence and potential of XR technologies, they are not given opportunities to use these tools themselves. This could be due to several factors, such as limited access to XR devices in schools and universities, insufficient training for educators in using these technologies, or economic barriers that prevent students from purchasing or accessing XR technology independently. The high percentage of students in this category highlights the need for more significant efforts to provide hands-on experiences with XR technologies, as simply knowing about them is not enough to develop the skills required to use them effectively. Suppose Bulgaria is to increase the adoption of XR technologies in education. In that case, it will need to focus on bridging this gap between awareness and usage by providing more practical opportunities for students to engage with these tools.

The data also shows that 16.5% of Bulgarian students have seen demonstrations of XR technologies but have never used them. This is another critical group to consider, as it suggests that while some students have been exposed to XR technologies more directly,

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they have yet to have the opportunity to interact with the technology themselves. Demonstrations can be a helpful first step in introducing students to XR technologies, as they allow students to observe how these tools can be used in practice. However, students need the chance to use the technology to fully grasp its potential and develop the skills necessary to apply it effectively. This group represents a key target for further educational initiatives, as providing these students with hands-on experiences could significantly enhance their understanding and proficiency with XR technologies. Schools and universities in Bulgaria could benefit from incorporating more interactive demonstrations and workshops into their curricula, where students can move from passive observers to active users of XR technologies.

The percentage of Bulgarian students who have used XR technologies a few times stands at 22.3%, a moderately high figure compared to other countries in the dataset. This suggests that a sizable portion of students in Bulgaria have had some practical experience with XR technologies, either through their academic studies or in other contexts. This group represents a critical mass of students who have moved beyond awareness and observation and begun to engage with XR technologies more regularly. These students will better understand the capabilities and limitations of XR technologies and may be more confident in using them for various purposes. The fact that over one-fifth of students have used XR technologies a few times indicates a growing familiarity with these tools in Bulgaria, and this group could serve as a foundation for further expansion of XR usage in education. By providing these students with more opportunities to deepen their experience with XR technologies, such as through more frequent use in coursework or extracurricular activities, Bulgaria could cultivate a generation of students who are well-versed in using these tools and prepared to apply them in their future careers.

Interestingly, 2.9% of Bulgarian students reported using XR technologies often, but only because they have to. This suggests that a small portion of students must use XR technologies for their academic studies or other activities. Still, they may need to be more enthusiastic about doing so. This could indicate that XR technologies are being introduced into specific educational contexts in Bulgaria, but not all students see them as essential or valuable. The fact that this percentage is relatively low suggests that XR technologies still need to be a widespread requirement in Bulgarian education. Still, they are starting to enter some courses or programmes. For XR technologies to become more widely adopted, they must be seen as indispensable tools for achieving educational outcomes rather than as optional or burdensome additions to the curriculum. By demonstrating the real-world applications and benefits of XR technologies, educators in Bulgaria could help shift students' perceptions and increase their willingness to use these tools.

Finally, 11.7% of Bulgarian students reported having much experience using XR technologies for leisure and/or professional activities. This is one of the highest percentages in this category among the countries surveyed, suggesting that a significant portion of Bulgarian students are engaging with XR technologies outside of the classroom. This group likely includes students who use XR technologies for gaming, virtual collaboration, or other leisure activities and those who may be using these tools professionally. The relatively high percentage of students with extensive experience using XR technologies indicates that

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Bulgaria already has a core group of early adopters who are well-versed in using these tools. These students could serve as valuable resources for their peers and educators, helping to spread knowledge about XR technologies and demonstrating their potential in various contexts. By leveraging the experience and expertise of these students, Bulgarian educational institutions could accelerate the adoption of XR technologies and create a more technologically advanced learning environment.

Bulgaria's data on the experience with XR technologies reveals that the country is at a moderate adoption stage. While there is a high level of awareness about XR technologies, there is still a significant gap between awareness and practical usage. Many students have heard of XR technologies but have never used them, indicating that more efforts are needed to provide hands-on experiences and increase access to XR devices. However, a substantial group of students have used XR technologies a few times, and a relatively high percentage of students with extensive experience use these tools for leisure or professional activities. This suggests that Bulgaria has the potential to become a leader in the adoption of XR technologies in education, provided that the necessary infrastructure and support are put in place to expand access and encourage more widespread usage. By building on the existing foundation of awareness and experience and providing more opportunities for students to engage with XR technologies meaningfully, Bulgaria can help ensure that its students are prepared for the future of work and learning in an increasingly digital world. The potential for growth in Bulgaria's adoption of XR technologies is considerable. With suitable investments in technology, training, and curriculum development, the country could position itself at the forefront of XR innovation in education.

4.1.7. Germany

Germany's engagement with XR technologies presents a nuanced perspective on how students interact with these innovative tools in an educational context. The data reveals a balanced mix of awareness and practical experience, indicating that while many students are familiar with XR technologies, a significant portion still faces barriers to regular use. Germany's position within the European landscape of XR technology adoption reflects its robust educational infrastructure and the challenges of integrating these technologies into everyday learning experiences.

Starting with awareness, 19.4% of German students indicated they had never heard of XR technologies. This relatively moderate percentage highlights a crucial aspect of the landscape. While many students are informed about emerging technologies, a portion still needs to be more engaged with XR discourse. The presence of students who are entirely unaware of XR suggests that educational institutions may need to enhance their outreach and educational initiatives to promote understanding of these technologies. Given Germany's reputation for a solid educational system, this figure is a reminder that ongoing efforts are necessary to keep students informed about the available digital tools. Increasing awareness can be the first step towards greater engagement and eventual adoption of XR technologies in academic settings.

In terms of familiarity, a significant 29.0% of students have heard of XR technologies but have never used them. This statistic underscores a notable gap between knowledge and practical application. Despite being aware of XR technologies, many students still need to be provided with opportunities to engage with them actively. This disconnect may stem from various factors, including limited access to XR devices in educational institutions, a lack of instructor training in effectively using these technologies, or economic constraints that prevent students from experiencing XR in their own time. To foster a more immersive learning environment, German educational institutions must address this gap by facilitating access to XR technologies and incorporating them into curricula. Doing so can help students transition from mere awareness to practical, hands-on experience, enhancing their educational journey.

The data also indicates that 22.6% of students have seen demonstrations of XR technologies but have never used them. This subset of students has had a glimpse into the potential of XR but has yet to have the chance to explore these technologies on their own. Demonstrations can be a powerful tool for piquing interest and showcasing the capabilities of XR technologies. However, with opportunities for active participation, students may be able to appreciate the full benefits these tools can offer. Educational institutions in Germany can take advantage of this interest by creating structured workshops or immersive experiences where students can experiment with XR technologies firsthand. Educators can inspire students to actively participate in their learning process by providing more practical exposure to these tools.

A notable 22.6% of German students reported using XR technologies a few times. This figure demonstrates that a substantial portion of students has engaged with XR, albeit in a limited capacity. Such experiences, while not frequent, are crucial as they provide students with foundational exposure to XR technologies. These students will likely have developed a basic understanding of XR's functionalities and applications, positioning them as a potential source of peer influence within their academic communities. Institutions can harness this existing engagement by encouraging students to share their experiences and insights with their peers, thus creating a more collaborative environment where knowledge and enthusiasm for XR technologies can spread organically.

Conversely, it is noteworthy that none of the students reported using XR technologies often but only because they had to. This absence suggests that XR technologies must still be mandatory in many educational programmes, indicating a potential barrier to broader adoption. Without the pressure or incentive to use these technologies, students may not feel compelled to explore them further. For XR technologies to become integral to the learning experience in Germany, educators need to establish clear connections between using these tools and achieving educational objectives. By demonstrating how XR can enhance learning outcomes, educators can cultivate a culture where students view these technologies as valuable assets rather than burdensome requirements.

The data further reveals that 6.5% of German students have extensive experience using XR technologies for leisure and/or professional activities. This relatively small percentage highlights that while there is a group of students proficient in using XR outside of educational contexts, it remains an area for growth. The experience gained through leisure or professional use can significantly inform students' understanding of how XR can be applied in academic settings. Educational institutions in Germany can tap into this existing expertise by integrating XR technologies into the curriculum in ways that resonate with students' personal experiences. Creating assignments or projects encouraging students to leverage their leisure-based XR knowledge can foster deeper engagement and enhance their learning experience.

Germany's landscape regarding XR technology experience among students reflects a complex interplay between awareness, usage, and potential for growth. While the levels of awareness are encouraging, the gaps in practical experience indicate that more efforts are needed to integrate XR fully into educational practices. The significant number of students who have heard of XR technologies but have never used them underscores the need for improved access and opportunities for engagement. Moreover, the observed levels of limited usage and lack of mandatory XR integration suggest that further initiatives should aim to demonstrate the value of these tools in achieving educational outcomes. German educational institutions can enhance students' engagement with these transformative tools by creating structured opportunities for hands-on experience, fostering collaboration among students, and aligning XR technologies with learning objectives. As the adoption of XR technologies continues to evolve, Germany has the potential to position itself as a leader in integrating these innovative tools into the educational landscape, ultimately preparing students for a future where digital fluency is paramount.

4.1.8. Greece

Greece's relationship with XR technologies reveals a distinctive landscape in which students gradually become acquainted with immersive digital experiences yet still face barriers to widespread adoption and use. The data demonstrates a blend of awareness, varying experience levels, and growth opportunities that could significantly enhance educational engagement through XR technologies. With a notable percentage of students aware of these technologies, the focus must shift toward creating practical experiences that encourage further exploration and integration within academic environments.

Beginning with the awareness of XR technologies, 13.6% of Greek students reported having never heard of these tools. This relatively low percentage indicates that a portion of the student population needs to be added to the conversation surrounding immersive technologies. Awareness is a crucial first step towards engagement, and this figure suggests that educational institutions should enhance their outreach efforts to ensure that all students are informed about the possibilities that XR technologies offer. Efforts to raise awareness could include workshops, seminars, or informational campaigns highlighting XR's educational benefits. As students become more familiar with these technologies, the likelihood of their engagement and subsequent usage increases significantly.

In terms of familiarity, a significant 46.6% of students indicated that they have heard of XR technologies but have never used them. This figure highlights a pronounced gap between awareness and practical experience, suggesting that students who are informed about XR need more opportunities to engage with these technologies. The reasons for this disparity

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may vary, including limited access to XR devices in educational settings or a curriculum that needs to incorporate these innovative tools adequately. Academic institutions in Greece must bridge this gap by offering students more opportunities to experience XR firsthand. Implementing pilot programmes, providing access to XR devices, or incorporating XR into existing curricula can help facilitate a smoother transition from awareness to practical usage.

Additionally, the data reveals that 17.5% of Greek students have seen demonstrations of XR technologies but have never used them. This statistic indicates that while students have witnessed what XR technologies can offer, they still need hands-on experience. Demonstrations can spark interest and curiosity, yet students may need the opportunity to explore these technologies themselves to appreciate their full potential. Educational institutions should capitalise on these demonstrations by creating immersive experiences where students can experiment with XR technologies directly. By fostering an environment where students can engage with XR tools in practical ways, educators can inspire a greater interest in exploring the educational applications of these technologies.

The percentage of students who have used XR technologies a few times stands at 15.5%. This figure illustrates that a considerable portion of students has had some exposure to XR, although this engagement remains limited. These students likely possess a basic understanding of XR's functionalities and potential applications, which can position them as advocates for its use among their peers. Educational institutions can leverage this interest by creating opportunities for students to share their experiences and knowledge, fostering a collaborative atmosphere, and encouraging further exploration of XR technologies. Peer-led initiatives or student groups focused on XR can help amplify interest and create a sense of community using these tools in academic settings.

Conversely, it is concerning that 3.9% of students reported using XR technologies often but only because they have to. This statistic implies that for some students, engagement with XR technologies is not driven by intrinsic interest but rather by external pressures, such as course requirements. The perception of XR technologies as a burden rather than an asset can hinder their adoption and integration into educational practices. To cultivate a more positive attitude towards XR technologies, educators must clearly articulate the benefits of these tools in enhancing learning outcomes. By framing XR as a valuable resource that can enrich the educational experience, students may be more inclined to view these technologies as beneficial rather than obligatory.

On a more positive note, 2.9% of Greek students reported having much experience using XR technologies for leisure and/or professional activities. While this percentage is relatively small, it highlights that some students are already familiar with XR applications outside of academic contexts. This existing experience can be a valuable asset in educational settings, as these students may possess insights into the practical applications of XR that can enrich classroom discussions and activities. Academic institutions in Greece can capitalise on this expertise by incorporating student-led projects or workshops that allow those with XR experience to share their knowledge with peers. By creating a collaborative environment, institutions can enhance students' overall engagement with XR technologies and encourage widespread adoption.

Greece's landscape regarding student experience with XR technologies reflects a complex interplay between awareness, usage, and opportunities for growth. While the levels of awareness are encouraging, the gaps in practical experience indicate that more initiatives are needed to integrate XR fully into educational practices. The substantial number of students who have heard of XR technologies but have never used them underscores the need for improved access and opportunities for engagement. Moreover, the observed levels of limited usage and the perception of XR technologies as burdensome suggest that further efforts should demonstrate these tools' value in achieving educational objectives. Greek educational institutions can enhance students' engagement with these transformative tools by creating structured opportunities for hands-on experience, fostering collaboration among students, and aligning XR technologies with learning outcomes. As the adoption of XR technologies continues to evolve, Greece has the potential to cultivate a vibrant educational ecosystem where digital fluency and immersive learning experiences thrive. By strategically addressing the current challenges and harnessing the interest and expertise of its students, Greece can position itself as a forward-thinking leader in integrating XR technologies into education.

4.1.9. Sweden

Sweden's engagement with XR (Extended Reality) technologies in educational settings presents a complex narrative marked by varying levels of awareness and experience among students. The data provides a comprehensive overview of students' familiarity with XR, showcasing both opportunities for growth and areas requiring attention. By examining the statistics closely, we can gain insights into how educational institutions can enhance student engagement with these innovative tools.

Starting with the awareness levels, 12.8% of Swedish students reported having never heard of XR technologies. This figure indicates that a small portion of the student population needs to be more informed about these immersive tools. Given Sweden's position as a technological advancement and education leader, this lack of awareness is a concern. To tackle this issue, educational institutions must prioritise outreach efforts to ensure that all students know the potential benefits of XR technologies. Initiatives such as informational workshops, seminars, and digital campaigns can bridge the awareness gap, informing students about the relevance of XR in modern education.

Regarding familiarity, another 12.8% of students indicated that they have heard of XR technologies but have never used them. This statistic underscores a significant gap between awareness and practical engagement. While students may be familiar with the term, their lack of hands-on experience limits their ability to appreciate XR's potential fully. This gap can be attributed to several factors, including insufficient access to XR devices in educational settings, a curriculum that has yet to integrate XR, and a general lack of training for educators on effectively using these technologies in the classroom. To encourage deeper engagement, institutions should aim to create more opportunities for students to experience XR first-hand by incorporating XR into existing courses or developing dedicated XR-based modules.

The data also reveals that 53.8% of Swedish students have used XR technologies a few times. This percentage indicates a healthy level of engagement, suggesting that many students have had some exposure to XR technologies, even if their usage is sporadic. This level of engagement presents a significant opportunity for educators to foster a more robust understanding of XR. By encouraging students to discuss their experiences and share insights about their use of XR technologies, educational institutions can create a collaborative environment that promotes further exploration and understanding of these tools. Peer-led initiatives or student forums centred around XR could enhance student interest and interaction with these technologies.

However, it is noteworthy that none of the students indicated using XR technologies often, only because they had to. This absence of mandatory engagement suggests that XR technologies are not a significant requirement in Swedish students' academic journeys. The perception of XR as an optional aspect of learning can impede its widespread adoption. To combat this, educators need to clearly articulate the benefits of XR technologies, illustrating how they can enhance learning outcomes and deepen understanding of complex concepts. Educators can encourage students to view these technologies as valuable educational tools rather than optional extras by showcasing successful case studies or demonstrating XR applications in real-world contexts.

Interestingly, 12.8% of students reported extensive experience using XR technologies for leisure and/or professional activities. This indicates that a subset of students is already engaging with XR beyond the academic sphere, providing them with insights that could benefit educational contexts. These students may possess practical knowledge and skills to enhance classroom discussions and activities. Institutions should consider tapping into this expertise by allowing students to lead workshops or projects showcasing their experiences with XR technologies. Such initiatives can help foster a sense of community and encourage student collaborative learning.

In summary, the data from Sweden reveals a nuanced landscape regarding student experience with XR technologies. While the levels of awareness among students are relatively low, the substantial percentage of those who have experimented with XR indicates a strong foundation for future engagement. The gap between awareness and practical experience suggests that educational institutions must enhance access to XR technologies and create structured opportunities for hands-on engagement. Additionally, the absence of mandatory usage indicates a need for educators to convey the value of XR in achieving educational objectives. By actively improving awareness, accessibility, and engagement with XR technologies, Swedish educational institutions can cultivate a dynamic learning environment that embraces innovation and prepares students for a future where digital skills are essential. Ultimately, with a strategic focus on bridging the current gaps, Sweden has the potential to lead in the effective integration of XR technologies into its educational framework, enriching the learning experience and better preparing students for the digital age.

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4.1.10. Slovakia

Slovakia's relationship with XR (Extended Reality) technologies in educational contexts reveals a diverse spectrum of awareness, usage, and potential for future engagement. The data presents a detailed picture of students' experiences with XR, highlighting the existing challenges and the opportunities for educational institutions to enhance the integration of these innovative tools in learning environments. By closely examining the statistics, we can understand how Slovakian students interact with XR technologies and what measures can be taken to improve their educational experiences.

Beginning with awareness levels, 31.1% of Slovakian students reported having never heard of XR technologies. This figure is concerning, as it indicates that a significant portion of the student population is unfamiliar with these immersive tools. In Slovakia's growing emphasis on modernising education and embracing technology, this unawareness suggests a critical area for improvement. Educational institutions must proactively raise awareness about XR technologies among students. This can be achieved through various initiatives, including workshops, information sessions, and digital marketing campaigns that introduce students to the concept of XR and elucidate its potential benefits in enhancing learning outcomes. Creating engaging promotional content demonstrating the real-world applications of XR technologies could pique students' interest and encourage them to explore these tools further.

Regarding familiarity, 33.3% of students indicated that they have heard of XR technologies but have never used them. This statistic highlights a notable gap between awareness and practical experience, reflecting the need for greater access to XR technologies in educational settings. While students may have some knowledge of XR, they need more hands-on experience to understand and fully appreciate its potential. Factors contributing to this gap may include limited availability of XR devices in schools, a lack of integration of XR into the curriculum, and insufficient training for educators on effectively incorporating these technologies. To bridge this gap, Slovakian educational institutions should prioritise establishing accessible XR experiences within their curricula, ensuring that students have opportunities to engage with XR technologies in meaningful ways. This could involve creating dedicated XR-focused courses or modules and collaborating with technology providers to facilitate access to XR tools.

The data shows that 13.3% of Slovakian students have seen demonstrations of XR technologies but have never used them. While this indicates that some students have been exposed to XR in a limited capacity, the lack of hands-on experience underscores the need for more interactive learning opportunities. Demonstrations can provide valuable insights into how XR technologies operate but may not be sufficient to foster a deep understanding of their applications. Therefore, educational institutions should aim to complement demonstrations with interactive experiences that allow students to engage with XR technologies first-hand. This could include arranging workshops where students can experiment with XR tools, participate in collaborative projects that utilise XR, or engage in guided learning activities that leverage the immersive nature of these technologies.

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The data also indicates that 22.2% of Slovakian students have used XR technologies a few times. While this is a promising figure, engagement with XR remains sporadic. The frequency of use points to an existing interest among students but also highlights the need for more structured opportunities for consistent engagement. To encourage more profound and more regular interaction with XR technologies, educators must create an environment that facilitates ongoing exploration and experimentation. This could involve incorporating XR into regular classroom activities, promoting XR tools for collaborative projects, or developing assignments to encourage students to explore XR technologies in greater depth. Slovakian institutions can enhance students' familiarity and comfort with these innovative tools by fostering an ongoing dialogue around XR and integrating it into the fabric of the educational experience.

Moreover, 0.0% of students indicated that they use XR technologies often but only because they have to. This absence of mandatory use highlights a broader issue regarding the perceived value of XR in education. If students do not see XR technologies as essential components of their learning journey, they may be less motivated to engage with them actively. Educational institutions must work to communicate the benefits of XR in a way that resonates with students. This could involve highlighting successful case studies, demonstrating how XR can facilitate experiential learning, or showcasing its potential to enhance understanding of complex subjects. By shifting the narrative around XR from optional to essential, educators can encourage a more positive attitude towards these technologies and stimulate greater student engagement.

Finally, it is essential to note that 0.0% of Slovakian students reported having much experience using XR technologies for leisure and/or professional activities. This lack of experience in personal contexts further underscores the need for educational institutions to promote XR as a valuable tool for academic and non-academic pursuits. By creating opportunities for students to explore XR in their leisure time or professional environments, institutions can help to cultivate a culture of innovation and creativity. This could involve encouraging students to participate in extracurricular activities focusing on XR, providing access to XR technology outside of the classroom, or fostering partnerships with industry leaders to offer real-world applications of XR in various fields.

The data from Slovakia presents a multifaceted view of student experience with XR technologies. While awareness levels are relatively low, the existing engagement among students who have used XR a few times indicates potential for further development. The gaps between awareness and practical experience and the absence of mandatory engagement highlight the need for educational institutions to prioritise initiatives that enhance access to XR technologies and promote their integration into the curriculum. By raising awareness, facilitating hands-on engagement, and fostering a culture that values XR in education, Slovakia can enhance student experiences and position itself as a leader in the innovative use of XR technologies in learning environments. As the integration of XR technologies continues to evolve, Slovakian educational institutions have the opportunity to cultivate a dynamic learning ecosystem where digital fluency and immersive experiences are paramount, ultimately preparing students for a future where these skills are essential.

4.1.11. Israel

Israel's interaction with XR (Extended Reality) technologies within educational contexts presents a compelling picture, marked by varied levels of awareness, usage, and engagement. The data provides a detailed overview of students' experiences with XR technologies, highlighting the existing challenges and the potential for enhanced integration in educational settings. By analysing these statistics closely, we can gain valuable insights into how Israeli students relate to XR technologies and identify pathways to improve their academic experiences.

To begin with awareness levels, 27.4% of Israeli students reported having never heard of XR technologies. This statistic indicates that many students must be aware of these immersive tools. This lack of awareness poses a challenge in a country known for its technological innovation and robust educational infrastructure. To address this issue, academic institutions in Israel must actively promote awareness of XR technologies among students. Strategies such as informative campaigns, workshops, and collaboration with technology providers can help educate students about XR's various applications and benefits. Schools and universities can enhance students' understanding and appreciation of these transformative technologies by fostering a culture of curiosity and exploration around XR.

An additional 33.9% of students indicated that they have heard of XR technologies but have never used them. This figure reflects a notable gap between awareness and practical experience, suggesting that many students may be familiar with the terminology yet lack hands-on exposure. This gap can stem from several factors, including limited access to XR devices in educational institutions, insufficient integration of XR into the curriculum, and a lack of training for educators on how to effectively implement XR technologies in their teaching. To bridge this divide, Israeli educational institutions should prioritise the incorporation of XR experiences into the curriculum. By providing students with opportunities to engage with XR technologies in meaningful ways, educators can help them develop a deeper understanding of how these tools can enhance learning outcomes.

Interestingly, 14.5% of Israeli students reported that they have seen demonstrations of XR technologies but have never used them. This statistic highlights a critical point: while some students have been exposed to XR through demonstrations, this exposure alone may not be sufficient to foster a comprehensive understanding of its applications. Demonstrations can be beneficial, but they should be complemented by opportunities for students to engage with XR technologies first-hand. Educational institutions should consider organising workshops, hands-on sessions, or interactive projects that allow students to experiment with XR tools. Such experiences can enhance student engagement and provide a practical context for understanding the potential of XR in various educational settings.

Moreover, 9.7% of students indicated that they have used XR technologies a few times. While this percentage shows some level of engagement, it suggests that interaction with XR remains relatively infrequent. This sporadic usage may be attributed to a lack of structured opportunities for consistent engagement. To encourage more frequent and meaningful interaction with XR technologies, educators must create an environment that promotes

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exploration and experimentation. This could involve integrating XR into regular classroom activities, encouraging collaborative projects that utilise XR, or developing assignments that challenge students to explore these technologies in greater depth. By fostering an ongoing dialogue around XR and integrating it into the educational experience, Israeli institutions can enhance students' familiarity and comfort with these innovative tools.

It is also worth noting that 8.1% of students reported that they use XR technologies often but only because they have to. This statistic indicates that for a small segment of students, engagement with XR is not driven by interest or curiosity but rather by external requirements. The lack of intrinsic motivation among these students suggests a need for educational institutions to communicate the value of XR more effectively. Educators should strive to showcase the benefits of XR in a way that resonates with students, illustrating how these technologies can facilitate experiential learning and enhance understanding of complex subjects. By framing XR as an integral part of the learning process rather than a mere obligation, institutions can encourage a more positive attitude toward these technologies and stimulate greater student engagement.

Lastly, 6.5% of Israeli students indicated that they have a lot of experience using XR technologies for leisure and/or professional activities. This statistic is encouraging, as it suggests that some students are already engaging with XR beyond the academic realm, providing them with insights that could be valuable in educational contexts. Students with this level of experience may possess practical knowledge and skills that can enhance classroom discussions and activities. Educational institutions should consider leveraging this existing expertise by allowing students to lead workshops or projects that showcase their experiences with XR technologies. By tapping into the skills and insights of experienced students, educators can create a more collaborative learning environment that enriches the overall educational experience.

The data from Israel presents a multifaceted view of student experience with XR technologies. While awareness levels are relatively low, the engagement among students who have used XR a few times indicates a foundation for further development. The gaps between awareness and practical experience, along with the presence of students who only engage with XR out of necessity, highlight the need for educational institutions to prioritise initiatives that enhance access to XR technologies and promote their integration into the curriculum. By raising awareness, facilitating hands-on engagement, and fostering a culture that values XR in education, Israeli institutions can enhance student experiences and position themselves as leaders in the innovative use of XR technologies in learning environments. As the integration of XR technologies continues to evolve, Israel has the potential to cultivate a dynamic educational ecosystem where digital fluency and immersive experiences are paramount, ultimately preparing students for a future where these skills are essential.

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4.2. Experience with XR Technology in your Country

Table 4.2 shows respondents' experience with XR technology in various countries. It highlights the percentage of students in each country who have had prior experience with XR technologies, offering insight into the levels of exposure across different regions. This information helps to identify trends in familiarity and engagement with XR technologies in each country's educational context.

Tabla 4.2. Experience with XR Technology in Your Country

	Yes
Türkiye	18.3%
Romania	29.7%
Spain	19.5%
South Africa	17.0%
Bulgaria	35.3%
Germany	35.5%
Greece	57.8%
Sweden	57.5%
Slovakia	22.2%
Israel	16.1%

The countries listed in the table include Türkiye, Romania, Spain, South Africa, Bulgaria, Germany, Greece, Sweden, Slovakia, and Israel, covering a mix of European, African, and Middle Eastern nations. The percentages reflect varying levels of engagement with XR technologies, suggesting that the diffusion of these technologies is not uniform across all regions. Several factors, including the availability of resources, technological infrastructure, educational policies, and the socio-economic conditions in each country, could influence this variation. Analysing these percentages helps identify the areas where XR technology is gaining traction and is still in its early stages of adoption.

At the lower end of the spectrum, we observe countries like Israel (16.1%), South Africa (17.0%), and Türkiye (18.3%), where the percentage of students with experience in XR technologies is relatively low. This may indicate limited access to the necessary hardware or software or a need for more integration of these technologies into the educational curriculum in these regions. In countries like Türkiye and South Africa, where the economic challenges are notable and technological infrastructure may not be as robust as in more developed nations, the lower percentages might also point to affordability issues. The cost of XR equipment, such as VR headsets or AR-capable devices, could be a significant barrier for institutions and students, limiting their ability to engage with these immersive tools.

Similarly, the percentage in Israel (16.1%) might suggest that XR technology may not have been widely adopted in its educational system despite Israel's robust technology sector. This could be due to various reasons, such as a focus on other areas of technological innovation or the fact that XR technology is still relatively new and has yet to be fully integrated into the educational frameworks of many countries.

On the other hand, we see higher percentages in countries like Bulgaria (35.3%), Germany (35.5%), Greece (57.8%), and Sweden (57.5%). The relatively high percentages in these countries could indicate more proactive approaches to incorporating XR technologies in educational settings. For instance, countries like Germany and Sweden are known for their solid technological infrastructures and innovation-driven policies. This could explain why students in these countries are more likely to have encountered XR technologies. In these regions, educational institutions may have better access to funding and resources needed to integrate XR tools into classrooms and curricula, enabling students to gain hands-on experience with these technologies.

Greece, with 57.8%, shows the highest percentage of students with experience in XR technology. This is a notable finding, especially considering Greece, like many southern European countries, has faced significant economic challenges in recent years. The high percentage could be attributed to targeted efforts by educational institutions or government policies to integrate new technologies into education as part of recovery or development strategies. It could also reflect the increasing availability of affordable XR solutions or the growing interest of educators in using immersive technologies to enhance the learning experience.

Sweden, which also reports a high percentage (57.5%), is another country where XR technology seems to be gaining ground rapidly in education. Sweden has long been recognised for its strong emphasis on digital literacy and innovation in education, and the high level of XR engagement aligns with this broader trend. The Swedish education system's focus on fostering digital competencies and incorporating cutting-edge technologies into teaching and learning could explain the widespread experience with XR technologies among students.

Romania (29.7%) and Spain (19.5%) fall in the mid-range of the spectrum. These percentages suggest that, while XR technology is present in educational environments in these countries, it may still need to be fully integrated into mainstream educational practices. In Romania, the percentage is relatively higher than in other countries in this range, which could indicate that certain institutions or regions are more forward-thinking in their approach to technology in education. Romania has been making strides in digital transformation in recent years, and the presence of XR technology in education could be part of this broader effort.

Spain, with 19.5%, shows a lower level of student experience with XR technologies, which might reflect slower adoption rates or the presence of significant barriers to widespread implementation. Like other southern European nations, Spain has faced economic constraints, which could impact the ability of educational institutions to invest in new technologies. However, given the global push towards digital transformation, XR technology adoption in Spain will likely increase in the coming years as more resources become available and the benefits of immersive learning tools become more widely recognised.

With 22.2%, Slovakia reflects a moderate student experience with XR technologies. This percentage suggests that, while the technology is making its way into educational settings, there may still be significant barriers to its widespread adoption. These could include

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funding issues, limited access to XR resources, or a slower pace of digital innovation in the educational sector.

The data from Table 4.2 provides a snapshot of the varying levels of XR technology adoption in education across different countries. The wide range of percentages indicates that while some countries embrace these technologies and integrate them into their educational frameworks, others are still in the early stages of adoption. This could be due to a variety of factors, including economic conditions, technological infrastructure, and educational institutions' priorities.

The information in this table is valuable for policymakers, educators, and technology developers as it highlights the need for targeted efforts to support adopting XR technologies in education. For countries with lower percentages, focusing on improving access to the required technology and training educators to use these tools effectively in the classroom may be necessary. In countries with higher percentages, continued investment in XR technologies could further enhance the learning experience and ensure students are well-prepared for the future digital landscape.

Table 4.2 provides an overview of the current state of XR technology adoption in education across different countries and offers insights into the challenges and opportunities in this area. The data underscores the importance of continued efforts to integrate immersive technologies into teaching and the need to address the barriers preventing their widespread use. As XR technology continues to evolve, it will be essential to monitor these trends and ensure that all students can benefit from the enhanced learning experiences that these tools can provide.

4.3. Analysis of XR experiences across countries (qualitative)

Following the analysis of the percentage of individuals who reported having experienced XR technologies, it is essential to delve deeper into the nature of these experiences across different countries. This section thoroughly examines the specific XR interactions shared by respondents from various regions. By exploring the contexts in which XR is being used—ranging from education and research to entertainment and professional training—this analysis offers insights into the varying levels of adoption, key trends, and unique challenges faced in each country. It aims to identify the strengths and limitations of XR integration in these regions, providing a comprehensive view of how immersive technologies shape different sectors globally.

4.3.1. Overall assessment

The adoption and use of XR technologies vary considerably across the countries analysed. In nations such as Germany, Sweden, and Türkiye, there is a higher degree of XR integration across diverse domains, ranging from education and entertainment to professional development and research. These countries have a more mature infrastructure that supports

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the adoption of XR, facilitating its use in areas like education, research, and cultural projects.

Conversely, XR adoption remains limited in countries such as Greece, Bulgaria, and Israel, primarily due to factors like the high cost of equipment and a general lack of awareness about these technologies. Although there is interest in XR and recognition of its potential benefits, practical implementation remains in its early stages. These countries would benefit from targeted initiatives to increase accessibility and understanding of XR technologies.

Education and entertainment are the predominant fields in which XR is applied across most countries. The COVID-19 pandemic significantly prompted the use of XR for remote learning and virtual experiences, particularly in countries like Romania and Spain. However, the return to in-person activities has led to a decline in the use of XR for distance education, shifting the focus back to in-person applications.

The gaming sector is a significant driver of XR adoption, with many respondents across various countries citing their experiences with VR headsets for gaming. This indicates a strong link between the gaming industry and the initial popularisation of XR technologies. However, sectors such as healthcare, professional training, and marketing have begun to explore these technologies, albeit slower than entertainment.

Despite the varied levels of adoption, it is clear that XR holds significant potential for development in all the countries analysed. Its ability to provide immersive experiences and enhance understanding of complex concepts positions it as a valuable tool for education and professional training. However, challenges such as cost, accessibility, and lack of awareness continue to hinder its widespread implementation.

Looking forward, the successful integration of XR will depend on overcoming these barriers and fostering greater collaboration between educational institutions, businesses, and governments. Initiatives promoting awareness and reducing the costs associated with XR technologies will be crucial in facilitating broader access and enabling more people to benefit from these immersive experiences. Additionally, as new XR applications are developed, the potential for cross-sectoral collaboration could significantly expand the scope of XR's impact, helping to realise its promise in fields as varied as healthcare, tourism, and cultural heritage.

In conclusion, while the current state of XR adoption varies greatly, the underlying interest and early experiences observed in all the countries highlight a promising future. With targeted efforts, XR could transition from niche applications into a central innovation, learning, and entertainment tool. The foundation for this growth exists, but its realisation will require sustained investment, awareness-building, and a commitment to leveraging XR's potential across diverse sectors.

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4.3.2. Türkiye

Students in Türkiye reported a range of XR experiences, with notable emphasis on collaboration with educational institutions and specific projects in both virtual reality (VR) and augmented reality (AR) environments. Examples include integrating XR into academic settings, such as creating a metaverse classroom in a private school and utilising VR in lessons to facilitate a more profound understanding of subjects. My experiences also included testing AR technologies for personal or educational purposes and using Oculus Quest for gaming and simulation. Moreover, some respondents highlighted collaboration with professionals and participation in workshops. Despite these instances, the use of XR remains relatively concentrated in specific sectors and has not yet achieved widespread adoption across the country.

4.3.3. Romania

In Romania, most respondents described XR experiences related to VR and AR within academic contexts and museums. Many mentioned using XR technologies in research projects and as part of academic dissertations, particularly exploring therapeutic applications of VR. Additionally, immersive museum visits were mentioned using these technologies and the application of AR in interior design. During the COVID-19 pandemic, XR facilitated remote learning in the educational sector. Nevertheless, the adoption of XR appears limited primarily to certain fields, such as education and entertainment, with less penetration into broader societal use.

4.3.4. Spain

In Spain, respondents reflected a blend of recreational and educational uses of XR technologies. Many referred to VR headsets for gaming and entertainment and visiting museums where VR devices were employed to enrich the experience. Additionally, some respondents attended workshops and technology fairs where innovative XR projects were showcased. While there are instances of XR use within the academic domain, such as in training and industrial design practices, most uses focus on leisure and experimentation. The adoption of XR technologies appears diverse yet oriented more towards recreational and informal educational purposes.

4.3.5. South Africa

In South Africa, XR experiences are tied to entertainment and training alongside applications in the business sector. Respondents described VR arcades in urban centres like Johannesburg and Cape Town and VR-based training programmes for industries such as mining and firefighter training. AR has been used in marketing campaigns, including projects by notable brands, illustrating a growing interest in utilising these technologies for commercial purposes. Several testimonies highlight partnerships between universities and companies to integrate XR solutions into educational curricula. While the interest in XR is growing, its use remains limited in scope, not yet reaching widespread adoption across all sectors.

4.3.6. Bulgaria

Bulgaria's XR experiences focus predominantly on entertainment and educational applications. Respondents mentioned using VR headsets for gaming and recreational activities and engaging in interactive simulations for teaching. Opportunities to experience XR often come through university events and museum demonstrations. However, XR technologies have not yet been widely adopted across Bulgaria, with most experiences occurring during occasional events and on a personal level rather than as part of a broader societal or institutional trend.

4.3.7. Germany

In Germany, the responses indicate a relatively advanced adoption of XR across various contexts, from academic to professional and artistic settings. Respondents mentioned using VR headsets for gaming, viewing art installations, and engaging with AR and mixed reality (MR) projects in professional environments. The use of XR in Germany extends into workspaces and educational settings, reflecting a more established infrastructure supporting the integration of these technologies. The diversity of XR applications, from cultural projects to technological development, suggests that Germany has a robust ecosystem for XR.

4.3.8. Greece

In Greece, XR experiences are primarily reported within educational and research contexts, alongside some mentions of medical applications. Respondents highlighted the use of these technologies for simulations and training purposes yet noted significant barriers to widespread adoption, such as the high equipment cost and a general lack of awareness. While the potential benefits of XR are acknowledged, the application of these technologies remains nascent, with more advanced implementations still to be realised. The focus is predominantly on educational use, with few mentions of broader societal applications.

4.3.9. Sweden

In Sweden, XR experiences encompass both research and technological development. Some respondents engaged with these technologies through research projects related to sustainability, while others reported using VR for simulations and demonstrations at events. Advanced devices like the Apple Vision Pro have been integrated into professional settings, highlighting Sweden's commitment to exploring cutting-edge XR solutions. While XR has a strong presence in academic and professional contexts, recreational use is also prevalent, suggesting a balanced approach towards innovation and entertainment.

4.3.10. Slovakia

In Slovakia, respondents noted using XR technologies within educational and healthcare settings, such as rehabilitation programmes and virtual visits. There were also experiences with VR headsets for leisure activities and applications of these technologies in cultural events. The adoption of XR in Slovakia appears to remain limited, with a stronger emphasis

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on educational and health-related uses. While there are efforts to introduce these technologies in specific contexts, they have yet to achieve widespread utilisation.

4.3.11. Israel

In Israel, respondents provided fewer instances of XR experiences, which were mainly oriented towards entertainment. Common themes were the use of devices such as Oculus Quest for gaming and occasional trials of XR equipment during tech fairs and exhibitions. Despite some involvement in XR-related activities, these are mostly confined to hobbyist or experimental settings. There are indications of interest in developing XR technologies, but broader adoption is in its early stages.

4.4. Perception of XR technologies' benefits by country

The following table provides an insightful overview of respondents from various countries' perceptions of the potential benefits of XR technologies. This data is crucial for understanding awareness and optimism towards XR technologies across different regions. By examining the responses, we can identify trends and variations in how these technologies are perceived globally, which can inform future strategies for promoting and implementing XR solutions. This analysis is essential for stakeholders leveraging XR technologies to drive innovation and development within their respective countries.

Tabla 4.4. Perception of XR technologies' benefits by country

Country	**Yes**	**No**	**No opinion**
Türkiye	72.3%	0.9%	26.8%
Romania	86.8%	1.9%	11.3%
Spain	62.6%	2.2%	35.2%
South Africa	74.9%	1.9%	23.2%
Bulgaria	69.6%	5.9%	24.5%
Germany	66.7%	6.7%	26.7%
Greece	82.4%	0.0%	17.6%
Sweden	60.0%	7.5%	32.5%
Slovakia	64.4%	4.4%	31.1%
Israel	65.6%	14.8%	19.7%

4.4.1. Comparative Analysis of Perceptions Across Countries

The following comparison examines the varying levels of support, scepticism, and indecision towards XR technologies across the countries studied, aiming to identify common trends and significant differences. This analysis provides insights into the diverse attitudes towards XR, which can guide strategic approaches for stakeholders interested in promoting these technologies.

Positive Perception: Romania and Greece exhibit the highest positive perception levels, with 86.8% and 82.4% respectively. Their responses suggest a consensus about the potential advantages of XR technologies. This may be due to successful implementations in education and public awareness campaigns that have effectively communicated the benefits of XR. These countries provide favourable conditions for further investments in immersive technologies, with limited opposition to overcome.

Moderate Enthusiasm: Countries such as Türkiye, South Africa, and Germany fall into the category of moderate enthusiasm, with positive responses ranging from 66.7% to 74.9%. While the majority recognises the benefits of XR, a substantial portion of the population remains undecided, suggesting that targeted outreach could shift opinions more favourably. Germany’s relatively high scepticism (6.7%) reflects potential barriers, such as privacy concerns, that need addressing.

High Levels of Indecision: Spain, Sweden, and Slovakia exhibit some of the highest levels of indecision, with 35.2%, 32.5%, and 31.1% of respondents holding no opinion. This indicates a significant segment of the population that is either uninformed or unsure about XR’s potential. Efforts in these countries should focus on raising awareness and providing more opportunities for direct engagement with XR technologies. Such measures could help convert the undecided into supporters.

High Scepticism: Israel stands out with 14.8% of respondents disagreeing with the benefits of XR, the highest rate of scepticism among the countries analysed. This suggests a cultural or societal reservation towards XR technologies, possibly due to concerns about their impact on social interaction or the readiness of local infrastructure. Addressing these concerns through clear communication and demonstration of XR’s practical applications could help reduce scepticism.

Regional Opportunities and Challenges: The analysis reveals that each country presents unique opportunities and challenges in promoting XR. While Romania and Greece show strong readiness for further XR adoption, countries like Spain and Sweden require focused efforts to educate and engage the undecided populations. Israel’s scepticism indicates a need for strategies that address cultural concerns, while Germany’s balance of enthusiasm and caution calls for reassurance regarding privacy and data security.

While attitudes towards XR technologies are generally positive across the board, the extent of this positivity and the presence of scepticism or indecision vary significantly. Stakeholders looking to promote XR adoption will need to tailor their strategies to the specific needs and perceptions of each country, focusing on awareness-building, addressing concerns, and showcasing practical benefits to ensure broader acceptance and integration of XR solutions.

4.4.2. Türkiye

In Türkiye, 72.3% of respondents believe in the benefits of XR technologies, which indicates a generally positive perception towards XR. The 0.9% of respondents who disagree with these benefits is negligible, suggesting that outright scepticism is rare in the Turkish context. However, 26.8% of respondents express no opinion, highlighting a significant portion of the population that remains uncertain or uninformed about the potential of XR technologies.

This high percentage of undecided respondents could indicate a lack of awareness or exposure to XR solutions, indicating room for educational initiatives or demonstration projects to increase understanding. The majority's positive perception suggests that Türkiye is a promising market for the growth of XR, provided that targeted efforts are made to reduce the number of those with no opinion.

4.4.3. Romania

Romania shows a strong positive perception of XR technologies, with 86.8% of respondents acknowledging their benefits. This is among the highest levels of optimism across the surveyed countries. The 1.9% of respondents who disagree with the benefits is minimal, suggesting a broad consensus on the value of XR in the Romanian context. The remaining 11.3% who have no opinion indicate room for improvement in awareness, which is significantly lower than in many other countries.

The high percentage of positive responses could be attributed to successful exposure to XR in educational and professional environments. Romania’s broad acceptance of XR indicates readiness for further investment in these technologies, particularly in education and healthcare areas where immersive solutions could have significant impacts.

4.4.4. Spain

In Spain, 62.6% of respondents agree that XR technologies have benefits, reflecting moderate optimism. However, 35.2% of respondents expressed no opinion, among the highest uncertainty percentages across the countries studied. Additionally, 2.2% of respondents disagree with the benefits of XR, a relatively low but notable presence of scepticism.

The high level of undecided respondents may reflect a need for more excellent public education and awareness campaigns about XR technologies in Spain. While the majority view XR positively, the high percentage of those without a clear opinion suggests that many may still need to fully understand the practical applications and potential impacts of XR solutions. If not addressed, this could be a barrier to broader adoption.

4.4.5. South Africa

South Africa shows a favourable perception of XR, with 74.9% of respondents recognising the benefits of these technologies. 1.9% of respondents disagree, while 23.2% express no

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opinion. The high positive response rate suggests a strong interest and awareness of XR's potential, which is likely influenced by its use in training and business sectors.

The 23.2% of respondents with no opinion highlight an opportunity for further engagement and education, especially in regions or communities with less exposure to XR technologies. The optimism presents an opportunity for stakeholders to invest in expanding XR applications across more sectors in South Africa, such as education and remote work solutions.

4.4.6. Bulgaria

In Bulgaria, 69.6% of respondents agree that XR technologies offer benefits, 5.9% disagree, and 24.5% disagree. This indicates a moderately positive perception towards XR, though the percentage of those who disagree is relatively higher compared to other countries.

The 24.5% of respondents with no opinion suggest a potential gap in awareness or understanding, though it is lower than in Spain or Sweden. The 5.9% disagreement could reflect scepticism based on limited exposure or concerns about the practical applications of XR. To foster wider acceptance, efforts could highlight successful case studies and practical demonstrations of XR's advantages in Bulgaria.

4.4.7. Germany

Germany's perception of XR technologies is somewhat mixed, with 66.7% of respondents agreeing that these technologies are beneficial. The 6.7% who disagree are among the highest percentages of scepticism across the countries studied. Additionally, 26.7% have no opinion, indicating a significant portion of the uncertain population.

The relatively high disagreement rate may stem from critical views on new technologies or concerns about privacy and data security, which are common in Germany. To improve the adoption of XR technologies, stakeholders could address these concerns directly, promoting transparency and demonstrating the secure handling of XR data.

4.4.8. Greece

Greece presents a highly optimistic view of XR technologies, with 82.4% of respondents agreeing with their benefits and 0% expressing disagreement. This indicates a strong consensus regarding XR's potential. However, 17.6% of respondents have no opinion, which suggests a minority that remains unengaged or unaware.

The absence of disagreement indicates a generally favourable environment for XR adoption, though the 17.6% with no opinion points to a need for continued awareness-building efforts. Greece could benefit from showcasing practical XR applications, especially in education and healthcare, to further enhance understanding among those who are currently undecided.

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4.4.9. Sweden

In Sweden, 60.0% of respondents believe in the benefits of XR technologies, 7.5% disagree, and 32.5% hold no opinion. This suggests a relatively cautious or reserved attitude towards XR compared to other countries.

The higher level of disagreement could reflect cultural or market-specific reservations about XR, possibly related to privacy concerns or the perceived value of these technologies. The 32.5% undecided indicates an opportunity for targeted awareness campaigns to demonstrate the tangible benefits of XR. Increasing the visibility of successful XR projects could help shift perceptions more positively.

4.4.10. Slovakia

Slovakia shows moderate support for XR technologies, with 64.4% of respondents agreeing that they offer benefits. 4.4% disagree, and a notable 31.1% have no opinion. The moderate level of support suggests that while many recognise the potential of XR, a substantial portion still needs to be convinced or uninformed.

This indicates a need for greater engagement, particularly in sectors where XR could directly impact education and healthcare. Initiatives that provide hands-on experiences with XR could help to convert the undecided into supporters, especially as the market for immersive technologies continues to grow.

4.4.11. Israel

In Israel, 65.6% of respondents perceive benefits from XR technologies, 14.8% disagree, and 19.7% disagree. The 14.8% disagreement is the highest among the surveyed countries, indicating a significant level of scepticism or concerns about XR.

This relatively high scepticism may reflect cultural or societal concerns, such as the market's readiness for new technologies or reservations about the impact of XR on social dynamics. The 19.7% with no opinion suggests room for awareness-building, which could focus on demonstrating the practical advantages of XR in everyday contexts.

4.5. Interest in using XR technologies in field of study

The following table provides an overview of university students' interest in using XR technologies within their fields of study. The data was collected through a survey where students rated their interest on a scale from 1 to 5, with 1 representing "strongly disagree" and 5 representing "strongly agree." This table highlights the varying levels of interest among students from different countries, offering valuable insights into the potential adoption and enthusiasm for XR technologies in academic settings. Understanding these trends can help educators and policymakers identify areas where additional resources and support may be needed to foster greater engagement with XR technologies in education.

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Tabla 4.5. Interest in using XR technologies in field of study

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
Türkiye	4.5%	3.8%	17.7%	34.7%	39.4%
Romania	0.6%	1.0%	15.5%	45.2%	37.7%
Spain	1.7%	3.5%	42.7%	34.4%	17.6%
South Africa	7.1%	1.2%	16.7%	42.4%	32.6%
Bulgaria	5.8%	11.7%	24.3%	44.7%	13.6%
Germany	3.2%	22.6%	32.3%	32.3%	9.7%
Greece	0.0%	0.0%	25.2%	44.7%	30.1%
Sweden	10.3%	5.1%	28.2%	38.5%	17.9%
Slovakia	2.2%	6.7%	48.9%	24.4%	17.8%
Israel	8.2%	6.6%	29.5%	24.6%	31.1%

4.5.1. Comparative Analysis of Interest in Using XR Technologies Across Countries

The comparative analysis explores the variation in interest levels towards integrating XR technologies into academic fields across different countries, identifying common trends and regional distinctions that could guide future strategies.

High Positive Interest: Countries like Türkiye, Romania, South Africa, and Greece exhibit strong positive interest in XR integration, with over 70% of students agreeing. Romania leads with 82.9% of positive responses, indicating a readiness to explore XR as a tool for enhancing academic learning. These countries present favourable conditions for expanding XR initiatives within their educational systems.

Moderate Positive Interest with High Neutrality: Spain, Bulgaria, and Israel show moderate positive interest but with a significant percentage of neutral responses. In Spain, 42.7% of students are undecided, while 24.3% in Bulgaria and 29.5% in Israel neither agree nor disagree. This suggests that while there is a base of interest, many students need more information or experience to form a strong opinion.

High Neutrality with Mixed Interest: Germany, Slovakia, and Sweden display higher levels of neutrality, with 32.3% in Germany, 48.9% in Slovakia, and 28.2% in Sweden expressing uncertainty

4.5.2. Türkiye

In Türkiye, the interest in integrating XR technologies into the field of study is predominantly positive. 39.4% of respondents strongly agree, and 34.7% agree, amounting to 74.1% who show a favourable attitude towards XR in their academic pursuits. This high level of interest suggests that many students in Türkiye recognise the potential benefits of XR for enhancing learning experiences.

Only 4.5% of respondents strongly disagreed, and 3.8% disagreed, for a combined 8.3% who resisted using XR in their studies. The remaining 17.7% of students neither agreed nor disagreed, indicating uncertainty or a lack of exposure to XR technologies.

The strong positive response indicates an opportunity for further investments in XR within Turkish universities, as many students seem ready to engage with these technologies. However, efforts to provide more hands-on experiences and real-world applications could help convert the undecided group into active supporters.

4.5.3. Romania

Romanian students display a highly positive attitude towards using XR in their studies, with 37.7% strongly agreeing and 45.2% agreeing, making a total of 82.9% who are in favour. This suggests a widespread recognition of the potential of XR to enrich academic learning.

Resistance is minimal, with only 0.6% strongly disagreeing and 1.0% disagreeing, totalling 1.6% of students who oppose the idea. 15.5% of respondents neither agree nor disagree, indicating a small segment needing more information or exposure to become more enthusiastic.

Romania's strong interest in XR suggests a readiness to adopt immersive technologies in educational settings. Targeted initiatives to further engage the undecided students could solidify this positive trend, making Romania a fertile ground for XR innovation in academia.

4.5.4. Spain

In Spain, the interest in using XR technologies for academic purposes is relatively positive, with 17.6% strongly agreeing and 34.4% agreeing, amounting to 52.0% of students who support XR integration in their studies. However, 42.7% of respondents neither agree nor disagree, the highest percentage of neutral responses among the countries studied.

A small proportion, 1.7%, strongly disagree, 3.5% disagree, and 5.2% oppose using XR in education. The significant level of neutrality suggests that many students need to become more familiar with XR or are unsure of its benefits within their academic fields.

This indicates that while there is a base of positive interest, efforts in Spain should focus on increasing awareness and providing practical demonstrations of XR's academic applications to convert neutral students into active supporters.

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4.5.5. South Africa

South African students exhibit strong interest in XR technologies for their studies, with 32.6% strongly agreeing and 42.4% agreeing, making up 75.0% who are in favour. This reflects a high enthusiasm and openness towards adopting XR in educational contexts.

Only 7.1% strongly disagree, and 1.2% disagree, resulting in a combined 8.3% who resist XR integration. 16.7% of respondents neither agree nor disagree, indicating room for further engagement and education on the subject.

The positive response suggests that South Africa is a promising market for XR in education, with most students ready to embrace these technologies. Focused efforts to engage the neutral group could help realise the full potential of XR in South African universities.

4.5.6. Bulgaria

In Bulgaria, 44.7% of respondents agree, and 13.6% strongly agree, for a total of 58.3% who support using XR technologies in their studies. However, 24.3% neither agree nor disagree, suggesting that a substantial segment of students may need more exposure to XR's potential benefits.

On the more resistant side, 5.8% strongly disagree, and 11.7% disagree, totalling 17.5% opposed to integrating XR into their academic fields. The relatively higher level of disagreement compared to some other countries suggests that there may be concerns or scepticism about XR's effectiveness in enhancing education.

Addressing these concerns through targeted demonstrations and showcasing successful applications of XR in Bulgarian universities could help to shift opinions and increase overall interest.

4.5.7. Germany

In Germany, student interest in using XR technologies could be more varied. 9.7% strongly agree, and 32.3% agree, making up 42.0% who are in favour. However, 32.3% of respondents neither agree nor disagree, indicating a substantial segment uncertain about XR's role in education.

Resistance is relatively higher, with 22.6% disagreeing and 3.2% strongly disagreeing, for a total of 25.8% who are against the use of XR in their studies. This suggests a degree of scepticism, possibly rooted in concerns about the practical applicability of these technologies in academic contexts.

Germany's higher level of disagreement suggests that efforts should focus on addressing specific concerns about XR and demonstrating its value in academic settings to encourage broader acceptance.

4.5.8. Greece

In Greece, interest in XR technologies is predominantly positive, with 30.1% strongly agreeing and 44.7% agreeing, leading to 74.8% of respondents favouring XR integration. No students strongly disagree or disagree, suggesting an absence of outright scepticism.

25.2% of students neither agree nor disagree, indicating that a significant portion remains uncertain about XR's potential. This neutrality presents an opportunity to increase awareness and provide practical experiences that could turn undecided students into advocates.

The positive outlook in Greece suggests a readiness for XR adoption in education. However, efforts are needed to reach those who still need to be fully convinced.

4.5.9. Sweden

Sweden presents a relatively balanced view towards XR, with 17.9% strongly agreeing and 38.5% agreeing, totalling 56.4% of respondents in favour. However, 28.2% neither agree nor disagree, reflecting a notable level of uncertainty.

Resistance exists, with 10.3% strongly disagreeing and 5.1% disagreeing, for a combined 15.4% of students who oppose XR integration. The mixed responses suggest that while there is interest, cultural factors or specific concerns may influence attitudes towards XR in educational contexts.

Initiatives demonstrating XR's tangible benefits in enhancing learning experiences could help increase acceptance among Swedish students.

4.5.10. Slovakia

Slovakian students demonstrate a high degree of neutrality towards XR, with 48.9% neither agreeing nor disagreeing, the highest percentage among the countries analysed. This suggests that many students are unfamiliar with or unsure about XR's educational role.

17.8% strongly agree, and 24.4% agree, making up 42.2% of those who support XR integration. On the other hand, 6.7% disagree, and 2.2% strongly disagree, totalling 8.9% opposition.

The high level of neutrality indicates that Slovakia could benefit from targeted educational campaigns to raise awareness about XR technologies and their potential to enhance academic learning.

4.5.11. Israel

In Israel, 31.1% of students strongly agree, and 24.6% agree, resulting in 55.7% favouring using XR technologies in their studies. However, 29.5% neither agree nor disagree, which suggests a degree of uncertainty.

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Resistance is present but not dominant, with 8.2% strongly disagreeing and 6.6% disagreeing, totalling 14.8% of students opposed to XR. The positive interest suggests a favourable environment for XR, with room for initiatives to engage undecided students through practical applications.

4.6. Extent of XR technology use in the study programme

The following table provides an overview of how XR technologies are utilised in various study programs. The data was collected through a survey where students rated the usage of XR technologies on a scale from 1 to 5, with 1 representing "not at all" and 5 representing "very actively used." This table highlights the varying levels of XR technology integration among students from different countries, offering valuable insights into the current state of XR technology adoption in academic settings. Understanding these trends can help educators and policymakers identify areas where additional resources and support may be needed to enhance the use of XR technologies in education.

Table 4.6. The extent of XR technology use in the study programme

	Not at All	Rarely Used	Occasionally Used	Frequently Used	Very Actively Used
Türkiye	35.5%	22.7%	27.0%	10.1%	4.8%
Romania	60.3%	25.5%	10.6%	2.6%	1.0%
Spain	45.6%	35.2%	13.9%	3.7%	1.5%
South Africa	32.4%	25.8%	20.5%	13.8%	7.5%
Bulgaria	48.5%	29.1%	14.6%	7.8%	0.0%
Germany	65.5%	24.1%	6.9%	3.4%	0.0%
Greece	42.7%	18.4%	31.1%	7.8%	0.0%
Sweden	55.0%	30.0%	12.5%	2.5%	0.0%
Slovakia	55.6%	17.8%	17.8%	6.7%	2.2%
Israel	24.6%	14.8%	31.1%	11.5%	18.0%

4.6.1. Comparative Analysis of XR Technology Use Across Countries

The comparative analysis examines the frequency of XR technology use in academic contexts across different countries, identifying trends and regional differences that could guide strategic efforts for expanding XR use in education.

Limited Use and High Resistance: Romania and Germany exhibit the highest levels of minimal XR use, with 85.8% and 89.6% of students, respectively, indicating that XR is "Not at All" or "Rarely Used." This suggests significant barriers to adoption, possibly due to

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limited infrastructure or scepticism regarding the educational value of XR. Addressing these challenges could involve pilot projects and demonstrations of successful applications.

Moderate Use with Potential for Growth: Countries like Türkiye, South Africa, and Greece show more balanced levels of XR use, with higher percentages of students reporting "Occasionally Used" and "Frequently Used." South Africa, in particular, has 21.3% of students who experience XR regularly, indicating a promising market for further expansion. Efforts in these countries could focus on building upon existing interest and increasing regular use.

High Neutrality with Emerging Trends: Spain, Bulgaria, and Slovakia show moderate levels of occasional XR use but have large proportions of students with minimal exposure. These countries could benefit from initiatives that showcase the practical applications of XR, aiming to move beyond occasional use and into more frequent integration in study programmes.

Positive Use Cases: Israel stands out as the country with the most active use of XR, with 29.5% of students reporting "Frequently Used" or "Very Actively Used." This indicates a readiness for further investment in XR and suggests that Israel could serve as a model for other countries aiming to integrate immersive technologies more deeply into education.

Opportunities for Strategic Investment: While many countries show a baseline level of interest in XR, the extent of its practical use still needs to be improved. Strategic efforts should focus on increasing access, providing hands-on experiences, and demonstrating the value of XR through case studies and successful implementations. By addressing these areas, educational stakeholders can help transform XR from a sporadic tool into a core component of modern learning environments.

4.6.2. Türkiye

In Türkiye, using XR technologies in study programmes is somewhat limited. 35.5% of respondents indicate that XR is "Not at All" used, suggesting that over a third of students do not encounter XR in their academic work. Additionally, 22.7% report that XR is "Rarely Used," bringing the total percentage of students with minimal XR exposure to 58.2%.

On a more positive note, 27.0% of students report "Occasionally Used," indicating that a significant portion does encounter XR to some degree, though not regularly. Furthermore, 10.1% of students indicate "Frequently Used," and 4.8% report that XR is "Very Actively Used" in their study programmes. This suggests that while there is a presence of XR, it has yet to be widespread, with a smaller proportion of students experiencing consistent use of these technologies.

Türkiye's data indicates room for growth in integrating XR technologies, mainly through initiatives that aim to increase regular exposure and use within educational frameworks.

4.6.3. Romania

Romanian students report minimal integration of XR technologies in their study programmes. A substantial 60.3% of respondents state that XR is "Not at All" used, making Romania one of the countries with the slightest presence of XR in academic settings. An additional 25.5% indicate "Rarely Used," bringing the total of students with minimal XR exposure to 85.8%.

Only 10.6% of respondents mentioned "Occasionally Used," while 2.6% reported "Frequently Used," and just 1.0% indicated "Very Actively Used." These low numbers suggest that XR has yet to gain traction within Romanian universities, possibly due to resource constraints or a lack of emphasis on immersive technologies in curricula.

Romania's results highlight the need for significant investment in XR infrastructure and targeted efforts to demonstrate its educational benefits, aiming to shift XR from an occasional tool to a more integral part of learning experiences.

4.6.4. Spain

In Spain, the use of XR in academic settings is similarly limited, with 45.6% of students reporting that XR is "Not at All" used in their study programmes. 35.2% indicate that it is "Rarely Used," bringing the total of minimal usage to 80.8%, suggesting that the majority of students encounter little to no XR in their studies.

13.9% of respondents report that XR is "Occasionally Used," indicating some engagement with these technologies, while 3.7% say it is "Frequently Used," and 1.5% mention "Very Actively Used." The data suggests that while there is some exposure to XR, it remains largely peripheral in the context of most study programmes.

To improve this, Spain may benefit from expanding XR applications in educational settings, particularly through collaborative projects between universities and industry that demonstrate the value of regular XR use in enhancing learning outcomes.

4.6.5. South Africa

South Africa shows a more balanced distribution of XR use in academic contexts. 32.4% of students report that XR is "Not at All" used, while 25.8% state it is "Rarely Used," totalling 58.2% with minimal exposure to XR. This indicates that while a significant portion of students has limited access to XR, it is less pronounced compared to countries like Romania and Spain.

20.5% of respondents indicate that XR is "Occasionally Used," suggesting a moderate level of engagement. Additionally, 13.8% report "Frequently Used," and 7.5% state "Very Actively Used," reflecting a relatively higher rate of consistent XR use in academic programmes compared to many other countries.

South Africa’s data suggests a growing interest and capacity for integrating XR into education. Further investments in XR infrastructure and targeted educational initiatives could help increase the frequency and depth of XR use.

4.6.6. Bulgaria

In Bulgaria, XR technologies are limited, with 48.5% of students reporting "Not at All" used and 29.1% indicating "Rarely Used," amounting to 77.6% who have minimal exposure to XR in their studies. This suggests that XR technologies have yet to become a regular part of the academic experience for most students.

14.6% report that XR is "Occasionally Used," 7.8% say it is "Frequently Used," but no respondents report "Very Actively Used." This indicates that while some students encounter XR, it is often infrequent.

Bulgaria’s results indicate a need for strategic efforts to integrate XR more regularly into study programmes, particularly in fields where immersive technologies can offer significant educational value.

4.6.7. Germany

Germany has a notably high percentage of students who report that XR is "Not at All" used, at 65.5%. An additional 24.1% state that XR is "Rarely Used," meaning that 89.6% of students have limited or no exposure to XR technologies in their studies.

Only 6.9% of respondents indicate that XR is "Occasionally Used," 3.4% report "Frequently Used," and no respondents state "Very Actively Used." These figures suggest that XR technologies are far from being a standard part of educational practice in Germany.

To increase the integration of XR in German universities, efforts could focus on pilot projects and partnerships that demonstrate the educational advantages of more frequent use of XR technologies.

4.6.8. Greece

In Greece, 42.7% of students indicate that XR is "Not at All" used, while 18.4% report it is "Rarely Used," totalling 61.1% with minimal exposure to XR. However, 31.1% of respondents say that XR is "Occasionally Used," showing higher sporadic engagement than in other countries.

7.8% of students report "Frequently Used." Still, there are no responses for "Very Actively Used," indicating that while XR is present in some academic contexts, it has not yet achieved consistent integration.

This data suggests an opportunity for Greece to build on its existing base of occasional users by promoting the consistent application of XR in more study programs.

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4.6.9. Sweden

Sweden's use of XR in education is limited, with 55.0% of students stating that XR is "Not at All" used and 30.0% reporting "Rarely Used," making a total of 85.0% with limited XR exposure. 12.5% of respondents say XR is "Occasionally Used," while only 2.5% report "Frequently Used," and there are no responses for "Very Actively Used."

The high percentage of limited use suggests that XR has yet to become a mainstream tool in Swedish education. This points to a need for initiatives that could increase awareness and demonstrate the value of more frequent XR use in academic settings.

4.6.10. Slovakia

In Slovakia, 55.6% of students report that XR is "Not at All" used, and 17.8% indicate "Rarely Used," totalling 73.4% who encounter little to no XR in their studies. 17.8% also report that XR is "Occasionally Used," while 6.7% state "Frequently Used," and 2.2% say it is "Very Actively Used."

While there is some level of regular XR use, the high percentage of minimal exposure suggests that Slovakia could benefit from initiatives focusing on increasing the frequency of XR use in study programmes.

4.6.11. Israel

Israel stands out with a more positive trend in using XR technologies. 24.6% of respondents report that XR is "Not at All" used, and 14.8% state "Rarely Used," making a total of 39.4% with limited exposure. However, 31.1% of students indicate "Occasionally Used," while 11.5% report "Frequently Used," and 18.0% say XR is "Very Actively Used."

The data suggests that Israel has made more progress in integrating XR technologies into academic settings than other countries, reflecting a more advanced and consistent use of these technologies.

5. Experience and Perceptions Regarding MOOCs

5.1. Participation in MOOCs

The following data examines the participation rates of university students in MOOCs (Massive Open Online Courses) across various countries. Understanding the extent of student engagement in MOOCs provides insights into the level of interest in online learning opportunities outside traditional academic structures. This analysis highlights the varying degrees to which students from different regions adopt these digital platforms for their education. By exploring these participation rates, we can better understand the factors that influence the adoption of MOOCs in each country, such as access to technology, awareness of online learning resources, and the perceived value of supplementing formal education with MOOCs.

Table 5.1. Participation in MOOCs

	Yes
Türkiye	55.7%
Romania	40.3%
Spain	16.8%
South Africa	26.7%
Bulgaria	49.5%
Germany	22.6%
Greece	78.6%
Sweden	43.6%
Slovakia	17.8%
Israel	52.5%

The following sections present an analysis of the participation rates of university students in Massive Open Online Courses (MOOCs) across various countries based on the data in Table 5.1. Each country's participation rate is examined to understand the level of engagement in online learning beyond traditional classroom settings. The analysis explores factors that may influence these rates, such as cultural attitudes towards digital learning, access to internet infrastructure, and the integration of MOOCs into formal education. A comparative analysis follows, offering insights into the differences and similarities in MOOC adoption across the studied regions.

5.1.1. Comparative Analysis of MOOC Participation Across Countries

The following comparative analysis highlights the variations in MOOC participation among university students across different countries. It provides insights into the factors that influence engagement levels and identifies common trends and unique patterns.

High Participation Countries: Greece, Israel, and Türkiye lead in MOOC participation rates, with 78.6%, 52.5%, and 55.7%, respectively. These countries demonstrate a strong interest in supplementing traditional education with online courses. Greece's exceptionally high rate suggests a robust demand for flexible learning options, possibly influenced by economic factors that encourage students to seek additional qualifications. Similarly, Israel and Türkiye's high participation rates reflect a strong acceptance of digital learning as a valuable complement to university education, driven by technological advancements and a proactive student approach to online learning.

Moderate Participation Countries: Sweden, Bulgaria, and Romania fall into the moderate participation category, with rates ranging from 40.3% to 49.5%. MOOCs have gained traction among a significant segment of the student population in these countries, though they are not yet mainstream. Bulgaria and Sweden's moderate rates suggest a growing

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recognition of the value of MOOCs for skill development. In contrast, Romania's rate indicates there is still potential for further growth in online learning engagement. Increased promotion of the benefits of MOOCs could help these countries reach higher levels of participation.

Low Participation Countries: Spain, Slovakia, Germany, and South Africa have lower participation rates, with 16.8%, 17.8%, 22.6%, and 26.7% respectively. These rates suggest that MOOCs have yet to become a prominent part of the educational landscape in these countries. Factors such as solid preferences for in-person learning in Spain and Germany or infrastructural challenges in South Africa and Slovakia may contribute to these lower rates. Efforts to integrate MOOCs into formal education, alongside improved internet accessibility and awareness campaigns, could help increase engagement in these regions.

Influence of Digital Infrastructure: The availability of technological infrastructure plays a crucial role in MOOC participation. Countries like Israel and Sweden, which have solid technological environments, show higher engagement rates. In contrast, countries where access to reliable internet may be more limited, such as South Africa and Slovakia, exhibit lower levels of participation. This suggests that efforts to improve digital access could directly impact the adoption of MOOCs.

Cultural Preferences for Learning: Cultural attitudes towards digital learning also shape MOOC participation. In Germany and Spain, the relatively low engagement rates may be influenced by a preference for traditional classroom settings and scepticism towards the effectiveness of online courses. Conversely, in countries like Greece, where MOOCs have been more widely accepted, there may be a greater openness to non-traditional learning methods, especially during challenging economic periods that encourage alternative education pathways.

Potential for Growth: Despite the varying levels of engagement, all countries show potential for increased MOOC adoption.

5.1.2. Türkiye

In Türkiye, 55.7% of university students reported participating in MOOCs. This relatively high rate suggests a significant interest in online learning among students, indicating that many are keen to explore educational opportunities outside conventional classroom settings. Factors contributing to this engagement may include the accessibility of online platforms and the willingness of students to seek additional resources to complement their university education.

The high participation rate could also reflect the broader acceptance of digital solutions in education within the country. Türkiye's integration of technology into teaching and a growing emphasis on digital literacy may have contributed to the appeal of MOOCs among students seeking to enhance their skills or explore new fields of study.

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5.1.3. Romania

Romania has a moderate participation rate in MOOCs, with 40.3% of university students engaging in these online courses. This level of participation suggests a significant interest in digital learning but highlights room for growth in the adoption of MOOCs among the student population. The appeal of MOOCs in Romania may be driven by students' desire to access knowledge that is only sometimes available within their local academic institutions, particularly in specialised or emerging fields.

However, the participation rate also indicates that many students rely primarily on traditional learning methods. The potential for increased MOOC adoption in Romania could be realised through greater promotion of the benefits of these courses, improved internet accessibility, and awareness of global learning platforms.

5.1.4. Spain

Spain’s participation in MOOCs is relatively low, with only 16.8% of university students reporting involvement in these online courses. This suggests that MOOCs have not yet become a mainstream option for supplementary learning among Spanish students. Several factors could explain this low participation rate, such as a stronger preference for face-to-face learning or less emphasis on integrating online courses into university curricula.

The low adoption rate may also indicate a need for greater awareness about MOOCs' potential benefits and how they can complement traditional education. To increase MOOC engagement, educational institutions in Spain might consider integrating these courses into hybrid learning models or promoting them as valuable resources for skill development.

5.1.5. South Africa

In South Africa, 26.7% of university students participate in MOOCs, indicating moderate engagement with online learning platforms. This rate suggests that while there is interest in MOOCs, barriers such as access to stable internet connectivity or awareness of these resources may limit broader participation.

The uptake of MOOCs in South Africa could be influenced by the need for flexible learning opportunities, especially when some students may face geographical or financial challenges in accessing traditional education. Expanding internet infrastructure and increasing awareness of MOOCs' value could boost participation rates and allow more students to benefit from these flexible learning options.

5.1.6. Bulgaria

Bulgaria has a relatively high participation rate in MOOCs, with 49.5% of university students engaging in these courses. This suggests a strong interest in leveraging online learning to supplement traditional education. The high participation rate may reflect a recognition among Bulgarian students of the value that MOOCs can offer in gaining additional qualifications, exploring new subjects, or improving existing skills.

Factors contributing to this engagement may include the accessibility of digital platforms and students' willingness to pursue self-directed learning. However, there remains room to increase participation further through targeted campaigns that emphasise the benefits of MOOCs and the career advantages they can offer.

5.1.7. Germany

In Germany, 22.6% of university students participate in MOOCs, reflecting a relatively low level of engagement with these online learning platforms. This suggests that MOOCs have not yet become a central part of the educational experience for most students in Germany. Factors such as a strong preference for in-person learning or the availability of comprehensive educational resources within universities could explain this lower engagement.

To boost participation, there could be a focus on demonstrating how MOOCs can complement existing university courses, offering students a broader range of learning options. Highlighting the potential for MOOCs to provide access to niche subjects or global perspectives could also make these courses more appealing to German students.

5.1.8. Greece

Greece stands out with a very high MOOC participation rate, with 78.6% of university students reporting involvement in these courses. This suggests a widespread acceptance and recognition of the benefits that MOOCs can provide. The high rate may reflect a strong demand for alternative learning pathways and a proactive approach by students to enhance their knowledge and skills beyond what is offered in traditional university settings.

This level of engagement could be attributed to the promotion of online learning during periods of economic and educational challenges, where students sought to diversify their skills. Greece’s high MOOC engagement suggests a mature market for digital education, where students are open to exploring online resources to complement their formal studies.

5.1.9. Sweden

In Sweden, 43.6% of university students participate in MOOCs, indicating a moderate to high engagement with online courses. This participation rate suggests a balanced approach to integrating digital learning into academic routines. Swedish students appear to recognise the value of supplementing their university education with online resources, possibly due to a strong emphasis on digital literacy within the country’s educational system.

The relatively high rate may also reflect Sweden's strong technological infrastructure, which makes it easier for students to access online learning platforms. Continued promotion of MOOCs as valuable educational tools could further increase this engagement, helping students expand their academic horizons.

5.1.10. Slovakia

Slovakia has a low MOOC participation rate, with 17.8% of university students engaging in these courses. This suggests that online learning has yet to gain significant traction among the student population. The low rate may be due to a need for more awareness about MOOCs or limited integration of these courses into university curricula.

To increase participation, efforts could focus on raising awareness of MOOCs' benefits and how they can provide access to a wider range of topics and learning experiences. Additionally, improving access to reliable internet services and promoting MOOCs through academic institutions could help boost student engagement in Slovakia.

5.1.11. Israel

In Israel, 52.5% of university students participate in MOOCs, indicating a relatively high level of engagement with online learning platforms. This suggests that many students are interested in expanding their education through digital means. The high participation rate may be driven by the desire to access a diverse range of courses and the flexibility that MOOCs provide, allowing students to study at their own pace.

Israel's solid technological environment and its students' proactive approach to seeking additional learning opportunities could contribute to this high engagement. Well-established online learning platforms in the country may also facilitate this trend, making it easier for students to participate in MOOCs alongside formal studies.

5.2. Relevance of MOOCs for acquiring new skills

The following table provides an overview of the perceived relevance of Massive Open Online Courses (MOOCs) for acquiring new skills across several countries. It highlights the varying degrees of importance assigned to these courses, from not being relevant to being highly relevant, reflecting regional differences in how MOOCs are valued as a tool for skill development. This comparative analysis allows for a deeper understanding of MOOCs' role in different educational and professional contexts globally.

Table 5.2. Relevance of MOOCs for acquiring new skills

	Not Relevant at All	Slightly Relevant	Moderately Relevant	Very Relevant	Highly Relevant
Türkiye	7.3%	9.8%	32.5%	31.4%	19.1%
Romania	3.9%	6.5%	32.9%	34.5%	22.3%
Spain	9.9%	15.0%	48.0%	22.0%	5.2%
South Africa	10.9%	14.5%	25.6%	30.0%	19.1%
Bulgaria	8.7%	6.8%	36.9%	29.1%	18.4%
Germany	10.3%	17.2%	51.7%	20.7%	-
Greece	2.9%	33.0%	35.9%	28.2%	-
Sweden	10.3%	20.5%	30.8%	23.1%	15.4%
Slovakia	2.2%	22.2%	51.1%	11.1%	13.3%
Israel	6.5%	21.0%	24.2%	25.8%	22.6%

5.2.1. Comparative analysis

When comparing the countries, several patterns emerge. Germany and Slovakia stand out for their high proportions of respondents who find MOOCs moderately relevant, suggesting a cautious but positive stance towards these courses. Romania and Bulgaria, meanwhile, show the highest percentages of individuals who rate MOOCs as highly relevant, reflecting a more enthusiastic adoption of online learning for skill acquisition. On the other hand, Spain and South Africa exhibit relatively high levels of scepticism, with significant portions of their populations viewing MOOCs as either not relevant or only slightly relevant.

Greece is unique because it has a much higher proportion of respondents who find MOOCs only slightly relevant, indicating a broad but shallow acceptance of these courses. Sweden and Israel, while generally balanced, show that a substantial segment of their populations remains indifferent or critical of the relevance of MOOCs. Türkiye, South Africa, and Israel exhibit a more balanced distribution, where many respondents recognise MOOCs' value, but there is still some hesitancy or scepticism.

While MOOCs are generally seen as valuable for skill acquisition across the surveyed countries, the extent of their perceived relevance varies significantly. Romania and Bulgaria emerge as the most enthusiastic adopters, while Spain, South Africa, and Sweden show more scepticism. Germany and Slovakia, despite recognising the moderate utility of MOOCs, are more cautious about fully embracing them as essential learning tools. This diversity in perspectives underscores the complex nature of online education's role in different socio-economic and cultural contexts.

5.2.2. Türkiye

In Türkiye, the data reveals a generally positive perception of MOOCs for skill acquisition. The distribution indicates that 32.5% of respondents found MOOCs to be moderately relevant, with an additional 31.4% considering them very pertinent and 19.1% rating them as highly relevant. However, a notable proportion of individuals (7.3%) still see no relevance in these courses, while 9.8% perceive only slight relevance. This suggests that while most individuals recognise the value of MOOCs, a significant minority remains unconvinced or sceptical about their benefits.

5.2.3. Romania

Romanian respondents present a more favourable view of MOOCs than Türkiye. A relatively small portion (3.9%) regards these courses as irrelevant, and just 6.5% view them as slightly relevant. Most participants classify MOOCs as moderate (32.9%) or very relevant (34.5%). Furthermore, 22.3% rate them highly appropriate, the highest among the countries with a significant proportion in this category. This indicates strong recognition of MOOCs' role in skill development, and Romania stands out for its overall positive reception towards them.

5.2.4. Spain

In Spain, the perception of MOOCs is more mixed. A significant portion of the population (48.0%) views these courses as moderately relevant, representing the highest value for this category across all surveyed countries. However, the number of respondents who find MOOCs very or highly relevant is much lower (22.0% and 5.2%, respectively). Additionally, Spain has relatively high figures for those considering MOOCs irrelevant (9.9%) or only slightly relevant (15.0%). These numbers suggest a cautious or even lukewarm reception of MOOCs in Spain, where there is recognition of their potential but a reluctance to embrace them fully.

5.2.5. South Africa

South Africa displays a similar distribution to Türkiye, with a significant portion of respondents (30.0%) viewing MOOCs as very relevant and 19.1% as highly relevant. Interestingly, 25.6% of respondents find MOOCs moderately relevant, a smaller proportion than in other countries. In contrast, the percentages of those considering them irrelevant (10.9%) or only slightly relevant (14.5%) are also relatively high. This data suggests a balanced view, where MOOCs are respected for their potential, but a segment of the population remains indifferent or critical of their effectiveness.

5.2.6. Bulgaria

Bulgaria presents a somewhat optimistic view of MOOCs, though less overwhelmingly favourable than Romania. In this case, 36.9% of respondents find MOOCs moderately relevant, while 29.1% rate them as appropriate and 18.4% as highly relevant. The

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proportion of those considering MOOCs not applicable (8.7%) or slightly relevant (6.8%) is relatively low. This positions Bulgaria in a mid-tier category where a substantial portion of the population appreciates MOOCs, but they are only sometimes embraced with the same enthusiasm as Romania.

5.2.7. Germany

In Germany, the perception of MOOCs skews towards moderate relevance, with a notable 51.7% of respondents selecting this option. This is the highest percentage for this category across all countries in the dataset, indicating a cautious but strong recognition of MOOCs' importance for acquiring skills. However, only 20.7% consider them very relevant, and there are no data points for those who find MOOCs highly relevant. At the same time, a relatively high proportion (10.3%) believe MOOCs are inappropriate, while 17.2% perceive them as only slightly relevant. This paints a picture of Germany as a country where MOOCs are acknowledged for their utility, but there is some hesitation in viewing them as highly impactful.

5.2.8. Greece

Greece stands out for its unique distribution, where a substantial proportion (33.0%) finds MOOCs slightly relevant, much higher than in other countries. Additionally, 35.9% of respondents see MOOCs as moderately relevant, and 28.2% rate them as very appropriate. There are no respondents who consider MOOCs highly relevant in Greece, and only 2.9% find them irrelevant. The relatively low numbers for the extremes suggest a consensus in Greece that MOOCs have some utility, but they are not seen as particularly transformative or crucial for skill development.

5.2.9. Sweden

In Sweden, the opinions on MOOCs are relatively diverse, with 30.8% of respondents considering them moderately relevant and 23.1% viewing them as very relevant. Interestingly, Sweden has one of the higher percentages of respondents who see MOOCs as irrelevant (10.3%) and only slightly relevant (20.5%). Meanwhile, 15.4% of participants rate MOOCs as highly relevant, indicating that while a considerable portion of the population value MOOCs, there is also a significant level of scepticism or indifference regarding their importance.

5.2.10. Slovakia

Slovakia presents a distinctive distribution where over half of the respondents (51.1%) find MOOCs moderately relevant, among the highest values across all countries. However, only 11.1% see MOOCs as very relevant, and 13.3% regard them as highly relevant. Slovakia also shows one of the most diminutive proportions of individuals who find MOOCs not relevant at all (2.2%) or only slightly relevant (22.2%). This suggests a cautious but generally positive outlook towards MOOCs, where they are seen as helpful, but their transformative potential has yet to be widely recognised.

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5.2.11. Israel

In Israel, there is a fairly even distribution across the categories. 24.2% consider MOOCs moderately relevant, 25.8% rate them as very appropriate, and 22.6% believe they are highly relevant. The figures for those who see MOOCs as irrelevant (6.5%) or slightly relevant (21.0%) are moderate. Israel thus represents a balanced view where MOOCs are generally valued for their contribution to skill acquisition. Still, a significant portion of the population remains either indifferent or sceptical.

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6. Experience and perceptions regarding XR technologies in my field of study

6.1. Perceptions of XR technologies in learning and skills development

The following table provides an overview of students' perceptions regarding using XR technologies in learning and skills development across various countries. It highlights how respondents rate the added value of XR technologies in theoretical and practical learning experiences, their views on whether XR can improve learning outcomes, and their confidence in using these technologies within their respective fields of study. These insights help to understand the varying degrees of acceptance, trust, and perceived effectiveness of XR technologies in different educational environments.

Table 6.1. Perceptions of XR technologies in learning and skills development

	XR technologies provide added value to the **theoretical** learning experience.	XR technologies offer added value to the **practical** learning experience	**Improved learning** outcomes can be achieved through the use of XR technologies	I have the **capacities** required to use XR technologies in my field of study
Türkiye	3.87	4.14	4.10	3.33
Romania	3.86	4.09	4.04	3.55
Spain	3.25	3.73	3.60	3.18
South Africa	3.67	3.84	3.85	3.39
Bulgaria	3.43	3.77	3.76	3.29
Germany	2.97	3.77	3.27	2.47
Greece	4.15	4.33	4.32	3.52
Sweden	3.10	3.62	3.22	3.54
Slovakia	3.33	3.62	3.48	2.44
Israel	3.48	3.44	3.62	3.43

6.1.1. Comparative Analysis of XR Technologies Perceptions Across Countries

This section presents a comparative analysis of the perceptions of XR technologies in education across eight countries, based on four key variables: the added value of XR to theoretical learning, the added value to practical knowledge, the potential for improved learning outcomes through XR, and students' self-assessed capacity to use XR technologies.

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6.1.1.1. Added Value of XR to Theoretical Learning

The ratings for the added value of XR to theoretical learning reveal significant variations among countries. Greece stands out with the highest score of 4.15, indicating strong confidence in the ability of XR to enhance theoretical learning. In contrast, Germany ranks lowest with a score of 2.97, reflecting scepticism regarding the effectiveness of XR in this context. Other countries such as Türkiye (3.87) and Romania (3.86) display a moderately optimistic outlook, while Spain (3.25) and Slovakia (3.33) show a more reserved view. Sweden's score of 3.10 suggests that Swedish students are still exploring how XR can be effectively integrated into theoretical learning.

6.1.1.2. Added Value of XR to Practical Learning

When assessing the added value of XR to practical learning, Greece again leads with the highest score of 4.33, followed closely by Germany at 3.77 and Bulgaria at 3.77. This indicates a strong consensus among students in these countries that XR significantly enhances hands-on learning experiences. In contrast, Spain scored 3.73, while Türkiye (4.14) and Romania (4.09) also showed considerable agreement. Israel's rating of 3.44 suggests a moderate acceptance of XR's value in practical applications. The lowest score comes from Slovakia at 3.62, indicating a more cautious perspective on XR's practical utility.

6.1.1.3. Potential for Improved Learning Outcomes through XR

Regarding the potential for improved learning outcomes through XR technologies, Greece again ranks highest with a score of 4.32, suggesting a solid belief in XR's impact on academic performance. Türkiye (4.10) and Romania (4.04) closely follow, which show similar confidence in XR's potential benefits. Other countries, including South Africa (3.85) and Bulgaria (3.76), reflect moderate optimism regarding XR's role in enhancing learning outcomes. However, Spain, with a score of 3.60, and Germany, with 3.27, exhibit more reserved views on the effectiveness of XR for improving educational results.

6.1.1.4. Self-Assessed Capacity to Use XR Technologies

The results indicate varying confidence levels when examining students' self-assessed capacity to use XR technologies. Greece scores the highest at 3.52, indicating a reasonable self-evaluation of skills. Romania follows with 3.55, reflecting a similar level of confidence. Conversely, Germany reports the lowest self-assessment at 2.47, suggesting significant apprehension about using XR technologies. Türkiye's score of 3.33 and South Africa's 3.39 suggest moderate confidence, while Spain's 3.18 and Slovakia's 2.44 indicate a sense of inadequacy in utilising XR. This discrepancy across countries highlights the need for targeted training and resources to enhance students' ability to effectively engage with XR technologies.

The comparative analysis illustrates a clear divide in perceptions of XR technologies across the eight countries. Greece consistently scores highest across all four variables, reflecting a strong belief in the value of XR in both theoretical and practical contexts. In contrast,

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Germany exhibits a more sceptical perspective, particularly regarding theoretical learning and self-assessed capacity. Countries like Türkiye, Romania, and Bulgaria show moderate optimism regarding the potential benefits of XR technologies, while Spain, Sweden, and Slovakia present a more cautious stance. This analysis underscores the importance of context-specific educational strategies to enhance the effective use of XR technologies in various learning environments.

6.1.2. Türkiye

In Türkiye, students rated the added value of XR technologies for theoretical learning at 3.87 out of 5. This relatively high score suggests that Turkish students recognise the benefits of XR in enhancing their understanding of complex theoretical concepts. XR's ability to provide immersive experiences likely helps students engage more deeply with abstract subjects, which can otherwise be difficult to visualise.

Regarding practical learning, the perception improves further, with a rating of 4.14. This indicates that students find XR technologies beneficial for hands-on activities, likely because of their ability to simulate real-world environments where students can practise and refine their skills. The higher rating for practical learning suggests that students see XR as more beneficial for developing tangible, applicable skills than theory, where the technology’s immersive qualities may not always be as impactful.

The rating for improved learning outcomes through XR technologies stands at 4.10, showing strong belief among Turkish students that XR contributes to better educational performance. This implies that these technologies have the potential to enhance retention, understanding, and application of learned material, ultimately leading to improved results in both exams and practical applications. The high score in this category reinforces the idea that XR is seen as a valuable tool for enhancing the overall learning process.

However, there is a noticeable drop in the self-assessed capacities for using XR technologies, with a score of 3.33. While this score is still above average, it suggests that Turkish students may need more confidence in effectively utilising XR tools in their field of study. This lower score could indicate a gap in training or experience with these technologies, potentially limiting their ability to make the most of XR in their education. It’s possible that while students see the value in XR, they may feel underprepared to apply it independently, particularly in more specialised or advanced contexts.

Students in Türkiye view XR technologies positively, particularly in practical learning contexts where they find the technology most beneficial. The relatively high scores for theoretical learning and improved outcomes further highlight the potential of XR in enhancing education across different domains. However, the lower score for self-assessed capacity indicates a need for further training or resources to help students feel more confident and capable when using XR in their studies. This suggests that increasing hands-on experience and providing more targeted training could be the key to fully unlocking the potential of XR in Türkiye’s educational landscape.

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6.1.3. Romania

In Romania, the perceptions of XR technologies are quite positive across all categories. The added value of XR technologies for theoretical learning is rated at 3.86. This score indicates that Romanian students agree that XR enhances their theoretical learning experience. XR's ability to visually represent abstract ideas may help students understand complex theories that are harder to grasp through traditional teaching methods. Although not the highest score in the dataset, this number suggests that Romanian students find meaningful benefits from XR, primarily when visualising intricate or abstract content.

The score for XR's value in practical learning is even higher, at 4.09. Romanian students believe that XR is particularly effective in practical applications, reflecting its ability to simulate real-life situations where students can practice skills in a controlled environment. This high score suggests that XR is viewed as a crucial tool for skill development, providing interactive learning experiences that likely go beyond what traditional methods offer. The immersive nature of XR could significantly impact how students in Romania engage with hands-on tasks, allowing them to apply what they've learned in real-world contexts.

Romanian students also rated the ability of XR technologies to improve learning outcomes at 4.04. This score indicates a strong belief that using XR tools can lead to better academic performance and overall learning. The fact that this score is closely aligned with the ratings for both theoretical and practical learning suggests that students see XR technologies as beneficial for various aspects of their education, from conceptual understanding to skill application. It highlights XR's broad potential in creating an interactive and dynamic learning environment.

However, the rating for students' perceived capacity to use XR technologies in their field of study is slightly lower, at 3.55. While this is still a reasonably high score, it does indicate that some students in Romania may feel they need more confidence in their ability to use XR tools effectively. This gap between the perceived value of XR and students' confidence in using it could be due to limited access to these technologies or insufficient training. Despite the recognised benefits, the slightly lower score suggests room for improvement in equipping students with the necessary skills to leverage XR fully.

Romanian students show a strong appreciation for the value that XR brings to both theoretical and practical learning, and they recognise its ability to enhance their academic outcomes. However, the slight gap in their self-assessed ability to use XR suggests that more focus should be placed on ensuring students have adequate exposure and training. By addressing this, the educational potential of XR in Romania could be maximised, allowing students to understand its value and confidently apply it in their academic and professional endeavours.

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6.1.4. Spain

In Spain, the perception of XR technologies is somewhat mixed compared to other countries. The added value of XR technologies for theoretical learning receives a score of 3.25, which is lower than other nations. This suggests that Spanish students are not entirely convinced of XR's ability to enhance their theoretical learning experience. One possible explanation is that the benefits of XR in visualising abstract concepts may not be fully understood or appreciated in the educational context of Spain. Alternatively, access to XR technologies might be limited, making it harder for students to see its full potential in theoretical applications.

However, the score rises to 3.73 for practical learning, indicating a more positive perception. Spanish students recognise that XR technologies can provide value in practical settings, such as hands-on tasks or simulations. Although the score is still lower than in some other countries, it reflects a belief that XR can aid in skill development, likely through its ability to simulate real-world environments or allow students to practice more interactively. The technology holds more promise in practical applications, which suggests that with further implementation and exposure, students may become more confident in its use.

Improved learning outcomes through XR technologies are rated at 3.60 in Spain, again showing moderate agreement. This score suggests that students believe XR can enhance their academic performance somewhat, though they may view it as something other than a game-changing tool for significantly better results. The relatively cautious rating could reflect a lack of exposure to fully immersive XR experiences or a cultural hesitancy to embrace newer technologies without seeing proven results.

The lowest score for Spain comes from students' self-assessed capacities to use XR technologies, at 3.18. This indicates that Spanish students need more confidence in effectively utilising XR technologies in their field of study. The combination of moderate scores in perceived value and this lower score in self-confidence suggests that Spanish students might need more training or hands-on experience with these tools. Closing this gap with more robust educational initiatives or access to XR technologies could help students feel more comfortable and capable, thereby increasing their perceived value and ability to integrate XR into their learning.

Spanish students have a cautiously optimistic view of XR technologies, particularly in practical learning contexts. However, the relatively low scores across all categories suggest that more exposure and training are needed to help Spanish students fully embrace the potential benefits of XR.

6.1.5. South Africa

In South Africa, the perception of XR technologies is generally favourable. The added value of XR for theoretical learning is rated at 3.67, which suggests that students see XR as a helpful tool for understanding theoretical concepts. The score indicates that South African students recognise the benefits of XR's immersive capabilities, particularly in helping them visualise complex ideas or concepts that might be harder to grasp through traditional learning methods.

The score for XR's value in practical learning rises to 3.84, showing that South African students believe XR technologies are even more helpful for hands-on learning experiences. This higher score reflects the belief that XR can provide significant advantages in skill development, such as through interactive simulations or virtual practice scenarios. This aligns with the global trend where XR is seen as more effective in practical applications than purely theoretical learning, thanks to its ability to recreate real-world environments where students can practise without real-world consequences.

Improved learning outcomes through XR technologies are rated at 3.85, closely aligned with the practical learning score. This suggests that South African students feel that XR can directly contribute to better academic results, particularly in applied fields where hands-on learning is essential. The consistent scores across these categories reflect a strong belief that XR technologies can enhance the overall learning experience, leading to better comprehension and application of knowledge.

However, there is a slight dip in students' self-assessed capacity to use XR technologies, with a score of 3.39. While this score is not drastically low, it indicates that South African students feel somewhat less confident in using XR tools effectively in their studies. This gap between perceived value and self-confidence may be due to limited access to XR technology or insufficient training, which could prevent students from fully realising the potential of these tools in their educational journey.

South African students generally see the value in XR technologies, especially in practical learning contexts and improving learning outcomes. However, the slightly lower confidence in their ability to use these tools points to a need for greater access to and training in XR technologies, which could help students feel more prepared and capable of integrating these tools into their learning.

6.1.6. Bulgaria

In Bulgaria, the perceptions of XR technologies are relatively positive, although the scores are lower than in some other countries. The added value of XR for theoretical learning is rated at 3.43, indicating moderate agreement among Bulgarian students. While students acknowledge that XR technologies can enhance theoretical knowledge, they may only partially see it as transformative. The immersive aspects of XR might be less widely implemented or appreciated in Bulgaria's theoretical context, possibly due to limited exposure or resources.

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The value of XR in practical learning is rated higher, at 3.77, reflecting a stronger belief in its utility for hands-on activities. Bulgarian students agree that XR technologies provide valuable support in practical learning, likely through simulations or interactive learning environments that allow them to practise skills. This higher score aligns with global trends. XR is often seen as more beneficial in practical contexts where students can actively engage with content in a simulated real-world setting.

Improved learning outcomes through XR technologies receive a score of 3.76, closely matching the practical learning score. This suggests that Bulgarian students believe XR can help them achieve better results, especially in fields where hands-on learning and skill development are essential. The correlation between the scores for practical learning and learning outcomes indicates that students feel XR has the potential to impact their academic success directly.

However, the score for self-assessed capacity to use XR technologies in Bulgaria is somewhat lower, at 3.29. While this is still a fairly positive rating, Bulgarian students may feel slightly underprepared or lack the necessary skills to utilise XR technologies entirely in their studies. This gap between perceived value and self-confidence indicates that more training or access to these tools could be beneficial. Providing more opportunities for students to engage with XR technologies in a structured learning environment could help build their confidence and improve their ability to leverage XR for theoretical and practical purposes.

Bulgarian students consider XR technologies valuable for practical learning and improved outcomes. However, their slightly lower self-assessed capacity suggests a need for more support in developing their skills in using these tools effectively, which could lead to greater confidence and higher perceived value.

6.1.7. Germany

In Germany, the perception of XR technologies is notably more reserved compared to other countries. The added value of XR for theoretical learning receives a relatively low score of 2.97, indicating that German students are somewhat sceptical of XR's ability to enhance theoretical education. This score suggests that students may not yet fully see the benefits of XR in helping to understand complex concepts, or perhaps XR technologies have not been widely implemented in a way that showcases their potential in theoretical learning contexts.

The score improves to 3.77 for practical learning, suggesting that German students see more value in XR technologies when applied to hands-on activities. The ability of XR to simulate real-world scenarios may be more appealing to students in practical fields where skill development is crucial. However, the fact that the score remains moderate indicates that while students recognise the potential benefits of XR, they may not see it as a game-changer for practical learning just yet.

The score for improved learning outcomes through XR technologies is 3.27, reflecting moderate agreement. German students seem to feel that XR can contribute to better academic performance. Still, the relatively low score compared to other countries suggests

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that they may not believe it leads to significantly better outcomes. This could be due to a lack of exposure to XR technologies in education or a more cautious approach to adopting new technologies within the German educational system.

The lowest score for Germany comes from students' self-assessed capacities to use XR technologies, at 2.47. This score indicates that German students feel considerably underprepared to use XR tools in their field of study. The combination of relatively low scores across all categories suggests that XR technologies may still need to be widely integrated into German educational environments or that students need more training to use these tools. As a result, they may feel they need more confidence in their ability to apply XR effectively, limiting their perceived value of the technology.

In conclusion, while German students acknowledge some potential for XR technologies, particularly in practical learning contexts, their overall scepticism and low confidence suggest that XR's exposure, training, and integration into education are needed to unlock its full potential in Germany.

6.1.8. Greece

In Greece, perceptions of XR technologies are among the most positive across all countries surveyed. The added value of XR for theoretical learning is rated at 4.15, indicating that Greek students strongly believe in XR’s ability to enhance their understanding of theoretical concepts. This high score suggests that the immersive nature of XR is particularly effective in helping students visualise and engage with abstract or complex material, making it easier to comprehend.

The score for practical learning is even higher, at 4.33, reflecting a strong belief in the utility of XR for hands-on learning experiences. Greek students seem to find significant value in XR's interactive and immersive qualities, which allow them to practice and develop skills in a more dynamic and engaging way. This high score for practical learning indicates that XR is seen as a crucial tool for skill development, especially in fields where hands-on practice is essential.

Improved learning outcomes through XR technologies also receive a high score of 4.32, suggesting that Greek students are confident that using XR can lead to better academic performance. This substantial agreement indicates a collective belief that XR technologies can enhance their learning experiences and positively impact their educational outcomes. The consistently high scores across the categories reflect a robust recognition of XR's potential to transform educational practices in Greece.

However, the score for self-assessed capacity to use XR technologies is 3.52, which, while still positive, indicates a moderate level of uncertainty among Greek students about their skills in utilising these tools effectively. Although they perceive the value of XR, they may feel somewhat underprepared or need more training to apply XR technologies confidently in their studies. This gap between perceived value and self-assessed ability suggests an opportunity for educational institutions to focus on increasing access to XR resources and providing comprehensive student training.

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The strong perception of XR technologies in Greece highlights an encouraging trend towards embracing innovative learning tools. It suggests that students are ready to adopt XR in their educational journeys, but the educational system must also support this transition by offering training and resources. By addressing the slight deficit in students' self-confidence regarding XR, Greek educational institutions can further leverage the potential of XR technologies to enhance learning and skill development.

Greek students have a very positive outlook on XR technologies, particularly for theoretical and practical learning, and they strongly believe they can improve learning outcomes. However, to maximise the benefits of XR, it is essential to bolster training and support to enhance students' confidence and ability to use these technologies effectively in their academic pursuits.

6.1.9. Sweden

In Sweden, perceptions of XR technologies reflect a cautiously optimistic view. The added value of XR for theoretical learning is rated at 3.10, indicating that while students recognise some benefits, they do not strongly agree on the effectiveness of XR in enhancing theoretical education. This score suggests that Swedish students are still discovering how XR can be applied to abstract concepts and theories, indicating a need for more integration of these technologies into the theoretical curriculum.

The score for XR's value in practical learning rises to 3.62, showing that students are more convinced of its usefulness in hands-on activities. This higher rating indicates that Swedish students see XR as beneficial in practical settings, where simulations and interactive environments allow them to apply their knowledge and develop skills more engagingly. This suggests that while theoretical learning may be viewed with some scepticism, the practical applications of XR are more readily embraced.

The rating for improved learning outcomes through XR technologies is relatively low at 3.22. This indicates that while students see the potential for XR to enhance their educational experiences, they still need to believe it leads to significantly better results. This cautious perspective may be influenced by limited exposure to practical XR implementations or a preference for traditional learning methods proven over time.

Students' self-assessed capacity to use XR technologies is rated at 3.54, reflecting moderate confidence in their abilities. While this score suggests that Swedish students feel relatively capable of using XR, it also highlights that there is still room for improvement. The combination of moderate scores across the categories indicates that while students recognise the potential of XR, there may be barriers to fully engaging with the technology, such as access or training limitations.

Swedish students are cautious but open about XR technologies, particularly in practical learning contexts. However, their relatively low scores in theoretical learning and improved outcomes suggest that further efforts are needed to integrate XR more effectively into the educational landscape. By providing greater access and support for XR technologies, Swedish educational institutions can help students better understand and utilise these tools, enhancing their learning experience.

6.1.10. Slovakia

In Slovakia, perceptions of XR technologies are mixed, with varying levels of agreement across different categories. The added value of XR for theoretical learning is rated at 3.33, indicating a moderate level of acceptance. This suggests that Slovak students recognise some benefits of XR in theoretical contexts but may still need to believe in its transformative potential fully. The score may reflect a lack of exposure to XR technologies in educational settings, resulting in uncertainty about their effectiveness in enhancing understanding abstract concepts.

However, the value of XR for practical learning receives a more favourable score of 3.62, indicating that Slovak students are more optimistic about its application in hands-on experiences. This higher rating suggests that students see XR as beneficial for skill development and practical applications, where immersive simulations can enhance engagement and learning outcomes. The positive perception of XR in practical contexts aligns with the global trend of students valuing experiential learning facilitated by advanced technologies.

The score for improved learning outcomes through XR technologies is slightly lower at 3.48, indicating a moderate belief that XR can contribute to better academic performance. This score reflects a cautious optimism, suggesting that while students see potential benefits, they may not consider XR a guaranteed method for significantly improving learning outcomes. This perspective may stem from limited exposure to XR technologies and a need for established evidence demonstrating their effectiveness in enhancing educational results.

The lowest self-assessed capacity to use XR technologies is 2.44. This score indicates that Slovak students need to prepare to use XR tools effectively in their studies. The disparity between the perceived value of XR and students' self-confidence suggests a need for greater access to training and resources that can help bridge this gap. Enhancing students' skills in using XR technologies could increase confidence and a stronger belief in its value for theoretical and practical learning.

Slovak students moderately perceive XR technologies, particularly valuing their practical applications. However, the lower self-assessed capacity highlights the need for more training and resources to empower students to engage effectively with XR. By addressing these challenges, educational institutions in Slovakia can unlock the full potential of XR technologies to enhance learning and skill development.

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6.1.11. Israel

In Israel, the perceptions of XR technologies are generally positive across the board. The added value of XR for theoretical learning is rated at 3.48, indicating moderate agreement among Israeli students. This suggests that while students recognise some benefits of XR in enhancing theoretical understanding, they may not see it as a revolutionary tool for learning complex concepts. This score reflects a cautious optimism, as students are beginning to appreciate how XR can make abstract theories more accessible and engaging.

The score increases to 3.44 for practical learning, demonstrating a more favourable view of XR's utility in hands-on experiences. Israeli students appear to believe that XR technologies provide significant value for skill development and practical application. This higher score aligns with the global general trend. XR is often viewed as a powerful tool for immersive learning, enabling students to practice and apply their skills in a safe and controlled environment.

The score for improved learning outcomes through XR technologies is rated at 3.62, suggesting that Israeli students feel these tools can enhance their academic performance. This higher score indicates a strong belief that XR can contribute to their overall educational success, reinforcing that immersive experiences lead to better retention and understanding of the material. The positive perception of XR in this context reflects a growing recognition of its potential to transform educational experiences.

However, the self-assessed capacity to use XR technologies is rated at 3.43, indicating that while students feel reasonably capable of using XR, there is still room for improvement. This score suggests that while students see the value in XR, they may feel underprepared to leverage these technologies fully in their studies. This gap between perceived value and self-assessment underscores the need for educational institutions to provide better access to XR technologies and training, ensuring that students feel confident in their abilities to utilise these tools effectively.

Israeli students generally perceive XR technologies positively, particularly in enhancing practical learning and improving outcomes. However, to maximise the benefits of XR in education, it is essential to strengthen training and support systems that empower students to engage fully with these technologies. By addressing the slight deficit in self-assessed capacity, educational institutions in Israel can unlock the transformative potential of XR technologies, paving the way for richer learning experiences.

6.2. Competencies for effective use of XR technologies

The following table outlines the competencies essential for students across various countries to use XR technologies effectively. It highlights the relevance of skills such as creativity, technical literacy, adaptability to new interfaces, safety awareness, and understanding of XR's ethical implications. It also examines the importance of technical and creative design skills in leveraging these advanced technologies. By capturing students' perceptions of these competencies, the table provides valuable insights into the skills needed to navigate and utilise XR effectively in educational settings. This information can serve as a foundation for

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developing targeted training programs that equip students with the abilities to thrive in an increasingly technology-driven learning environment.

Table 6.2. Competencies for effective use of XR technologies

	Creativity	Technical Literacy	Adaptability to New Interfaces	Safety Awareness	Understanding the Ethics Surrounding XR	Technical Design Skills	Creative Design Skills
Türkiye	4.04	4.31	4.26	4.22	4.18	4.1	4.12
Romania	3.86	4.09	4.2	3.98	3.89	3.4	3.48
Spain	3.75	3.75	3.8	3.56	3.54	3.65	3.72
South Africa	3.59	3.76	3.74	3.71	3.57	3.65	3.73
Bulgaria	3.57	3.97	3.9	3.47	3.52	3.45	3.5
Germany	3.03	4.1	3.5	3.3	3.41	2.87	2.8
Greece	4.15	4.32	4.24	4.17	4.13	4.05	4.12
Sweden	3.65	3.75	3.85	3.52	3.03	3.35	3.5
Slovakia	2.84	3.82	3.89	3.69	3.8	2.93	3.07
Israel	3.45	3.6	3.7	3.74	3.64	3.54	3.51

6.2.1. Comparative Analysis of Competencies for Effective Use of XR Technologies

In the realm of creativity, Türkiye and Greece stand out with scores of 4.04 and 4.15, respectively, indicating a strong belief in the relevance of creativity for the effective use of XR technologies. Romania follows with a score of 3.86, showing a moderate emphasis on creativity. Spain and South Africa score around 3.75 and 3.59, respectively, reflecting moderate relevance. Bulgaria and Sweden score similarly at 3.57 and 3.65, indicating a mild emphasis on creativity. Germany and Slovakia, however, score the lowest at 3.03 and 2.84, respectively, suggesting a lesser focus on creativity. Israel scores 3.45, indicating a moderate relevance. The implications of these findings suggest that countries like Türkiye and Greece may have a more innovative approach to integrating XR technologies. In contrast, countries like Germany and Slovakia may need to emphasise fostering creativity to leverage XR technologies fully.

Regarding technical literacy, Greece leads with a score of 4.32, highlighting the importance of operating devices. Türkiye follows closely with a score of 4.31, showing a strong emphasis on technical literacy. Germany also scores high at 4.10, indicating its importance. Romania and Bulgaria score 4.09 and 3.97, respectively, reflecting a good level of technical literacy. Spain and Sweden score 3.75, showing a moderate emphasis on technical literacy. South Africa scores 3.76, indicating a moderate relevance. Slovakia and Israel scored 3.82 and 3.60, respectively, showing moderate emphasis. The implications suggest that countries with higher technical literacy scores are better prepared to handle the technical aspects of

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XR technologies. In comparison, those with lower scores may need to invest in technical training and education.

Adaptability to new interfaces is another crucial competency. Türkiye scores the highest at 4.26, reflecting the importance of being flexible with the latest technologies. Greece follows with a score of 4.24, indicating a similar high regard for adaptability. Romania and Slovakia score 4.20 and 3.89, respectively, showing good importance. South Africa and Bulgaria score 3.74 and 3.90, respectively, indicating a moderate need for flexibility. Spain and Sweden scored 3.80 and 3.85, respectively, showing moderate emphasis. Germany scores the lowest at 3.50, indicating moderate relevance. Israel scores 3.70, reflecting a mild need for adaptability. The implications suggest that countries with higher adaptability scores are more likely to integrate and utilise new XR technologies successfully. In comparison, those with lower scores may face challenges adapting to new interfaces.

Safety awareness is another critical competency. Türkiye scores the highest at 4.22, underscoring the significance of understanding safety protocols. Greece follows closely with a score of 4.17, showing a similar high regard for safety awareness. Romania and Slovakia score 3.98 and 3.69, respectively, indicating good importance. South Africa and Bulgaria score 3.71 and 3.47, respectively, showing moderate importance. Spain and Sweden score 3.52, indicating a mild emphasis on safety awareness. Germany scores the lowest at 3.30, indicating moderate relevance. Israel scores 3.74, showing a good level of importance. The implications suggest that countries with higher safety awareness scores are better prepared to handle the safety aspects of XR technologies. In comparison, those with lower scores may need to invest in safety training and protocols.

Understanding the ethics surrounding XR is another crucial competency. Türkiye scores the highest at 4.18, highlighting the importance of ethical considerations. Greece follows with a score of 4.13, indicating a similar high regard for ethics. Romania and Slovakia score 3.89 and 3.80, respectively, showing good importance. South Africa and Bulgaria score 3.57 and 3.52, respectively, indicating a moderate relevance. Spain and Sweden scored 3.54 and 3.03, respectively, showing moderate emphasis. Germany scores 3.41, indicating a moderate relevance. Israel scores 3.64, showing a good level of importance. The implications suggest that countries with higher ethics scores are more likely to consider the ethical implications of XR technologies. In comparison, those with lower scores may need to invest in ethics training and education.

Technical design skills are also crucial for the effective use of XR technologies. Türkiye scores the highest at 4.10, indicating a strong belief in the relevance of technical design skills. Greece follows closely with a score of 4.05, showing a similar high regard for technical design skills. Romania and Slovakia score 3.40 and 2.93, respectively, indicating a moderate relevance. South Africa and Bulgaria score 3.65 and 3.45, respectively, showing a moderate emphasis. Spain and Sweden scored 3.65 and 3.35, respectively, indicating moderate relevance. Germany scores the lowest at 2.87, suggesting a lesser focus on technical design skills. Israel scores 3.54, showing a moderate relevance. The implications suggest that countries with higher technical design skills scores are better prepared to handle the technical aspects of XR technologies. In comparison, those with lower scores may need to invest in technical design training and education.

Creative design skills are also crucial for the effective use of XR technologies. Türkiye and Greece score 4.12, indicating a strong belief in the relevance of creative design skills. Romania and Slovakia score 3.48 and 3.07, respectively, indicating a moderate relevance. South Africa and Bulgaria score 3.73 and 3.50, respectively, showing a moderate emphasis. Spain and Sweden score 3.72 and 3.50, respectively, indicating a moderate relevance. Germany scores the lowest at 2.80, suggesting a lesser focus on creative design skills. Israel scores 3.51, showing a moderate relevance. The implications suggest that countries with higher creative design skills scores are better prepared to handle the creative aspects of XR technologies. In contrast, those with lower scores may need to invest in creative design training and education.

Overall, the comparative analysis reveals that Türkiye and Greece consistently score high across all competencies, indicating a strong belief in the relevance of these skills for effective use of XR technologies. This suggests that these countries are well-prepared to integrate and utilise XR technologies effectively. On the other hand, Germany and Slovakia tend to score lower across most competencies, suggesting a more moderate emphasis on these skills. This indicates that these countries may need to invest more in training and education to fully leverage XR technologies' potential. The other countries fall somewhere in between, showing varying levels of importance placed on these skills. This analysis highlights the need for a balanced approach to developing competencies for effective use of XR technologies, with a focus on technical and creative skills and safety and ethical considerations.

6.2.2. Türkiye

In Türkiye, the competencies for effective use of XR technologies are rated highly across all categories. Creativity scores an average of 4.04, indicating a strong belief in its relevance. Technical Literacy is rated even higher at 4.31, showing that operating devices are crucial. Adaptability to New Interfaces also scores high at 4.26, reflecting the importance of being flexible with new technologies. Safety Awareness is rated at 4.22, underscoring the significance of understanding safety protocols. Understanding the Ethics Surrounding XR is rated at 4.18, highlighting the importance of ethical considerations. Technical Design Skills and Creative Design Skills are rated at 4.10 and 4.12, respectively, indicating that both technical and creative aspects are valued.

6.2.3. Romania

The competencies are also rated positively in Romania, though slightly lower than in Türkiye. Creativity scores 3.86, showing moderate relevance. Technical Literacy is rated at 4.09, indicating its importance. Adaptability to New Interfaces scores 4.20, reflecting a strong need for flexibility. Safety Awareness is rated at 3.98, showing a good level of importance. Understanding the Ethics Surrounding XR scores 3.89, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 3.40 and 3.48, respectively, showing a moderate emphasis on these skills.

6.2.4. Spain

In Spain, the ratings are generally moderate. Creativity scores 3.75, indicating a moderate relevance. Technical Literacy is also rated at 3.75, showing its importance. Adaptability to New Interfaces scores 3.80, reflecting a mild need for flexibility. Safety Awareness is rated at 3.56, showing a moderate level of importance. Understanding the Ethics Surrounding XR scores 3.54, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 3.65 and 3.72, respectively, showing a moderate emphasis on these skills.

6.2.5. South Africa

In South Africa, the competencies are rated moderately to highly. Creativity scores 3.59, indicating moderate relevance. Technical Literacy scores 3.76, showing its importance. Adaptability to New Interfaces scores 3.74, reflecting a moderate need for flexibility. Safety Awareness scores 3.71, showing a good level of importance. Understanding the Ethics Surrounding XR scores 3.57, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 3.65 and 3.73, respectively, showing a moderate emphasis on these skills.

6.2.6. Bulgaria

In Bulgaria, the competencies are rated moderately to highly. Creativity scores 3.57, indicating moderate relevance. Technical Literacy is rated at 3.97, showing its importance. Adaptability to New Interfaces scores 3.90, reflecting a mild need for flexibility. Safety Awareness is rated at 3.47, showing a moderate level of importance. Understanding the Ethics Surrounding XR scores 3.52, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 3.45 and 3.50, respectively, showing a moderate emphasis on these skills.

6.2.7. Germany

In Germany, the competencies are rated moderately. Creativity scores 3.03, indicating moderate relevance. Technical Literacy is rated at 4.10, showing its importance. Adaptability to New Interfaces scores 3.50, reflecting a mild need for flexibility. Safety Awareness is rated at 3.30, showing a moderate level of importance. Understanding the Ethics Surrounding XR scores 3.41, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 2.87 and 2.80, respectively, emphasising these skills less.

6.2.8. Greece

In Greece, the competencies are rated highly across all categories. Creativity scores 4.15, indicating a strong belief in its relevance. Technical Literacy is rated even higher at 4.32, showing that operating devices are crucial. Adaptability to New Interfaces also scores high at 4.24, reflecting the importance of being flexible with new technologies. Safety Awareness is rated at 4.17, underscoring the significance of understanding safety protocols. Understanding the Ethics Surrounding XR is rated at 4.13, highlighting the importance of ethical considerations. Technical Design Skills and Creative Design Skills are rated at 4.05 and 4.12, respectively, indicating that both technical and creative aspects are valued.

6.2.9. Sweden

In Sweden, the competencies are rated moderately. Creativity scores were 3.65, indicating moderate relevance. Technical Literacy scores 3.75, showing its importance. Adaptability to New Interfaces scores 3.85, reflecting a moderate need for flexibility. Safety Awareness scores 3.52, showing a moderate level of importance. Understanding the Ethics Surrounding XR scores 3.03, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 3.35 and 3.50, respectively, showing a moderate emphasis on these skills.

6.2.10. Slovakia

In Slovakia, the competencies are rated moderately. Creativity scores 2.84, indicating moderate relevance. Technical Literacy scores 3.82, showing its importance. Adaptability to New Interfaces scores 3.89, reflecting a moderate need for flexibility. Safety Awareness scores 3.69, showing a good level of importance. Understanding the Ethics Surrounding XR scores 3.80, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 2.93 and 3.07, respectively, showing a moderate emphasis on these skills.

6.2.11. Israel

In Israel, the competencies are rated moderately. Creativity scores 3.45, indicating moderate relevance. Technical Literacy scores 3.60, showing its importance. Adaptability to New Interfaces scores 3.70, reflecting a moderate need for flexibility. Safety Awareness scores 3.74, showing a good level of importance. Understanding the Ethics Surrounding XR scores 3.64, indicating ethical considerations are moderately important. Technical Design Skills and Creative Design Skills are rated at 3.54 and 3.51, respectively, showing a moderate emphasis on these skills.

6.3. Self-perceived competency levels in XR technologies

This section of the report analyses self-perceived competency levels in various areas related to XR technologies. The data has been organised into a table highlighting the respondents' self-assessed proficiency in critical competencies such as creativity, technical literacy, adaptability to new interfaces, safety awareness, understanding of ethics surrounding XR, technical design skills, and creative design skills. The table provides a comparative view of these competencies across different countries, offering valuable insights into how individuals perceive their abilities in the context of XR technologies.

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Table 6.3. Self-perceived competency levels in XR technologies

	Creativity	Technical Literacy	Adaptability to New Interfaces	Safety Awareness	Understanding the Ethics Surrounding XR	Technical Design Skills	Creative Design Skills
Türkiye	3.73	3.76	3.85	3.93	3.75	3.45	3.56
Romania	3.69	3.58	3.97	3.92	3.40	2.84	3.08
Spain	3.38	3.23	3.40	3.36	3.22	2.85	3.07
South Africa	3.64	3.64	3.71	3.72	3.38	3.39	3.51
Bulgaria	4.00	4.05	3.82	3.50	3.07	3.08	3.35
Germany	3.27	3.40	3.23	3.47	2.90	2.47	2.77
Greece	3.78	3.40	4.01	3.08	2.92	3.14	3.47
Sweden	3.65	4.18	4.40	3.83	3.07	3.38	3.30
Slovakia	3.36	3.18	3.33	3.07	2.71	2.77	2.86
Israel	3.36	3.31	3.56	3.43	3.30	3.20	3.36

6.3.1. Comparative analysis of self-perceived competency levels in XR technologies

6.3.1.1. Creativity

In terms of creativity, Bulgaria leads with a score of 4.00, indicating a very high level of confidence. Greece follows with a score of 3.78, showing a high level of confidence. Türkiye and South Africa also score high at 3.73 and 3.64, respectively. Sweden and Romania score similarly at 3.65 and 3.69, indicating a high level of confidence. Israel and Slovakia both score 3.36, reflecting a moderate level of confidence. Spain and Germany score the lowest at 3.38 and 3.27, respectively, indicating a moderate level of confidence. The implications suggest that countries like Bulgaria and Greece may have a more innovative approach to integrating XR technologies, while countries like Spain and Germany may need to place more emphasis on fostering creativity to fully leverage XR technologies.

6.3.1.2. Technical Literacy

Sweden leads in technical literacy with a score of 4.18, highlighting a very strong belief in the ability to operate devices. Bulgaria follows closely with a score of 4.05, showing a strong emphasis on technical literacy. Türkiye and South Africa both score 3.76 and 3.64, respectively, indicating a high level of proficiency. Greece and Germany score similarly at 3.40, showing a moderate proficiency. Romania and Israel score 3.58 and 3.31, respectively, indicating a moderate level of proficiency. Spain and Slovakia score the lowest at 3.23 and 3.18, respectively, indicating a moderate level of proficiency. The implications suggest that countries with higher technical literacy scores are better prepared to handle the technical aspects of XR technologies, while those with lower scores may need to invest in technical training and education.

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6.3.1.3. Adaptability to New Interfaces

Sweden scores the highest in adaptability to new interfaces with a score of 4.40, reflecting a very high level of flexibility. Greece follows with a score of 4.01, indicating a strong belief in flexibility with new technologies. Romania and Türkiye score similarly at 3.97 and 3.85, respectively, showing a high level of importance. Bulgaria and South Africa score 3.82 and 3.71, respectively, indicating a high level of flexibility. Israel and Spain score 3.56 and 3.40, respectively, showing a moderate level of flexibility. Germany and Slovakia score the lowest at 3.23 and 3.33, respectively, indicating a moderate level of flexibility. The implications suggest that countries with higher adaptability scores are more likely to successfully integrate and utilise new XR technologies, while those with lower scores may face challenges in adapting to new interfaces.

6.3.1.4. Safety Awareness

Türkiye scores the highest in safety awareness with a score of 3.93, underscoring the significance of understanding safety protocols. Romania follows closely with a score of 3.92, showing a similar high regard for safety awareness. Sweden and South Africa scored 3.83 and 3.72, respectively, indicating high importance placed on safety. Bulgaria and Germany score 3.50 and 3.47, respectively, moderately emphasising safety. Israel and Spain score 3.43 and 3.36, respectively, indicating moderate importance. Greece and Slovakia score the lowest at 3.08 and 3.07, respectively, indicating a moderate relevance. The implications suggest that countries with higher safety awareness scores are better prepared to handle the safety aspects of XR technologies. In comparison, those with lower scores may need to invest in safety training and protocols.

6.3.1.5. Understanding the Ethics Surrounding XR

Türkiye scores the highest in understanding the ethics surrounding XR with a score of 3.75, highlighting the importance of ethical considerations. Romania follows with a score of 3.40, indicating a moderate emphasis on ethics. South Africa and Israel score similarly at 3.38 and 3.30, respectively, showing moderate importance. Sweden and Spain score 3.07 and 3.22, respectively, indicating moderate relevance. Bulgaria and Greece score 3.07 and 2.92, respectively, emphasising ethics moderately. Germany and Slovakia score the lowest at 2.90 and 2.71, respectively, indicating a lower importance placed on ethical considerations. The implications suggest that countries with higher ethics scores are more likely to consider the moral consequences of XR technologies. In comparison, those with lower scores may need to invest in ethics training and education.

6.3.1.6. Technical Design Skills

Türkiye scores the highest in technical design skills with a score of 3.45, indicating a strong belief in the relevance of technical design skills. South Africa and Sweden follow closely with scores of 3.39 and 3.38, respectively, showing a similar high regard for technical design skills. Greece and Israel score 3.14 and 3.20, respectively, indicating a good level of proficiency. Bulgaria and Spain score 3.08 and 2.85, respectively, showing moderate relevance. Romania and Slovakia score 2.84 and 2.77, respectively, indicating a moderate level of proficiency. Germany scores the lowest at 2.47, suggesting a lesser emphasis on technical design skills. The implications suggest that countries with higher technical design skills scores are better prepared to handle the technical aspects of XR technologies. In comparison, those with lower scores may need to invest in technical design training and education.

6.3.1.7. Creative Design Skills

Türkiye and South Africa score the highest in creative design skills, with scores of 3.56 and 3.51, respectively, indicating a strong belief in the relevance of creative design skills. Greece and Israel follow closely with scores of 3.47 and 3.36, respectively, showing a similar high regard for creative design skills. Bulgaria and Sweden score 3.35 and 3.30, respectively, indicating a good level of proficiency. Romania and Spain score 3.08 and 3.07, respectively, showing moderate relevance. Slovakia and Germany score the lowest at 2.86 and 2.77, respectively, indicating a moderate level of proficiency. The implications suggest that countries with higher creative design skills scores are better prepared to handle the creative aspects of XR technologies. In contrast, those with lower scores may need to invest in creative design training and education.

The comparative analysis reveals varying levels of self-perceived competency across different countries. Sweden, Türkiye, and Bulgaria consistently score high across most variables, indicating a strong belief in their abilities to handle various aspects of XR technologies. On the other hand, Germany and Slovakia tend to score lower, suggesting a need for improvement in several areas. The other countries fall somewhere in between, showing high and moderate ratings. This analysis highlights the importance of targeted training and education to enhance competencies in XR technologies, with a focus on technical and creative skills and safety and ethical considerations.

6.3.2. Türkiye

In Türkiye, the self-perceived competency levels are relatively high across all variables. Creativity is rated at 3.73, indicating high confidence in creative abilities. Technical Literacy scores 3.76, showing a strong belief in the ability to operate devices. Adaptability to New Interfaces is rated at 3.85, reflecting high flexibility with new technologies. Safety Awareness scores the highest at 3.93, underscoring the importance of understanding safety protocols. Understanding the Ethics Surrounding XR is rated at 3.75, highlighting the significance of ethical considerations. Technical Design Skills and Creative Design Skills are rated at 3.45 and 3.56, respectively, indicating a good level of proficiency in both technical and creative aspects. The implications suggest that individuals in Türkiye feel well-prepared to handle various aspects of XR technologies, emphasising safety and adaptability.

6.3.3. Romania

In Romania, the self-perceived competency levels show high and moderate ratings. Creativity is rated at 3.69, indicating a moderate to high confidence level. Technical Literacy scores 3.58, showing good proficiency in operating devices. Adaptability to New Interfaces is rated the highest at 3.97, reflecting a solid belief in flexibility with new technologies. Safety

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Awareness scores 3.92, indicating a high importance placed on safety. Understanding the Ethics Surrounding XR is rated at 3.40, emphasising moderate ethical considerations. Technical Design Skills and Creative Design Skills are rated at 2.84 and 3.08, respectively, indicating a moderate level of proficiency. The implications suggest that individuals in Romania feel confident in their adaptability and safety awareness but may need to improve their technical and creative design skills.

6.3.4. Spain

In Spain, the self-perceived competency levels are generally moderate. Creativity is rated at 3.38, indicating a moderate level of confidence. Technical Literacy scores 3.23, showing a moderate proficiency in operating devices. Adaptability to New Interfaces is rated at 3.40, reflecting moderate flexibility. Safety Awareness scores 3.36, indicating a moderate emphasis on safety. Understanding the Ethics Surrounding XR is rated at 3.22, showing a moderate importance placed on ethical considerations. Technical Design Skills and Creative Design Skills are rated at 2.85 and 3.07, respectively, indicating a moderate level of proficiency. The implications suggest that individuals in Spain may need to improve their competencies across all areas to leverage XR technologies fully.

6.3.5. South Africa

In South Africa, the self-perceived competency levels are relatively high. Creativity is rated at 3.64, indicating a high level of confidence. Technical Literacy scores 3.64, showing a strong belief in the ability to operate devices. Adaptability to New Interfaces is rated at 3.71, reflecting high flexibility. Safety Awareness scores 3.72, indicating a high importance placed on safety. Understanding the Ethics Surrounding XR is rated at 3.38, emphasising moderate ethical considerations. Technical Design Skills and Creative Design Skills are rated at 3.39 and 3.51, respectively, indicating a good level of proficiency in both technical and creative aspects. The implications suggest that individuals in South Africa feel well-prepared to handle various aspects of XR technologies, with a particular emphasis on creativity and safety.

6.3.6. Bulgaria

In Bulgaria, the self-perceived competency levels are generally high. Creativity is rated at 4.00, indicating a very high level of confidence. Technical Literacy scores 4.05, showing a strong belief in the ability to operate devices. Adaptability to New Interfaces is rated at 3.82, reflecting high flexibility. Safety Awareness scores 3.50, indicating a moderate emphasis on safety. Understanding the Ethics Surrounding XR is rated at 3.07, showing a moderate importance placed on ethical considerations. Technical Design Skills and Creative Design Skills are rated at 3.08 and 3.35, respectively, indicating a good level of proficiency. The implications suggest that individuals in Bulgaria feel highly confident in their creative and technical abilities but may need to improve their understanding of ethics and safety awareness.

6.3.7. Germany

In Germany, the self-perceived competency levels are generally moderate. Creativity is rated at 3.27, indicating a moderate level of confidence. Technical Literacy scores 3.40, showing a moderate proficiency in operating devices. Adaptability to New Interfaces is rated at 3.23, reflecting moderate flexibility. Safety Awareness scores 3.47, indicating a mild emphasis on safety. Understanding the Ethics Surrounding XR is rated at 2.90, showing lower importance placed on ethical considerations. Technical Design Skills and Creative Design Skills are rated at 2.47 and 2.77, respectively, indicating a lower level of proficiency. The implications suggest that individuals in Germany may need to improve their competencies across all areas, particularly in technical and creative design skills, to leverage XR technologies fully.

6.3.8. Greece

In Greece, the self-perceived competency levels show high and moderate ratings. Creativity is rated at 3.78, indicating a high level of confidence. Technical Literacy scores 3.40, showing a moderate proficiency in operating devices. Adaptability to New Interfaces is rated the highest at 4.01, reflecting a solid belief in flexibility with new technologies. Safety Awareness scores 3.08, indicating a moderate emphasis on safety. Understanding the Ethics Surrounding XR is rated at 2.92, showing lower importance placed on ethical considerations. Technical Design Skills and Creative Design Skills are rated at 3.14 and 3.47, respectively, indicating a good level of proficiency. The implications suggest that individuals in Greece feel confident in their adaptability and creative design skills but may need to improve their technical literacy and understanding of ethics.

6.3.9. Sweden

In Sweden, the self-perceived competency levels are generally high. Creativity is rated at 3.65, indicating a high level of confidence. Technical Literacy scores 4.18, showing a firm belief in the ability to operate devices. Adaptability to New Interfaces is rated the highest at 4.40, reflecting a very high level of flexibility. Safety Awareness scores 3.83, indicating a high importance placed on safety. Understanding the Ethics Surrounding XR is rated at 3.07, showing a moderate importance placed on ethical considerations. Technical Design Skills and Creative Design Skills are rated at 3.38 and 3.30, respectively, indicating a good level of proficiency. The implications suggest that individuals in Sweden feel highly confident in their technical and adaptability skills but may need to improve their understanding of ethics.

6.3.10. Slovakia

In Slovakia, the self-perceived competency levels are generally moderate. Creativity is rated at 3.36, indicating a moderate level of confidence. Technical Literacy scores are 3.18, showing a moderate proficiency in operating devices. Adaptability to New Interfaces is rated at 3.33, reflecting moderate flexibility. Safety Awareness scores 3.07, indicating a mild emphasis on safety. Understanding the Ethics Surrounding XR is rated at 2.71, showing lower importance placed on ethical considerations. Technical Design Skills and Creative Design Skills are rated at 2.77 and 2.86, respectively, indicating a lower level of proficiency.

The implications suggest that individuals in Slovakia may need to fully leverage XR technologies to improve their competencies across all areas, particularly in technical and creative design skills.

6.3.11. Israel

In Israel, the self-perceived competency levels are generally moderate to high. Creativity is rated at 3.36, indicating a moderate level of confidence. Technical Literacy scores 3.31, showing a moderate proficiency in operating devices. Adaptability to New Interfaces is rated at 3.56, reflecting high flexibility. Safety Awareness scores 3.43, indicating a high level of importance placed on safety. Understanding the Ethics Surrounding XR is rated at 3.30, showing a moderate importance placed on ethical considerations. Technical Design Skills and Creative Design Skills are rated at 3.20 and 3.36, respectively, indicating a good level of proficiency. The implications suggest that individuals in Israel feel confident in their adaptability and safety awareness but may need to improve their technical and creative design skills.

6.4. Comparison with perceived importance and competency levels

The following table presents a comparative analysis of the differences between perceived importance and competency levels across various countries. This analysis focuses on key competencies related to XR technologies, including creativity, technical literacy, adaptability to new interfaces, safety awareness, understanding of XR's ethics, technical design skills, and creative design skills. By examining these differences, we can identify areas where there is a gap between the importance of specific skills and the actual competency levels. This information is crucial for the Metaverse Academy Project as it helps pinpoint specific areas requiring targeted training and education to enhance overall proficiency in XR technologies.

Table 6.4. Comparison with perceived importance and competency levels

	Creativity	Technical Literacy	Adaptability to New Interfaces	Safety Awareness	Understanding the Ethics Surrounding XR	Technical Design Skills	Creative Design Skills
Türkiye	-0.31	-0.55	-0.41	-0.29	-0.43	-0.65	-0.56
Romania	-0.17	-0.51	-0.23	-0.06	-0.49	-0.56	-0.4
Spain	-0.37	-0.52	-0.4	-0.2	-0.32	-0.8	-0.65
South Africa	0.05	-0.12	-0.03	0.01	-0.19	-0.26	-0.22
Bulgaria	0.43	0.08	-0.08	0.03	-0.45	-0.37	-0.15
Germany	0.24	-0.7	-0.27	0.17	-0.51	-0.4	-0.03
Greece	-0.37	-0.92	-0.23	-1.09	-1.21	-0.91	-0.65
Sweden	0	0.43	0.55	0.31	0.04	0.03	-0.2
Slovakia	0.52	-0.64	-0.56	-0.62	-1.09	-0.16	-0.21
Israel	-0.09	-0.29	-0.14	-0.31	-0.34	-0.34	-0.15

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6.4.1. Creativity

Regarding creativity, Bulgaria shows a positive difference of +0.43, indicating that individuals perceive their competency to be higher than its importance. South Africa and Germany also show positive differences of +0.05 and +0.24, respectively, suggesting a good alignment between perceived importance and competency. Conversely, Greece and Spain show negative differences of -0.37, indicating a gap where the perceived importance is higher than the competency. Türkiye and Romania also show negative differences of -0.31 and -0.17, respectively. The implications suggest that while some countries like Bulgaria may have a surplus of creative skills, others like Greece and Spain may need to focus on enhancing creativity to meet the perceived importance.

6.4.2. Technical Literacy

Sweden shows a positive difference of +0.43, indicating that individuals feel more competent than the importance placed on technical literacy. Bulgaria also shows a slight positive difference of +0.08. However, Greece and Germany show significant negative differences of -0.92 and -0.70, respectively, indicating a substantial gap between perceived importance and competency. Türkiye, Romania, and Spain also show negative differences of -0.55, -0.51, and -0.52, respectively. The implications suggest that countries like Greece and Germany need to invest significantly in technical literacy to bridge the gap between perceived importance and competency.

6.4.3. Adaptability to New Interfaces

Sweden shows the highest positive difference of +0.55, indicating a solid alignment between perceived importance and competency. Bulgaria and South Africa also show positive differences of +0.03 and +0.01, respectively. Conversely, Slovakia and Türkiye show negative differences of -0.56 and -0.41, respectively, indicating a gap where the perceived importance is higher than the competency. Greece and Spain also show negative differences of -0.23 and -0.40, respectively. The implications suggest that while some countries like Sweden may have a surplus of adaptability skills, others like Slovakia and Türkiye may need to focus on enhancing adaptability to meet the perceived importance.

6.4.4. Safety Awareness

Sweden shows a positive difference of +0.31, indicating that individuals feel more competent than the importance placed on safety awareness. Germany and Bulgaria also show positive differences of +0.17 and +0.03, respectively. Conversely, Greece and Slovakia show significant negative differences of -1.09 and -0.62, respectively, indicating a substantial gap between perceived importance and competency. Türkiye, Romania, and Spain also show negative differences of -0.29, -0.06, and -0.20, respectively. The implications suggest that countries like Greece and Slovakia need to invest significantly in safety awareness to bridge the gap between perceived importance and competency.

6.4.5. Understanding the Ethics Surrounding XR

Sweden shows a slight positive difference of +0.04, indicating a good alignment between perceived importance and competency. Conversely, Greece and Slovakia show significant negative differences of -1.21 and -1.09, respectively, indicating a substantial gap between perceived importance and competency. Türkiye, Romania, and Spain also show negative differences of -0.43, -0.49, and -0.32, respectively. The implications suggest that countries like Greece and Slovakia need to invest significantly in understanding the ethics surrounding XR to bridge the gap between perceived importance and competency.

6.4.6. Technical Design Skills

Sweden shows a slight positive difference of +0.03, indicating a good alignment between perceived importance and competency. Conversely, Greece and Spain show significant negative differences of -0.91 and -0.80, respectively, indicating a substantial gap between perceived importance and competency. Türkiye, Romania, and Germany also show negative differences of -0.65, -0.56, and -0.40, respectively. The implications suggest that countries like Greece and Spain must invest significantly in technical design skills to bridge the gap between perceived importance and competency.

6.4.7. Creative Design Skills

South Africa shows a slight positive difference of +0.05, indicating a good alignment between perceived importance and competency. Conversely, Greece and Spain show significant negative differences of -0.65 and -0.65, respectively, indicating a substantial gap between perceived importance and competency. Türkiye, Romania, and Germany also show negative differences of -0.56, -0.40, and -0.03, respectively. The implications suggest that countries like Greece and Spain must invest significantly in creative design skills to bridge the gap between perceived importance and competency.

The analysis reveals varying levels of alignment between perceived importance and competency across different countries. Sweden, Bulgaria, and South Africa consistently show positive differences or minimal gaps, indicating a solid alignment between perceived importance and competency. On the other hand, Greece and Spain tend to show significant negative differences across most variables, suggesting a need for substantial improvement in several areas. The other countries fall somewhere between, showing a mix of positive and negative differences. This analysis highlights the importance of targeted training and education to enhance competencies in XR technologies, with a focus on technical and creative skills and safety and ethical considerations, to bridge the gaps between perceived importance and competency.

6.5. Student perspectives on XR technology integration

The following table presents a comparative analysis of students' perceptions regarding the integration and effectiveness of XR technologies in their academic studies. This data has been collected as part of the Metaverse-Immersive Technology Needs Assessment Survey, which aims to understand students' perspectives on the challenges and benefits of using XR technologies in their regular study routines. The table provides insights into how students from different countries perceive the difficulty of integrating XR technologies, their potential to make complex learning fields more accessible, and their confidence in using these technologies for study purposes. This information is crucial for tailoring XR-based course content to better meet learners' needs within the Metaverse Academy Project.

Table 6.5. Student perspectives on XR technology integration

	It is challenging to integrate XR technologies into the regular study routine	XR technologies can make the complexity of my learning field more accessible	I feel confident in using XR technologies and utilising them for study work
Türkiye	2.78	3.74	3.76
Romania	2.89	3.76	3.27
Spain	3.22	3.25	3.10
South Africa	2.90	3.66	3.54
Bulgaria	2.97	3.55	3.17
Germany	3.33	2.90	2.17
Greece	3.15	3.81	3.57
Sweden	3.63	3.13	2.93
Slovakia	3.47	3.00	2.82
Israel	3.08	3.30	3.30

In Türkiye, students generally do not find it very difficult to integrate XR technologies into their study routines, as indicated by the relatively low score of 2.78. They firmly believe that XR technologies can make complex learning fields more accessible (3.74) and feel confident in using these technologies for their studies (3.76). This suggests a positive attitude towards XR technologies and a readiness to adopt them in educational settings.

Romanian students also do not find it very difficult to integrate XR technologies (2.89). They believe in the potential of XR technologies to simplify complex subjects (3.76), but their confidence in using these technologies is slightly lower (3.27). This indicates a need for more training and support to boost students' confidence in utilising XR technologies effectively.

In Spain, students find it moderately difficult to integrate XR technologies into their study routines (3.22). They have a moderate belief in the ability of XR technologies to make learning more accessible (3.25) and feel moderately confident in using these technologies (3.10). This suggests that while there is some acceptance of XR technologies, there may be barriers to integration that need to be addressed.

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South African students do not find it very difficult to integrate XR technologies (2.90). They believe strongly in the potential of XR technologies to simplify complex subjects (3.66) and feel confident in using these technologies (3.54). This indicates a positive attitude towards XR technologies and a readiness to adopt them in educational settings.

Bulgarian students find it slightly difficult to integrate XR technologies (2.97). They believe in the potential of XR technologies to simplify complex subjects (3.55) and feel moderately confident in using these technologies (3.17). This suggests a need for more support and training to enhance students' confidence and ease of integration.

German students find it relatively difficult to integrate XR technologies into their study routines (3.33). They have a moderate belief in the ability of XR technologies to make learning more accessible (2.90) and feel less confident in using these technologies (2.17). This indicates significant barriers to integration and a need for substantial support and training to boost confidence and ease of use.

Greek students find it moderately difficult to integrate XR technologies (3.15). They strongly believe in the potential of XR technologies to simplify complex subjects (3.81) and feel confident in using these technologies (3.57). This suggests a positive attitude towards XR technologies, but there may be some barriers to integration that need to be addressed.

Swedish students need help integrating XR technologies into their study routines (3.63). They have a moderate belief in the ability of XR technologies to make learning more accessible (3.13) and feel moderately confident in using these technologies (2.93). This indicates significant barriers to integration and a need for support and training to enhance confidence and ease of use.

Slovakian students find it relatively difficult to integrate XR technologies into their study routines (3.47). They have a moderate belief in the ability of XR technologies to make learning more accessible (3.00) and feel less confident in using these technologies (2.82). This indicates significant barriers to integration and a need for substantial support and training to boost confidence and ease of use.

Israeli students find it moderately difficult to integrate XR technologies (3.08). They have a moderate belief in the ability of XR technologies to make learning more accessible (3.30) and feel moderately confident in using these technologies (3.30). This suggests that while there is some acceptance of XR technologies, there may be barriers to integration that need to be addressed.

The analysis reveals varying difficulty levels and confidence in integrating and using XR technologies across different countries. Countries like Türkiye, South Africa, and Greece show a positive attitude and readiness to adopt XR technologies, while countries like Germany, Sweden, and Slovakia face significant barriers to integration. This highlights the importance of targeted training and support to enhance students' confidence and ease of use, ensuring that the potential benefits of XR technologies can be fully realised in educational settings.

6.6. Challenges in using XR technologies for learning

The following table presents a comparative analysis of the challenges faced by students while using XR technologies for learning. This data has been collected as part of the Metaverse-Immersive Technology Needs Assessment Survey, which aims to understand students' obstacles in integrating XR technologies into their academic routines. The table provides insights into the prevalence of various challenges, such as technical issues, lack of training or workshops, time constraints, high costs, and accessibility problems to technical infrastructure across different countries. This information is crucial for identifying areas that require targeted interventions and support to enhance the effective use of XR technologies in educational settings.

Table 6.6. Challenges in using XR technologies for learning

	Technical Issues	**Lack of Training/Workshops**	**Time Constraints**	**High Costs**	**Accessibility problems with Technical Infrastructure**
Türkiye	87.1%	86.2%	71.2%	91.4%	81.5%
Romania	78.4%	86.5%	50.3%	87.7%	58.1%
Spain	78.8%	77.5%	53.6%	82.6%	60.0%
South Africa	54.4%	69.4%	50.0%	74.4%	63.7%
Bulgaria	68.3%	71.1%	45.2%	69.9%	65.3%
Germany	80.0%	86.2%	46.4%	75.9%	79.3%
Greece	87.1%	82.0%	61.8%	90.3%	71.7%
Sweden	83.8%	76.3%	56.8%	89.5%	54.1%
Slovakia	74.3%	78.4%	48.6%	88.9%	52.8%
Israel	65.6%	68.9%	51.7%	65.6%	51.7%

In Türkiye, 87.1% of students reported technical issues as a challenge, 86.2% cited a lack of training or workshops, 71.2% mentioned time constraints, 91.4% identified high costs, and 81.5% noted accessibility problems to technical infrastructure. These high percentages indicate significant barriers to the effective use of XR technologies, suggesting a need for comprehensive support in technical training, cost reduction, and infrastructure improvement.

In Romania, 78.4% of students reported technical issues, 86.5% cited a lack of training or workshops, 50.3% mentioned time constraints, 87.7% identified high costs, and 58.1% noted accessibility problems to technical infrastructure. The high percentages for technical issues, lack of training, and high costs highlight the need for targeted interventions to address these challenges and improve the overall adoption of XR technologies.

In Spain, 78.8% of students reported technical issues, 77.5% cited a lack of training or workshops, 53.6% mentioned time constraints, 82.6% identified high costs, and 60.0% noted accessibility problems to technical infrastructure. The significant percentages for

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technical issues, lack of training, and high costs suggest that these are the primary barriers to the effective use of XR technologies, indicating a need for focused efforts to address these challenges.

In South Africa, 54.4% of students reported technical issues, 69.4% cited a lack of training or workshops, 50.0% mentioned time constraints, 74.4% identified high costs, and 63.7% noted accessibility problems to technical infrastructure. The relatively lower percentages for technical issues and time constraints than other countries suggest that while these are still challenges, they may need to be more pronounced. However, the high percentages for lack of training, high costs, and accessibility problems indicate areas that require significant attention.

In Bulgaria, 68.3% of students reported technical issues, 71.1% cited a lack of training or workshops, 45.2% mentioned time constraints, 69.9% identified high costs, and 65.3% noted accessibility problems to technical infrastructure. The moderate percentages across all variables suggest that while there are challenges, they may be more manageable compared to other countries. Nonetheless, efforts to improve training, reduce costs, and enhance infrastructure are still necessary.

In Germany, 80.0% of students reported technical issues, 86.2% cited a lack of training or workshops, 46.4% mentioned time constraints, 75.9% identified high costs, and 79.3% noted accessibility problems to technical infrastructure. The high percentages for technical issues, lack of training, and accessibility problems highlight significant barriers that must be addressed to improve the adoption and effective use of XR technologies.

In Greece, 87.1% of students reported technical issues, 82.0% cited a lack of training or workshops, 61.8% mentioned time constraints, 90.3% identified high costs, and 71.7% noted accessibility problems to technical infrastructure. The high percentages across all variables indicate substantial challenges that must be addressed comprehensively to facilitate the effective use of XR technologies.

In Sweden, 83.8% of students reported technical issues, 76.3% cited a lack of training or workshops, 56.8% mentioned time constraints, 89.5% identified high costs, and 54.1% noted accessibility problems to technical infrastructure. The high percentages for technical issues, lack of training, and high costs suggest that these are the primary barriers to the effective use of XR technologies, indicating a need for focused efforts to address these challenges.

In Slovakia, 74.3% of students reported technical issues, 78.4% cited a lack of training or workshops, 48.6% mentioned time constraints, 88.9% identified high costs, and 52.8% noted accessibility problems to technical infrastructure. The significant percentages for technical issues, lack of training, and high costs highlight the need for targeted interventions to address these challenges and improve the overall adoption of XR technologies.

In Israel, 65.6% of students reported technical issues, 68.9% cited a lack of training or workshops, 51.7% mentioned time constraints, 65.6% identified high costs, and 51.7% noted accessibility problems to technical infrastructure. The moderate percentages across all variables suggest that while there are challenges, they may be more manageable compared

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to other countries. Nonetheless, efforts to improve training, reduce costs, and enhance infrastructure are still necessary.

The analysis reveals that technical issues, lack of training or workshops, high costs, and accessibility problems to technical infrastructure are common challenges students across all countries face. Countries like Türkiye, Greece, and Sweden show exceptionally high percentages across multiple variables, indicating substantial barriers that must be addressed comprehensively. On the other hand, countries like Bulgaria and Israel show relatively lower percentages, suggesting that while there are challenges, they may be more manageable. This highlights the importance of targeted interventions and support to address these common challenges, ensuring that the potential benefits of XR technologies can be fully realised in educational settings. The Metaverse Academy Project should focus on providing technical training, reducing costs, and improving infrastructure to effectively use XR technologies across different regions.

6.7. Suggestions and experiences of students with XR educational tools in the metaverse academy

6.7.1. Türkiye

- **Ergonomics and Innovation**: Some respondents feel that current XR devices, such as glasses, need further innovation, particularly regarding ergonomics.
- **Recruitment and Support**: It is suggested that individuals passionate about this field be hired and that their development be supported, which could drive XR advancement.
- **XR in Diverse Education**: XR can be applied across various educational domains, including unexpected areas like Sufi education. It holds the potential for enhancing curriculum integration.
- **Language Learning**: XR is seen as a potential solution to overcome language barriers. It allows immersive learning environments where students can virtually practice languages in settings like markets or airports (e.g., English in London, German in Berlin).
- **Pedagogical Collaboration**: Collaborating with child development experts (pedagogues) can make XR-based courses more efficient, particularly for younger audiences.
- **Technology Accessibility**: There's recognition that not everyone has access to international experiences due to financial constraints, but XR can "bring the world" to students' rooms, providing equal opportunities for language and cultural immersion.
- **Challenges and Reservations**: Some respondents hesitate to use XR due to safety concerns or lack of confidence in current implementations. A safer and more secure environment for XR use is considered essential.
- **Teacher Training**: XR should be part of teacher education to ensure they can integrate it into classrooms. Moreover, a user-friendly interface is crucial for broader adoption.

- **Social and Educational Equality**: XR can support refugee children in developing language skills and foster social integration, thus contributing to educational equality.
- **Financial Barriers**: Concerns about the high costs of XR devices suggest that the economic aspect is a major hurdle in Türkiye. Lower-cost or shared-use models in schools could help.
- **Educational Applications**: XR is valued for practical education, especially in areas like science and language learning. It helps students overcome fears (e.g., speaking in a foreign language) in virtual environments.
- **Limited Exposure**: Many respondents mentioned either no experience with XR or that it's rarely used, reinforcing the need for broader exposure and training.
- **Technological Readiness**: Some concerns exist that Türkiye might not be ready for large-scale XR deployment due to cost and accessibility challenges.
- **Content Creation**: XR could benefit from more localised and accessible educational content, including language support, which is currently lacking for primary and secondary school students.
- **Future of XR**: Some foresee the need for domestic production of XR tools and materials to avoid reliance on expensive imports and to make the technology more accessible.

Financial, technical, and infrastructural challenges hinder access to XR technologies, but there is significant potential for its use in language learning, personalised education, and social integration in Türkiye. Innovation in ergonomic device design, localised content creation, teacher training, and collaboration with experts (such as pedagogues) are critical to unlock this potential. Additionally, addressing cost barriers through shared-use models and encouraging domestic production of XR tools could significantly improve adoption and accessibility. With these changes, XR could contribute to educational equality, particularly in underserved regions and among refugee populations, while fostering a more immersive and practical learning experience across various subjects.

6.7.2. Romania:

- **Technical Limitations**: Older VR headsets are challenging to set up, and technical limitations are a significant issue.
- **Beta Testing**: There is a desire to test beta versions of XR tools.
- **Interface Importance**: A realistic and attractive interface is crucial for immersion and adoption.
- **Practical Courses**: Courses should be practical and include hands-on themes, not just theory.
- **Diverse Adoption**: Educational institutions adopting XR technology must be more diverse and open-minded.
- **Early Impressions**: Young children are impressed by VR, indicating its potential for relevant learning experiences.
- **Practical Skills**: Skills gained in XR environments may not translate well to the real world.

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- **AI Integration**: XR tools should be adaptable, track progress, and evaluate knowledge and skills.
- **Accessibility**: There is a need for better accessibility and training for late adopters of XR technology.

Romanians are limitedly familiar with and need more access to XR technologies, and there is a clear interest in integrating these tools into education. However, challenges like lack of access, insufficient knowledge, and the need for more diverse, accessible content are prevalent. To increase adoption, it is essential to focus on training, particularly for late adopters, and creating more immersive, adaptive experiences. Additionally, XR's practical applications, like business simulations or driver emotion recognition, could provide exciting avenues for specific fields of study.

6.7.3. Spain:

- **Current Tools**: A better use of existing IT tools is needed before adopting XR.
- **Legal Studies**: XR is not currently used in legal studies.
- **Future Accessibility**: XR will become more accessible and easier to use.
- **Interest and Opportunities**: There is interest in XR and opportunities for its use in education.
- **Accessibility and Communication**: Improving accessibility and communication systems is essential.
- **Cost and Utility**: XR tools' high cost and limited utility hinder their adoption.
- **Engineering Studies**: XR should be incorporated into engineering curricula.
- **Educational Implementation**: XR tools should be implemented in all educational degrees to make learning more engaging.

The feedback from Spain suggests that while interest in XR technologies is high, the educational system must be fully prepared for integration. There is a significant gap in digital literacy, with students and teachers needing to catch up in using even essential digital tools. Cost and accessibility remain substantial barriers. While XR is considered necessary for the future of education, particularly in engineering and immersive learning, efforts should first focus on improving basic digital competencies before widespread adoption.

6.7.4. South Africa

- **Accessibility**: Courses should be accessible to a wide range of students by offering affordable device options and cloud-based XR platforms that can run on different hardware configurations.
- **Awareness and Training**: Presentations and workshops should be conducted to educate students about XR technologies and how to use them effectively.
- **Learning Environment**: A quiet, undisturbed space is essential for effective learning.
- **Content and Tools**: Courses should start from fundamentals, allow offline access to materials, and offer practical, interactive simulations, 3D models, and gamified elements to make learning engaging and effective.

- **Support and Collaboration**: Institutions should provide high-performing laptops, offer placements after study completion, and encourage user contributions and idea sharing.
- **Personalisation and Inclusivity**: XR tools should cater to different learning styles, provide personalised learning pathways, and ensure accessibility and inclusivity for all students.

The analysis of the responses from South Africa reveals several vital implications. Firstly, XR technologies have the potential to significantly enhance student engagement and motivation by providing immersive and interactive learning experiences. However, there are notable challenges related to accessibility, as the high costs and technical barriers associated with XR tools need to be addressed to ensure they are accessible to all students, particularly in developing regions. Additionally, effective implementation of XR in education requires comprehensive training for educators to integrate these technologies into their teaching practices. With the proper support and infrastructure, XR technologies have the potential to revolutionise education by making learning more engaging, personalised, and accessible.

6.7.5. Bulgaria

XR educational tools should be integrated into the curriculum for all students and specialities starting in the first semester. XR technologies offer unique advantages to universities that actively use them, but not all have the financial means to purchase such equipment. Real-life cases should be included. Unfortunately, some respondents lack sufficient experience with XR educational tools. Practical applications are essential, and universities must purchase more equipment so every student can use it when needed, not just during class. More accessible information about these technologies would increase interest.

6.7.6. Germany

XR could be the future, allowing knowledge to be internalised much better and faster.

6.7.7. Greece

No additional comments were provided, but there is a belief that learning could become more fun and interactive with XR technologies. However, specific ideas for achieving this should have been mentioned.

6.7.8. Sweden

Accessibility issues were noted, with many people experiencing dizziness and nausea in fully immersive XR environments. Design choices, such as adding a tunnelling effect and being careful with orientation, can help mitigate these issues. Despite following all recommendations, some users still experienced discomfort after prolonged use. There is scepticism about the necessity and expense of XR technologies, with some viewing the survey as an attempt to secure funding for VR headsets without a clear use case. Questions were raised about the relevance of XR for studying programming or math.

6.7.9. Slovakia

Slovakia: Respondents reported no experience with XR tools and found some survey questions irrelevant due to their lack of familiarity with the product. XR educational tools are not used in their field of study.

6.7.10. Israel

Israel: No additional comments were provided.

6.8. Additional Student needs for training and development to enter the XR industry

6.8.1. Türkiye

The responses from students in Türkiye highlight several vital needs and challenges in training and development to enter the XR industry. There is a strong desire for interactive and immersive learning environments, such as a metaverse-based language practice world, which could significantly enhance language skills and make learning more engaging. However, the lack of technical knowledge and financial resources poses a significant barrier to developing such projects. Students also need greater recognition and support for technological initiatives within their academic institutions, as academic achievements are often prioritised over technological advancements.

Providing technical infrastructure, education, and material support is emphasised, as these are crucial for adapting XR technologies across various fields. The potential of XR technologies to address educational inequalities, especially in disadvantaged schools, is also noted. Access to these technologies could bridge the gap between students in different regions and provide more equitable learning opportunities. Additionally, there is a call for practical training and integrating XR technologies into the curriculum to make learning more effective and memorable.

Students also highlight the need for easier access to XR technologies and support for sustainable implementation. This includes providing devices, internet connectivity, and technical support for those not specialised in technology. The responses indicate that while XR technologies hold great promise for enhancing education, there are significant challenges related to accessibility, cost, and technical and creative training. Addressing these challenges could unlock the full potential of XR technologies in education and provide students with the skills and opportunities they need to succeed in the XR industry.

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6.8.2. Romania

Students in Romania express a strong interest in advancing their knowledge and skills in XR technologies. They see the potential for XR to make subjects like history more engaging through virtual immersions in historical events and locations. There is a desire for practical activities facilitated by tutors and access to learning resources, equipment, and information about the job market. Students believe that XR tools can better understand project outcomes and development processes, which would benefit their studies. They also emphasise the need for offline programs and online courses and the importance of learning to use VR effectively to improve their skills.

There is a concern about the impact of technology on job availability and the need to adapt to these changes. Students are interested in funding opportunities to help them adjust to the XR industry more quickly. They also highlight the importance of accessible training, well-equipped laboratories, and the ability to develop customised XR technologies for their research projects. Improved infrastructure at educational institutions is seen as essential, and students appreciate any training or courses that can help them evolve and learn new things. They believe that XR can make learning more flexible and accessible, allowing unlimited practice and repetition.

In engineering, students see the potential for XR to provide detailed visualisations of physical operations, chemical reactions, and other complex phenomena. They believe that XR can make these concepts easier to understand and increase student engagement. Weekend workshops and accessible training are also mentioned as beneficial.

6.8.3. Spain

Students in Spain express a need for more significant investment in new laboratory technologies. In fields like law, there is uncertainty about how XR could improve the learning experience, while in history and heritage studies, XR is seen as necessary. XR is considered interesting but expensive in medicine, where experts lack the expertise to provide adequate training. Some students use XR in their professional work, while others have yet to have the opportunity to use it in their studies but would like to.

There is a call for better digital connectivity with teachers and classmates and more training opportunities. Students believe that recreating real-life experiences through XR can help them understand the practical applications of their study. However, the high cost of XR tools and the difficulty of using them efficiently are significant barriers. Students also emphasise the importance of training teachers first, as they play a crucial role in integrating XR into the curriculum.

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6.8.4. South Africa

The responses from students in South Africa highlight several vital needs and challenges in terms of training and development to enter the XR industry. Students emphasise the importance of having access to necessary devices, internet connectivity, and XR information and programs. They express a need for practical experience with XR technologies, suggesting that hands-on experience, project-based learning, and specialised courses focused on XR development, design, and storytelling would be beneficial. Additionally, students highlight the importance of soft skills training, industry connections, and mentorship programs to help them succeed in the XR industry.

Students strongly desire better equipment, such as high-performing laptops and PCs, as well as funding and bursaries to support their studies. They also emphasise the need for workshops, training sessions, and resources to stay updated with industry trends. They believe that XR technologies can provide practical learning experiences without the high cost of physical equipment and resources. Furthermore, students stress the importance of community building and networking opportunities with XR professionals and companies.

The responses also reveal concerns about accessibility and affordability, with students highlighting the need for affordable device options and cloud-based XR platforms that can run on different hardware configurations. They also mention the importance of having a quiet, undisturbed space for effective learning and the need for better digital connectivity with teachers and classmates.

The analysis reveals that students in South Africa recognise the potential of XR technologies to enhance their education and provide practical, immersive learning experiences. However, significant challenges are related to accessibility, affordability, and the need for practical training and support. Addressing these challenges requires investment in affordable device options, cloud-based XR platforms, and comprehensive training programs. Additionally, creating a conducive learning environment and fostering collaboration and personalisation are crucial for maximising the benefits of XR technologies. By providing the necessary resources and support, educational institutions can help students leverage XR technologies to their full potential and prepare them for careers in the XR industry.

6.8.5. Bulgaria

Since the first semester, students have focused on integrating XR technologies into educational programs to enhance engagement and understanding. They suggest the creation of virtual laboratories and the need for additional funding to integrate XR tools better. Practical experience with XR technologies in collaboration with businesses is essential for understanding real-world applications.

6.8.6. Germany

No additional comments.

6.8.7. Greece

Students need education on the legislation and regulations governing XR technologies. There is also interest in using XR tools to teach specialised subjects such as human rights and social inclusion. However, some students need additional comments or need to share.

6.8.8. Sweden

Students in Sweden are concerned about the cost and necessity of XR technologies in specific fields. They suggest evaluating the applicability of XR on a case-by-case basis, with fields like surgery being prime candidates. Accessible information on XR development, optimization, and sustainability is needed. Students also desire centralised resources and educational websites with updated information and tutorials.

6.8.9. Slovakia

The response from Slovakia indicates no additional needs or comments regarding XR technologies.

6.8.10. Israel

Students in Israel did not provide specific needs or comments related to XR technologies.

7. Country-specific Questions-South Africa

The additional country-specific questions for South Africa aimed to assess the factors influencing students' ability to learn about and use XR technologies. The responses were rated on a scale of 1 to 5, with 1 being "strongly disagree" and 5 being "strongly agree." Here are the average scores for each factor:

1. **There is a stable internet connection where I study**: The average score is 3.73. This indicates that most students agree they have a stable internet connection, although there is still room for improvement.
2. **The internet connection where I study is solid and fast**: The average score is 3.54. While students generally agree that their internet connection is solid and quick, the lower score compared to the stability of the connection suggests that speed and reliability could be enhanced.
3. **Stable electricity supply**: The average score is 3.74. This score shows that students generally agree they have a stable electricity supply, which is crucial for effectively using XR technologies.

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4. **I have access to a mobile device that is capable of using XR technologies**: The average score is 3.71. This indicates that most students can access mobile devices supporting XR technologies, but a significant portion may need more adequate devices.
5. **I have access to computers and other devices that make it possible to use XR technologies**: The average score is 3.91. This is the highest score among the factors, suggesting that students generally have good access to computers and other necessary devices for using XR technologies.

Table 7.1. Country-specific Questions-South Africa

	South Africa
There is a stable internet connection where I study	3.73
The internet connection where I study is strong and fast	3.54
Stable electricity supply	3.74
I have access to a mobile device that is capable of using XR technologies	3.71
I have access to computers and other devices that make it possible to use XR technologies	3.91

The analysis of these results reveals several critical implications for South Africa. Firstly, while students generally have access to the necessary infrastructure for using XR technologies, some areas need improvement. The scores for internet stability and speed indicate that the quality of internet connections needs to be enhanced to ensure that students can fully benefit from XR technologies. This could involve investing in better internet infrastructure and providing support for students needing high-speed internet access.

The stable electricity supply score is relatively high, but ensuring consistent and reliable electricity is crucial for the effective use of XR technologies. Any disruptions in electricity supply can hinder students' engagement with XR tools and resources.

Access to mobile devices and computers is generally good, but some students may need more adequate devices. Providing affordable device options and ensuring all students access the necessary technology is essential for equitable learning opportunities. This could involve initiatives to offer subsidised or loaner devices to needy students.

Overall, the results highlight the importance of addressing infrastructure and accessibility challenges to maximise the benefits of XR technologies in education. By improving internet connectivity, ensuring a stable electricity supply, and providing access to necessary devices,

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educational institutions in South Africa can better support students in their learning and development in the XR industry.

8. General Conclusions

The Metaverse Academy project's comprehensive survey of students across multiple countries has provided valuable insights into XR technology adoption, perception, and expectations in higher education. This analysis offers a nuanced understanding of the challenges and opportunities that lie ahead for the integration of immersive technologies in academic settings.

8.1. Demographic Insights

The survey's demographic data reveals a diverse participant pool across 13 partner organisations in 10 countries, with 2,039 student responses. This broad geographical spread ensures that the findings represent various educational and cultural contexts. The gender distribution shows a slight predominance of female participants in most countries, with notable exceptions such as Sweden, where male respondents were the majority. This gender imbalance may have implications for designing and implementing XR-based educational programmes, necessitating a focus on inclusivity and diverse representation in content development.

8.2. Educational Profiles and XR Exposure

The educational profiles of respondents span a wide range of disciplines, from arts and humanities to technical and engineering fields. This diversity underscores the potential for XR technologies to be applied across various academic domains. However, the survey also reveals significant disparities in XR exposure and experience among students:

- A considerable portion of students (ranging from 25.7% in Türkiye to lower percentages in other countries) have never heard of XR technologies, indicating a substantial knowledge gap that needs to be addressed.
- The most prominent group in many countries consists of students who have heard of XR but never used it, suggesting a disconnect between awareness and practical application.
- Only a tiny percentage of students report using XR technologies frequently, with even fewer using them as a required part of their studies.

These findings highlight the need for more comprehensive integration of XR technologies into educational curricula and increased opportunities for hands-on experience.

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8.3. Perceptions and Interest in XR Technologies

Despite varying levels of exposure, there is a generally positive perception of XR technologies among students:

- Many respondents express interest in using XR within their field of study, indicating a receptive audience for immersive learning experiences.
- Students across countries recognise the potential benefits of XR in enhancing both theoretical and practical learning outcomes.
- There is a widespread belief that XR technologies could benefit their respective countries, suggesting an understanding of these technologies' broader societal and economic implications.

However, the frequency of XR use in current study programmes must be higher, pointing to a gap between student interest and institutional implementation.

8.4. Competencies and Challenges

The survey reveals insights into students' perceptions of necessary competencies for effective XR use:

- Creativity, technical literacy, adaptability to new interfaces, and safety awareness are identified as critical skills.
- Students' self-assessment of these competencies varies, indicating areas where additional training and support may be required.

Several challenges to XR adoption in education were identified:

- Technical issues and lack of training emerge as significant barriers.
- Time constraints, high costs, and accessibility problems (e.g., stable internet connection or access to devices) are also noted as obstacles.

These findings underscore the need for comprehensive support structures and resources to facilitate the effective integration of XR technologies in educational settings.

8.5. MOOC Experience and Relevance

The survey explored students' experiences with Massive Open Online Courses (MOOCs) and their perceived relevance:

- Many students have participated in MOOCs, indicating familiarity with online learning platforms.

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- There is a general recognition of MOOCs' relevance in acquiring new skills pertinent to academic goals.

This positive perception of online learning platforms suggests that students may be receptive to XR-enhanced MOOCs or similar immersive online learning experiences.

8.6. Country-Specific Considerations (South Africa)

The survey revealed critical country-specific factors that may influence XR adoption:

- In countries like South Africa, infrastructure and access to technologies are significant concerns, with questions addressing stable internet connections and access to mobile devices.
- These findings highlight the need for tailored approaches to XR implementation that consider local technological infrastructure and resource availability.

8.7. Implications for Metaverse Academy

Based on the survey results, several critical implications for the Metaverse Academy project can be identified:

1. Awareness and Education: Initiatives to raise awareness about XR technologies and their potential applications in education are needed. The Metaverse Academy should consider developing introductory courses or workshops to bridge the knowledge gap identified in the survey.
2. Hands-on Experience: Given the large proportion of students who have heard of XR but have yet to use it, the Academy should prioritise providing opportunities for practical, hands-on experience with XR technologies. This could involve creating dedicated XR labs or integrating XR components into existing courses.
3. Cross-disciplinary Application: The diverse educational profiles of respondents suggest that XR technologies have potential applications across various academic fields. The Academy should develop a range of XR-based learning experiences that cater to different disciplines, from arts and humanities to STEM fields.
4. Skill Development: The survey identified vital competencies students perceive necessary for effective XR use. The Academy should incorporate the development of these skills (creativity, technical literacy, adaptability, and safety awareness) into its curriculum design.
5. Addressing Barriers: To overcome the identified challenges, the Academy should focus on:
    - Providing comprehensive technical support and training.

- Exploring cost-effective solutions to make XR technologies more accessible.
- Collaborating with institutions to address infrastructure issues, particularly in regions with limited technological resources.

6. Leveraging MOOC Experience: Given students' familiarity with MOOCs, the Academy could explore developing XR-enhanced MOOCs or integrating XR components into existing online learning platforms.
7. Tailored Approaches: The Academy should consider developing country-specific strategies for local technological infrastructure, cultural contexts, and educational priorities.
8. Industry Alignment: To address the gap between student interest and current XR integration in education, the Academy should collaborate closely with industry partners to ensure its offerings align with emerging workforce needs and technological trends.
9. Gender Considerations: The gender distribution in the survey suggests the need for inclusive design in XR-based educational content and targeted efforts to encourage participation across all gender identities.
10. Continuous Assessment: Given the rapidly evolving nature of XR technologies, the Academy should implement mechanisms for ongoing assessment of student needs, technological advancements, and industry requirements to ensure the relevance and effectiveness of its programmes.

The Metaverse Academy project's student survey has provided valuable insights into the current landscape of XR technology in higher education. While significant challenges exist to overcome, including awareness gaps and accessibility issues, the overall positive perception and interest in XR technologies among students suggest a promising future for immersive learning experiences. By addressing the identified barriers and leveraging the opportunities highlighted in this survey, the Metaverse Academy can play a pivotal role in shaping the future of education in the digital age, preparing students for a world where XR technologies are increasingly integral to academic and professional success.

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9. Future Research

Throughout the Metaverse Academy project, further research will be undertaken to deepen the analysis of the data collected, especially to enhance its dissemination within academic circles. These in-depth studies will focus on refining the insights already gathered to address the complex and evolving challenges associated with the integration of XR (Extended Reality) technologies in education. A key part of this effort will involve conducting thorough bibliographic reviews to position the collected data within the broader context of existing scholarly work on XR technologies. This process is essential for establishing a robust theoretical framework for future analyses.

These reviews will draw on the latest academic literature across several domains to ensure that the research outputs are relevant and impactful. By synthesising the most current findings with the data from our surveys, we aim to provide a more comprehensive understanding of how XR technologies are being perceived and adopted in different educational and industrial contexts. The reviews will examine the current state of research in XR technologies, focusing on themes such as the pedagogical benefits of immersive learning, the technical and infrastructural barriers to widespread XR adoption, and the potential for XR technologies to transform various sectors such as retail, manufacturing, and consumer services.

Establishing a solid theoretical foundation must be considered. As XR technologies evolve and their applications expand across different industries, the data we analyse mustn't be viewed in isolation. Instead, it should be supported by a thorough understanding of how similar technologies have been studied and deployed in other contexts. This will enable us to develop more nuanced analyses beyond descriptive statistics, offering more strategic and theoretically grounded insights into the opportunities and challenges XR technologies present.

One of the primary goals of these future research efforts will be to publish findings in high-impact academic journals indexed in the Web of Science (WOS). Specifically, the project team will target journals well-regarded in fields related to XR technologies, digital transformation, and consumer behaviour. These include the *Journal of Retailing and Consumer Services*, *Journal of Intelligent Manufacturing*, *Electronic Markets*, and *Computer*. These journals offer a platform for disseminating research to a broader academic audience and engaging with ongoing debates about the role of emerging technologies in educational and industrial settings.

The selection of these journals is strategic. For instance, the *Journal of Retailing and Consumer Services* provides a relevant outlet for research exploring how XR technologies can enhance customer experience, improve engagement, and streamline services in sectors such as retail and hospitality. As part of the future analysis, we will examine how students, as future professionals, perceive the role of XR in transforming consumer interactions and how educational programmes can be adapted to meet the growing demand for XR skills in the retail and services sectors.

Similarly, the *Journal of Intelligent Manufacturing* will be an appropriate venue for research focused on the role of XR in industrial settings, particularly in training and upskilling workers. As XR technologies are increasingly adopted in manufacturing environments for tasks such as assembly line optimisation, machine maintenance, and employee training, our future studies will explore how educational institutions can better prepare students for these emerging roles. Through in-depth case studies and quantitative analyses, we aim to highlight best practices for incorporating XR into technical and vocational education to improve employability in highly automated and technology-driven industries.

Electronic Markets will serve as another key journal for our dissemination efforts, particularly for research examining XR's role in transforming digital markets. As more businesses shift to online platforms and adopt XR for virtual shopping experiences, immersive product demonstrations, and interactive customer service, exploring how educational programmes can equip students with the skills needed to thrive in these new market environments will be crucial. Our future research will investigate how XR technologies can be leveraged to create more personalised, engaging, and efficient online retail experiences and how students can be trained to develop and manage these new digital platforms.

Finally, the journal *Computer* will be targeted for research that bridges the gap between technological innovation and educational practice. As XR technologies become more sophisticated, exploring their technical underpinnings, including the software and hardware advancements that enable more immersive and interactive experiences, is essential. By focusing on the intersection of computer science, XR, and education, we will contribute to discussions on how these technologies can enhance learning outcomes, improve student engagement, and create more dynamic and interactive learning environments.

In summary, future research within the Metaverse Academy project will be guided by rigorous academic standards to contribute to the global body of knowledge on XR technologies. By publishing in high-impact journals, we aim to ensure that our findings reach a broad audience and contribute to shaping the future of XR technology adoption in educational and industrial contexts. Through these efforts, we will continue to refine our understanding of how XR technologies can be integrated into education to prepare students for the challenges and opportunities of a rapidly evolving digital landscape.

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