To VR or not to VR? A Taxonomy for Assessing the Suitability of VR in Higher Education

Research Paper

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Abstract. Despite the educational potential of virtual reality (VR), its suitability for specific learning content remains unclear. To address this gap, we propose a taxonomy that systematically classifies reasons influencing VR's suitability for specific educational contexts. This taxonomy is grounded in three theoretical frameworks, including UTAUT2 and constructive alignment, and was developed through three iterations based on literature and interview insights. Its utility is demonstrated through an illustrative scenario in which a university employee with VR experience evaluates whether the learning content 'warehouse structures and functions' is suitable for VR by reflecting the taxonomy.

Keywords: Virtual Reality Suitability, Learning Content, Taxonomy, Higher Education.

1 Introduction

"*How should I decide if VR is suitable for my learning content?"* – this question frequently arises in discussions with university lecturers when talking about the use of virtual reality (VR) in university teaching (Johnston et al., 2018). Despite increasing enthusiasm for VR in higher education and its potential to enhance teaching and learning (Glaser et al., 2023; Maiero et al., 2023; Stracke et al., 2025), its suitability for specific learning content remains unclear. While VR can increase student engagement (Kavanagh et al., 2017) and provide safe environments for tasks such as operating machinery (Pellas et al., 2021) concerns persist about its educational effectiveness. Previous studies criticize the dominance of usability considerations over educational effectiveness (Radianti et al., 2020) and emphasize the need to better understand the instructional application of core VR features such as immersion, interactivity, and presence (Goertz et al., 2021; Mikropoulos & Natsis, 2011). These criticisms point to a central gap: the lack of a structured approach on how to assess when and why VR is likely to be suitable for specific learning content. Lecturers without prior VR experience cannot estimate its potential suitability (Mäkelä et al., 2025).

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Against this background, this study asks the research question: *How can reasons for the use and non-use of VR be described and classified?* To answer this question, we developed a taxonomy that structures reasons for VR's suitability for higher education learning content based on existing VR use cases. A taxonomy consists of dimensions and characteristics that help navigate through an area of knowledge (Nickerson et al., 2013) and can serve as a basis for theory building and method development (cf. Gregor & Hevner, 2013). The proposed taxonomy can support lecturers – especially those unfamiliar with VR – in navigating through reasons for VR use or non-use based on existing use cases. It represents an initial step in assessing VR's suitability, to be followed by expert evaluation. In the mid-term, the taxonomy may serve as a foundation for future decision-support tools.

To develop such a taxonomy, we first describe the core concepts of VR and suitability and then initial taxonomy dimensions based on relevant literature. These dimensions were then refined and enhanced based on expert input and literature findings. In doing so, we adapted the taxonomy development approach from Nickerson et al. (2013), as described in section three. In section four, we introduce the resulting taxonomy and illustrate its utility based on reflections from lecturers with prior VR experience. The final section discusses the findings, implications, limitations, and directions for future research.

2 Conceptual Background

2.1 The Concept of Virtual Reality and Suitability

VR is a digital technology that creates interactive, computer-generated simulations, tracks a user's position and actions, and enhances sensory feedback (e.g., visual, auditory, and haptic) to immerse users in a virtual environment (Sherman & Craig, 2019). In this study, VR serves as an umbrella term that encompasses immersive VR (I-VR), desktop VR (D-VR), and 360-degree VR (Hamilton et al., 2021; Matovu et al., 2023). I-VR uses head-mounted displays (HMDs) to replace the physical environment with a stereoscopic display of computer-generated 3D graphics for highly immersive experiences. D-VR provides virtual environments on a computer screen, typically controlled by a mouse and keyboard, with less immersion and limited interaction. 360-degree VR uses 360° videos or images viewed through HMDs (Hamilton et al., 2021; Kavanagh et al., 2017). VR 'type' selection (e.g., D-VR) depends on the situational context, including learning objectives, constraints (e.g., the venue or number of students), learning types (e.g. haptic), and the available resources (Sherman & Craig, 2019; Won et al., 2023).

We define 'suitability' as VR's ability to effectively support specific learning content. By 'effectively support', we mean that VR helps to achieve learning objectives – for example, the exploration of internal components of a computer to understand their functions (Dengel et al., 2022).

2.2 Approximation of VR's Suitability

To assess VR's suitability for specific learning content, we combine three theoretical frameworks. These were selected because each addresses a distinct aspect of the research problem: for which purposes VR has been suitable in the past (Problem Space Mapping Framework (PSMF), Bisswang et al., 2022), what should be didactically considered to assess VR's suitability (constructive alignment, Biggs & Tang, 2011), and under which conditions lecturers adopt VR (Unified Theory of Acceptance and Use of Technology 2 (UTAUT2), Venkatesh et al., 2012).

The PSMF serves as a foundation for our analysis. It structures problems a technology addresses and the solutions it enables through use cases, thereby facilitating reasoning from existing applications to future ones. For example, if VR was used to take on the role of a presenter and practice presentations in front of a virtual audience (Bisswang et al., 2023), VR may also be suitable to take on the role of a job applicant and simulate job interviews (Dincelli & Yayla, 2022). In our study, we use this idea to analyze recurring reasons why VR was used – or not used – in university lectures to assess VR's suitability for future applications (cf. Bisswang, 2022).

Constructive alignment emphasizes the alignment of learning objectives, activities, and assessment methods (Biggs & Tang, 2011; Loughlin et al., 2021). Learning objectives define what students should know, understand, and be able to do after a course. Learning activities are methods and tasks designed to help students achieve these objectives, while assessment methods evaluate whether the objectives have been met. Related to the TPACK framework (Technological Pedagogical Content Knowledge), which highlights the need to align technological, pedagogical, and content (subject) knowledge to integrate digital technologies into university teaching (Koehler et al., 2014), university lecturers should align the proposed medium (here: VR) with (1) the intended learning objectives, (2) the activities designed to achieve those objectives, and (3) the methods used to assess the competencies of the learners.

The UTAUT2 explains what influences technology adoption and use (Venkatesh et al., 2012). We selectively integrate dimensions assessable without requiring prior VR experience. Table 1 lists which factors are integrated [I] or excluded [E].

Table 1. UTAUT2 key factors and their integration into this study (Venkatesh et al., 2012)

Key factor: explanation	I/E
Performance expectancy: The degree to which VR is expected to help achieve learning objectives.	I
Effort expectancy: Not considered in this study, as lecturers without VR experience cannot assess VR's ease of use.	E
Social influence: The extent to which peers or institutions support VR use.	I
Hedonic motivation: The personal motivation of lecturers to use VR.	I
Price value: Not considered in this study, as lecturers cannot assess VR costs without VR experience.	E
Facilitating conditions: The availability of resources to support VR.	I

Key factor: explanation	I/E
Habit: Not considered in this study, as new VR users have no prior experience to form habits.	E

For example, performance expectancy and social influence are included, as lecturers can assess these based on their professional experience and expectations. In contrast, dimensions such as effort expectancy, and price value are excluded, as lecturers without prior VR experience typically cannot assess them reliably. This decision aligns with our research goal: to structure reasons for the use and non-use of VR to assess VR's suitability for specific learning content, especially for lecturers without VR experience.

Building on the PSMF, constructive alignment and the UTAUT2, we propose a **preliminary structure** (see Table 2) to systematically describe reasons for VR use and non-use in higher education settings.

Table 2. Preliminary structure to assess VR's suitability

Taxonomy's dimension candidates	Approach to define characteristics	Theoretical foundation
Learning objective	Retrospective analysis of existing VR learning content to assess the suitability of VR for future learning content (inspired by Bisswang et al. 2022).	Constructive alignment (Biggs & Tang, 2011; Loughlin et al., 2021)
Learning activities		
Learning assessment		
Social influence		UTAUT2 (Venkatesh et al., 2012).
Hedonic motivation		
Performance expectancy		
Facilitating conditions		

3 Research Methods to develop the Taxonomy

Based on expert interviews and validated through literature findings, we identified reasons for VR use and non-use. These reasons, along with preliminary dimension candidates (cf. Table 2), serve as data basis for taxonomy development (Nickerson et al., 2013), ensuring practical relevance and theoretical foundation.

3.1 Expert Interviews and Literature Analysis

We conducted **16 semi-structured interviews** (Myers, 2020) with two expert groups: nine university lecturers (IDs: E1-E9) with at least two years of VR experience (Group 1) and seven participants (IDs: E10-E16) who support lecturers, such as VR developers (Group 2). The interviews, conducted online via Microsoft Teams between July 3rd, 2024, and January 14th, 2025, lasted 60 to 90 minutes and were recorded and transcribed. We asked participants about their reasons for VR use (e.g., successful applications) and non-use (e.g., unsuitable scenarios). This builds on the PSMF's idea to analyze existing technology use cases to inform their future suitability (Bisswang, 2022).

To ensure consistency, we inductively and iteratively coded the statements and reviewed the codes after each interview. The codes were grouped into two categories: ‘reasons for VR use’ and ‘reasons for VR non-use’.

To validate and enhance our interview findings, we conducted a semi-structured literature review on VR use in higher education (cf. Snyder, 2019). This approach allowed for a focused integration of relevant and peer-reviewed sources. We focused on key studies from Q1 journals (ranked by the Scimago Journal Rank (SJR) (www.scimagojr.com)) in the field of education and VR: Computers & Education Journal (Mikropoulos & Natsis, 2011; Radianti et al., 2020; Won et al., 2023), Virtual Reality Journal (Pellas et al., 2021), and Studies in Science Education Journal (Matovu et al., 2023). These studies cover a broad range of VR applications in higher education from 1999 to 2023. A backward search identified 19 additional papers. If literature confirmed interview-derived codes, these codes were retained; if new insights emerged from interviews without support in literature, we – the author team – discussed their relevance and included them when justified. All coding, abstraction, and refinement steps were carried out by the author team through iterative consensus. Figure 1 illustrates the coding process (the complete data model is available upon request).

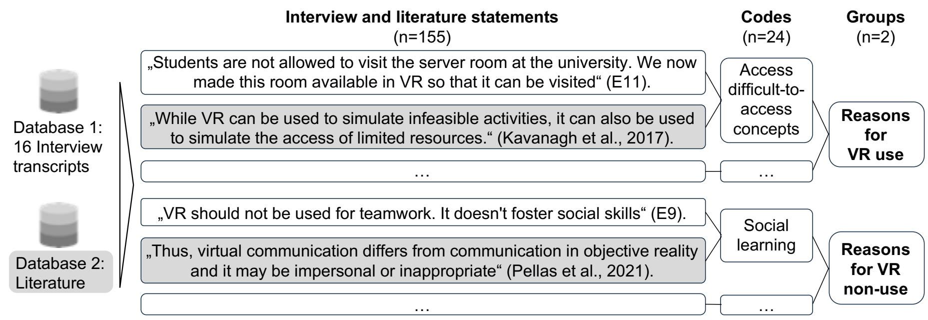

Figure 1. Coding process

3.2 Taxonomy development

To develop the taxonomy, we adapted Nickerson et al.’s (2013) taxonomy development process, which is widely used in information systems (Oberländer et al., 2019). The author team developed the taxonomy, and all decisions (e.g., coding, abstraction, classification) were made through iterative discussion and consensus. While this internal consensus approach ensured consistency, it may also introduce bias. Therefore, we conducted an independent external validation of the taxonomy, described in section 5.

First, we defined the **meta-characteristic**, which serves as the foundation of the taxonomy. In our study, the meta-characteristic is ‘VR suitability’, as the taxonomy’s purpose is to classify reasons for VR use and non-use in higher education.

Next, we defined **ending conditions** to determine when the taxonomy development process for this study would be complete. We adopted Nickerson et al.'s (2013) objective and subjective ending conditions. The objective conditions require mutually exclusive and collectively exhaustive characteristics for each dimension, unique dimensions and characteristics, and that no new elements added, merged, or split in the final iteration. The subjective conditions require the taxonomy to be concise, robust, comprehensive, extendible, and explanatory, to ensure structural integrity and practical utility.

The taxonomy was developed through **three iterations,** guided by Nickerson et al.'s (2013) approaches. In the **first iteration**, we followed a **conceptual-to-empirical approach** and build on the preliminary structure derived from UTAUT2 (Venkatesh et al., 2012) and constructive alignment models (Biggs & Tang, 2011; Loughlin et al., 2021). This reflects Nickerson et al.'s (2013) approach to propose dimension and characteristic candidates based on a theoretical model. To meet the 'uniqueness of the dimensions' objective condition, we discussed potential overlaps. We identified an overlap between performance expectancy (UTAUT2) and learning objectives (constructive alignment), as both address the expected VR benefits for achieving learning outcomes. We retained the learning objective dimension due to its direct relevance to the learning content. We also noted an overlap between social influence and facilitating conditions (UTAUT2) as institutional support often influences resource availability. We retained the social influence dimension, as it encompasses both peer and institutional factors.

In the **second iteration**, we followed an **empirical-to-conceptual approach**, using insights from expert interviews to refine dimensions and identify characteristics. According to Nickerson et al. (2013) an empirical approach involves the observation of empirical cases to determine taxonomy dimensions and characteristics. We understand "empirical" as data from expert insights, providing practical perspectives on VR use and non-use. However, as experts naturally theorize and interpret their experiences, our empirical approach also incorporates conceptual elements.

In the **third and final iteration**, we validated the taxonomy internally within the research team, as we are all lecturers, with one of us having a research focus on VR. As no new dimensions or characteristics were added or removed, we fulfilled both the subjective and objective ending conditions to conclude the iterative development process.

To **validate the taxonomy** and **its utility**, we used an illustrative scenario and adapted Szopinski et al.'s (2019) taxonomy evaluation framework. This framework covers three key questions: *who*? (the evaluators) – in this case, three university employees each with over two years of VR project experience, one VR developer (who creates VR applications for clients), and two university didactic consultants (who coaches lecturers on technology integration, e.g., VR); These individuals were selected for their ability to assess VR suitability and evaluate the taxonomy for non-VR users; *what?* (the object of evaluation) – existing VR higher education use cases; and *how?* (the method of evaluation) – through illustrative scenarios (Szopinski et al., 2019). The participants were asked to reflect on the taxonomy for their selected illustrative learning content. For space reasons, we describe the taxonomy application for one example in detail.

4 A Taxonomy to describe VR's Suitability

We classified the reasons for VR use and non-use into five dimensions and 24 characteristics. We organized these into two groups: those that are in favor of VR use ('+') and those that are not ('-'). By including reasons against VR, we aim to provide a 'balanced' overview, helping lecturers identify when VR is beneficial and when it may be unsuitable for specific learning content. For the social influence and hedonic motivation dimensions, we combined both characteristic types into single rows ('+/-'), as they represent the same characteristics but differ only in their expression (positive or negative). Figure 2 presents the final taxonomy as a morphological box.

<table>
<tr><th>Dimension</th><th colspan="7">Characteristics of VR use ('+') and VR non-use ('-')</th><th></th></tr>
<tr><td rowspan="2">Learning objective</td><td>Access inaccessible concepts</td><td>Access difficult-to-access concepts</td><td>Simulation of practical skills</td><td>Taking on another role</td><td>Spatial in-clusion</td><td>Increased and focused attention</td><td>Stable learning content</td><td>+</td></tr>
<tr><td colspan="2">Visualization of abstract concepts</td><td colspan="3">1:1 Transfer of existing learning content without modification</td><td colspan="2">Social learning</td><td>-</td></tr>
<tr><td rowspan="2">Learning activities</td><td colspan="2">Practical application</td><td colspan="3">Self-directed and explorative learning</td><td colspan="2">Joint interaction and knowledge exchange</td><td>+</td></tr>
<tr><td colspan="7">Joint creation of results</td><td>-</td></tr>
<tr><td rowspan="2">Learning assessment</td><td colspan="2">Formative assessment</td><td colspan="3">VR-adapted summative assessment</td><td colspan="2">Assessment outside VR</td><td>+</td></tr>
<tr><td colspan="7">Traditional summative assessment</td><td>-</td></tr>
<tr><td>Social influence</td><td colspan="2">(No) institutional support</td><td colspan="3">Positive/ negative perception of VR by colleagues</td><td colspan="2">Positive/ negative perception of VR by students</td><td>+/-</td></tr>
<tr><td>Hedonic motivation</td><td colspan="2">(No) motivation by personal interest</td><td colspan="3">(No) motivation through students</td><td colspan="2">(No) motivation by the expected benefit</td><td>+/-</td></tr>
</table>

Figure 2. Taxonomy of VR's suitability reasons

The learning objective dimension defines what students should achieve through a specific learning content (Biggs & Tang, 2011; Loughlin et al., 2021). Its characteristics along with their definitions and resources (e.g., literature and interview findings) are outlined in Table 3. To engage users to apply and evaluate the taxonomy, each dimension is enhanced with a guiding question. Reasons for VR use ('+') or non-use ('-') are mapped to each question, based on the narrative context of each reason. This table structure – dimension, question, and characteristics – is consistently applied and used for all dimensions described in the following.

Table 3. Learning objective dimension and characteristics

Dimension	*Question*
Learning objective	*What learning objectives do you aim to achieve by using VR for your learning content?*

Characteristics, definition, resources.	
(+) Access inaccessible concepts	VR makes content accessible and visualizable that is otherwise inaccessible due to human sensory limitations, such as molecular structures or historical events (Mikropoulos & Natsis, 2011; Won et al., 2023; E10; E13-E14; E16).
(+) Access difficult-to-access concepts	VR enables the exploration of difficult-to-access concepts, such as physical locations (e.g., server rooms) or spatial coordinates for students with limited spatial awareness (Chan et al., 2021; Kavanagh et al., 2017; Matovu et al., 2023; E1-E2; E4; E8-E11).
(+) Simulation of practical skills	VR enables the learning of practical skills, such as surgical techniques or negotiation scenarios, where training in the real world is costly, risky or ethically problematic (Goertz et al., 2021; Merchant et al., 2014; Stiefelbauer et al., 2023; E4; E7; E14).
(+) Taking on another role	VR allows students to experience different roles, such as historical figures or in interpersonal conflicts (Mikropoulos & Natsis, 2011; Pellas et al., 2021; Won et al., 2023 E54; E10; E11).
(+) Spatial inclusion	VR brings students from different locations together to interact in a shared virtual space, without the need for travel (Kavanagh et al., 2017; Pellas et al., 2021; Rinn et al., 2023; E5; E10; E14).
(+) Increased and focused attention	VR creates a self-contained learning environment that minimizes external distractions and focuses attention (Matovu et al., 2023; Mikropoulos & Natsis, 2011; Radianti et al., 2020; E5-E6; E9; E15).
(+) Stable learning content	VR is rather suitable for teaching stable, unchanging content, such as historical events or foundational anatomy (Kavanagh et al., 2017; Radianti et al., 2020; E5; E7; E10; E13).
(-) Realistic concretization of concepts	VR is rather not suitable to illustrate abstract concepts (e.g. supply and demand curves) or fully replicate physical interactions (e.g., lifting a box), which can lead to misunderstandings or incorrect movement patterns (Glaser et al., 2023; E5-E6; E8; E13).
(-) 1:1 Transfer of an existing learning content	VR is rather not suitable for directly transferring 2D content (e.g., PowerPoint slides) without adaptation, as a lot of reading is difficult in VR (Radianti et al., 2020 E4; E6-E7; E10-E11; E13; E15).
(-) Social learning	VR is rather not suitable to replicate nonverbal signals (e.g., facial expressions, body language) crucial for social learning (Netland & Hines, 2021; Pellas et al., 2021; E4; E7; E9; E14-E15).

The learning activity dimension involves methods that help students achieve the learning objectives (Biggs & Tang, 2011; Loughlin et al., 2021). Table 4 presents the characteristics of this dimension.

Table 4. Learning activity dimension and characteristics

Dimension	*Question*
Learning activities	*What specific learning activities need to be carried out by students in VR to achieve the intended learning objectives?*
Characteristics, definition, resources.	
(+) Practical application	VR enables practical exercises, such as lab simulations and allows students to apply knowledge in a contextual setting (Goertz et al., 2021; Matovu et al., 2023; Radianti et al., 2020; E5; E13; E16).
(+) Self-directed and exploratory learning	VR allows students to explore educational content at their own pace (Matovu et al., 2023; Mikropoulos & Natsis, 2011; Sunday et al., 2022; E1; E6; E8-E10; E15-E16).
(+) Joint interaction, knowledge exchange	VR facilitates collaborative learning, where students interact as avatars to exchange knowledge (Kavanagh et al., 2017; Mikropoulos & Natsis, 2011; Radianti et al., 2020; E11; E15-E16).
(-) Joint creation of results	VR is rather not suitable to create joint written outputs, such as documents or presentations (Netland & Hines, 2021; E5-E6; E9).

The learning assessment dimension describes the evaluation of whether the learning objectives have been met (Biggs & Tang, 2011; Loughlin et al., 2021). Table 5 presents the characteristics of this dimension.

Table 5. Learning assessment dimension and characteristics

Dimension	*Question*
Learning assessment	*What kind of knowledge assessment are you planning for the content you want to teach with VR?*
Characteristics, definition, resources.	
(+) Formative assessment	VR enables real-time feedback, such as interactive quizzes, to support ongoing assessment during the learning process (Gan et al., 2023; Radianti et al., 2020, E13).
(+) VR-adapted sum. assessment	VR can facilitate summative assessments, adapted to the virtual environment, to evaluate learning outcomes at the end of the VR learning process (Radianti et al., 2020, E9).
(+) Assessment outside VR	Knowledge evaluation can also take place outside VR to avoid the limitations of virtual environments (Matovu et al., 2023).
(-) Trad. summative assessment	VR is rather not suitable for traditional testing because there are still technical restrictions for writing and reading in VR (Mikropoulos & Natsis, 2011 E9, E12, E14).

Social influence refers to the support from colleagues, students, or institutions. **Hedonic motivation** reflects the lecturer's personal interest in using VR (Venkatesh et al., 2012). Both indirectly influence VR's suitability (Venkatesh et al., 2012). Table 6 presents the characteristics of these dimensions.

Table 6. Social influence and hedonic motivation dimensions and characteristics

Dimension	*Question*
Social influence	*How does your social environment perceive the use of VR in your lecture?*
Characteristics, definition, resources.	
(+/-) (No) institutional support	The perceived support of structures for VR within an institution (Kavanagh et al., 2017; Pellas et al., 2021; Radianti et al., 2020 E1, E9, E10).
(+/-) Positive/ negative perception of VR by colleagues	The perceived support and approval from colleagues for the use of VR in lectures (Pellas et al., 2021, E5).
(+/-) Positive/ negative perception of VR by students	The perceived enjoyment from students regarding the use of VR and interactivity with the learning content (Kavanagh et al., 2017; Radianti et al., 2020, E2, E9, E16).
Hedonic motivation	*What motivates you personally to use VR in your lecture?*
(+/-) (No) motivation by personal interest	The lecturer's intrinsic interest to use VR (Radianti et al., 2020, E1-E16).
(+/-) (No) motivation through students	The perception that students find VR motivating and enjoyable, which encourages lecturers to use it (Kavanagh et al., 2017; Radianti et al., 2020, E2, E9, E16).
(+/-) (No) motivation by the expected benefit	The belief that VR's benefits justify the effort required for implementation (Pellas et al., 2021, E10, E12, E16).

To demonstrate the utility of the taxonomy, we apply it to six scenarios, of which we present one in the following section.

5 A Cautious Evaluation of the Taxonomy's Utility

"I think these questions could be very helpful, e.g., in a coaching session or as preparation for one," said the university didactic consultant after reflecting on the taxonomy. *"I could easily use this as a checklist in client conversations. (...) the concepts really hit the mark,"* said the VR developer. Next, we describe an example of learning content – warehouse logistics management – applied to this taxonomy, as illustrated in Figure 3. This case was reflected by one university employee with VR experience and chosen to present it in this study for its adaptability to various contexts, such as virtual factory tours or other field-based learning experiences. The employee mentioned that organizing physical warehouse tours, such as Amazon's, is often too costly and involves significant logistical overhead.

One of the **learning objectives** in warehouse logistics management is to teach difficult-to-access concepts (e.g., structure and function of warehouses to teach logistics management), enable spatial inclusion for bachelor students from different locations, and deliver stable learning content (e.g., types of warehouses such as high-bay storage).

To achieve these objectives, the focus is on self-directed and exploratory **learning activities**. The **learning assessment** is planned to be outside of VR.

Dimension	Characteristics of VR use ('+') and VR non-use ('-')							
Learning objective	Access inaccessible concepts	Access difficult-to-access concepts	Simulation of practical skills	Taking on another role	Spatial inclusion	Increased and focused attention	Stable learning content	+
	Visualization of abstract concepts	1:1 Transfer of existing learning content without modification	Social learning					-
Learning activities	Practical application	Self-directed and explorative learning	Joint interaction and knowledge exchange					+
	Joint creation of results							-
Learning assessment	Formative assessment	VR-adapted summative assessment	Assessment outside VR					+
	Traditional summative assessment							-
Social influence	Institutional support	Positive perception of VR by colleagues	Positive perception of VR by students					+
Hedonic motivation	Motivation by personal interest	Motivation through students	Motivation by the expected benefit					+

Figure 3. Applied taxonomy

The employee has VR headsets and the necessary infrastructure at his university, and VR is positively perceived by both colleagues and students (**social influence**). The employee is personally interested in VR, aims to motivate students, and expects benefits such as cost reduction and resource efficiency (**hedonic motivation**). Examining the taxonomy's pattern after the application to the illustrative learning content (cf. Figure 4), it is estimated that VR is rather suitable. We say 'rather suitable' because the taxonomy provides a description of the reasons for both VR use and non-use with the aim to assess VR's suitability rather than make a definitive decision about VR's suitability.

"I think this makes total sense. Even though I have VR experience, I believe this would help university professors to get a first assessment," the university employee reflected and thus, emphasized the taxonomy's utility. Additionally, we conducted five further evaluations with two university employees with VR experience (learning content: design of research experiments, human resource management), one VR developer (production machine functions), and two university didactic consultants (qualitative interviews, archaeological site excursions), all of whom provided positive feedback. Due to space limitations, only one example is presented here.

6 Discussion and Conclusion

This study develops a taxonomy to structure reasons for VR use and non-use for higher education learning content with the aim – inspired by the PSMF (Bisswang, 2022) – to assess VR's suitability for future learning content. The taxonomy organizes reasons for VR use and non-use into five dimensions with 24 distinct characteristics.

Contribution to theory. While constructive alignment is widely adopted, it lacks the alignment of a medium (e.g., a technology) with learning objectives, activities and assessments. This led us to the consideration of the TPACK framework, which proposes to align technological, pedagogical and content knowledge for an effective integration of digital technologies into university teaching (Koehler et al., 2014). By combining constructive alignment (representing pedagogical knowledge) with UTAUT2 (representing knowledge about technology), we aimed to systematically assess VR's suitability for a given learning content (representing content knowledge), thereby addressing other researchers call to approach the decision on VR's use (Johnston et al., 2018).

Contribution for practice. The taxonomy supports university lecturers in making an informed initial assessment of whether VR might be appropriate for a particular learning context without forcing binary decisions or restricting academic freedom. For example, for the illustrative learning content on warehouse logistics management, VR was considered as rather suitable due to its ability to simulate access to a warehouse environment, reduce travel expenses, and support distributed collaboration. This example illustrates the taxonomy's utility to assess VR's suitability and inform decisions to use VR for a specific learning content.

Limitations and future research. The taxonomy was evaluated by three university employees with VR experience, one VR developer and two university didactic consultants. While their feedback was positive, a key limitation is the lack of input from lecturers without prior VR experience. Future research should involve this target group to refine the taxonomy and progress towards a VR assessment method for lecturers.

For learning content considered as 'rather suitable', further experts such as VR developers should be involved to assess contextual (e.g., class size) and technical factors (e.g., I-VR vs. D-VR, development effort) (cf. Won et al., 2023) when transforming learning content into a VR application. This study uses VR as an umbrella term; however, differentiating between VR types in future research could enhance the taxonomy's practical application. Moreover, factors such as costs, infrastructure, and cybersickness – a well-documented barrier to large-scale VR integration in classrooms (Mäkelä et al., 2025) – must be addressed in subsequent steps. Even when VR is 'rather suitable', technical limitations may remain – for example, *"holding the Oculus Quest handset controllers is not the same as holding laboratory equipment"* (Jin et al., 2022, p. 9). We therefore emphasize that our taxonomy offers initial orientation rather than a definitive decision-making tool; technical constraints should be evaluated by experts. A further limitation is the taxonomy's validity, as ongoing VR developments may introduce new use cases and require its expansion (cf. Jin et al., 2022; Mäkelä et al., 2025).

In the mid-term, we encourage future research to expand this taxonomy based on new VR software and hardware developments and the resulting didactic possibilities, and to explore the development of a VR assessment as a decision tool to operationalize the taxonomy. In the long-term, we encourage further research to develop a method to integrate VR into university teaching as the integration of VR in university teaching is a recognized research gap (Pellas et al., 2021; Radianti et al., 2020).

Conclusion. This study introduced a taxonomy to assess VR's suitability for higher education learning content. While the taxonomy is descriptive, future research is required to expand it to keep it up to date and to operationalize it.

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