DEVELOPING A VALUE SENSITIVE VR LEARNING ENVIRONMENT FOSTERING PROFESSIONALS' COMMUNICATION SKILLS

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E-learning using virtual reality (also called v-learning) made it possible to create a 'scalable v-learning platform', enabling anyone without programming experience to create v- learning content for soft skill training. In the current project, Large Language Model algorithms are developed that help make it easier to create content and to generate more realistic and interactive virtual trainings. In order to study which human values and design principles are relevant for developing a skill training virtual reality learning environment, we used a Value Sensitive Design (Friedman, 1996) method in order to gather the human values of varying stakeholders. First, we studied values to be taken into account from both student and teacher perspectives, including educational and didactical values. These human values based on literature studies were supplemented by the perceptions of stakeholders, including commercial ones, and their human values in mutual interactions (empirical perspective). For this, an ethical matrix (comp. Van der Stappen & Van Steenbergen, 2020) was used as an instrument (for empirical research) for (a) identifying the harms and benefits of the use of the VR learning environment and (b) discussing essential human values in the development and implementation process. Finally, these two perspectives – one conceptual the other empirical – are brought together and some recommendations are offered for designing ethical, transparent, and effective digital learning environments that support both students and educators in their professional development.

Keywords:
artificial intelligence,
virtual reality,
communication skills,
design principles,
e-learning

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1 Introduction

Higher education and professional training programs face increasing challenges, including rising student populations, heightened workloads for educators, and persistent shortages of teaching staff (Adubra et al., 2019). These issues contribute to reduced student-teacher interactions, limited opportunities for skill development, and potential declines in learning outcomes (van Ginkel et al., 2015). To address these challenges, digital learning environments powered by Artificial Intelligence (AI) have emerged as a promising solution, providing scalable, efficient, and interactive platforms for education and professional training. AI-driven virtual reality (VR) environments, in particular, offer immersive, adaptive, and realistic simulations that support skill acquisition in ways traditional methods often cannot (Bond et al., 2024). AI-enhanced digital learning environments have been shown to benefit student development across various domains, including science education (Lamb et al., 2021), language acquisition (Wei, 2023), and soft skill training (van Ginkel et al., 2019). By enabling personalized learning experiences, automating feedback, and providing real-time insights into learners' progress, these technologies can help alleviate the burden on educators while enhancing the quality of instruction.

However, the widespread integration of AI and VR (or broader: Extended Reality (XR)) in education (in a broad sense) has raised ethical concerns regarding autonomy of users or students, data privacy, and equitable access to learning resources (Van der Stappen & Van Steenbergen, 2020). These concerns are particularly relevant as AI-based tools become more autonomous in guiding learning processes, potentially affecting students' cognitive abilities, such as decision-making, analytical reasoning, and critical thinking (Zhai et al., 2024). Additionally, the use of AI-driven learning analytics to collect and interpret student data introduces questions about consent, data ownership, and fairness in educational settings (Ferguson, 2019). Further, the adoption of VR environments for learning brings challenges related to user autonomy and the potential manipulation of learning experiences (Skulmowski, 2023). While immersive simulations can enhance engagement and facilitate experiential learning, they may also inadvertently shape perceptions and behaviours in ways that warrant ethical scrutiny. These concerns highlight the need for a structured approach to integrating AI-driven VR tools in education—one that ensures alignment with educational goals while respecting the values and needs of diverse learners (Nguyen et al., 2023).

E-learning using virtual reality (also called v-learning) made it possible to create a 'scalable v-learning platform', enabling anyone without programming experience to create v- learning content for soft skill training. In a project financed by Kansen voor West, Large Language Model algorithms are developed by commercial companies that help make it easier to create content and to generate more realistic and interactive virtual trainings (project called 'AI generated v-learning content'). This study explores the ethical considerations and design principles for creating such a platform, aimed at enhancing professional communication skills. By adopting a Value Sensitive Design (VSD) approach (Friedman & Hendry, 2019), we aim to identify the key concerns and expectations of students, teachers, and professional trainees regarding the use of these technologies, in particular a scalable v-learning platform. Through two phases of our VSD-approach, a conceptual and empirical phase, we assess the potential benefits and risks associated with AI-enhanced learning, gathering insights from i) a (educational and technological) literature study and ii) structured workshops. To structure our empirical analysis, we employed the ethical matrix methodology (Van der Stappen & Van Steenbergen, 2020), enabling us to systematically capture the perspectives of different stakeholders on the potential harms and benefits of AI-driven VR environments. This contribution will conclude by offering recommendations for designing ethical, transparent, and effective digital learning environments that support both students and educators in their professional development. In doing so, the findings from this study contribute to the broader discourse on responsible AI and Virtual Reality use in education.

The study addresses the following research questions:

(1) Which human values are essential for stakeholders in AI-driven VR learning environments?

(2) How can these identified values effectively inform the design of ethically-aligned VR learning platforms?

2 Theoretical framework

2.1 Conceptualizing this study

This study investigates how a v-learning platform can foster professional communication skills while accounting for ethical considerations and stakeholder perspectives. As mentioned before, we used the framework of Value Sensitive Design (VSD), which has been widely used in various domains, including information and communication technology, biotechnology, sustainability, and healthcare (Friedman et al., 2006). Despite its broad applications, VSD remains relatively underexplored in the context of professional post-higher education training and digital learning environments in higher education. Recently, the ethical matrix, a tool used to support VSD, has been used by the University of Applied Sciences Utrecht in digital innovation projects to assess stakeholder perceptions on ethical values in education (Van der Stappen & Van Steenbergen, 2020). These theoretical insights have been used as a guide for our current study and for the following section on the VSD framework and the ethical matrix methodology.

2.2 Technological Advancements in Learning

Experiential learning, a pedagogical approach emphasizing active engagement, reflection, and real-world application (Kolb, 2014), has been significantly transformed by advancements in artificial intelligence (AI) and virtual reality (VR). These technologies offer immersive, adaptive, and data-driven learning experiences that enhance skill development across educational and professional training contexts (Makransky & Petersen, 2021). By simulating complex environments, VR enables learners to practice communication, problem-solving, and decision-making in realistic yet controlled settings, bridging the gap between theoretical knowledge and practical application (Radianti et al., 2020).

AI-driven learning environments further augment experiential learning by providing personalized feedback, intelligent tutoring, and automated assessment (Luckin, 2017). Such enhancements support self-directed learning and continuous improvement, making AI-powered VR tools particularly effective for skill-intensive domains, including professional communication and interpersonal training (Gopalan et al., 2023). Practice and feedback are some of the foremost aspects, aided by the VR technology, that aid in the education of soft-skills (Van Ginkel et at., 2019; Van Dongen 2024).

Despite these advantages, the ethical implications of AI and VR in experiential learning remain a growing concern. Issues such as data privacy, algorithmic bias, and the potential over-reliance on technology challenge the responsible deployment of these tools in educational settings (Zhai et al., 2024). Moreover, questions about the impact of immersive simulations on learners' cognitive load and emotional well-being necessitate further investigation (Parsons, 2021). A recent exploratory study in law showed significant increases in heart rate and electrodermal activity occurred from rest into the activity of presenting in VR (called 'pleading'; Van Dongen 2024). These described risks need to be managed with a safe and holistic approach, where an overview of information and priorities such as intrinsic stakeholder values regarding the technology play a prominent role. The design and implementation of AI-driven VR learning environments must therefore adopt a value-sensitive approach, ensuring that technological advancements align with educational goals while safeguarding ethical considerations (Nguyen et al., 2023).

2.3 The concept of Value Sensitive Design

Value Sensitive Design (VSD) is an approach that integrates human values throughout the design process, ensuring that ethical considerations are embedded in technological development (Friedman et al., 2006). Rather than focusing solely on usability and functionality, VSD examines the broader societal and ethical implications of new technologies (Flanagan et al., 2008). Within this framework, values are defined as 'what is important to people in their lives, with a focus on ethics and morality' (Friedman & Hendry, 2019, p. 24).

VSD identifies four categories of stakeholders whose values should be accounted for: (1) the sponsors or funders of the design, (2) the project team developing the technology, (3) direct stakeholders who actively use the technology, and (4) indirect stakeholders who may be affected by the technology without directly using it. Understanding the impact on indirect stakeholders requires forward-looking and adaptive design thinking, considering both the long-term effects and the potential for unintended consequences as AI-driven tools expand in use (Nathan et al., 2008). In this study, indirect stakeholders specifically include institutional IT support staff, policymakers involved in educational technology regulation, and future students indirectly impacted by technology adoption.

The VSD approach is applied through an iterative process involving two perspectives: both conceptual and empirical. At the conceptual level, stakeholders and relevant values are identified based on existing literature and theoretical considerations. The empirical level focuses on gathering stakeholders' perspectives using methods such as focus groups, interviews, or surveys, allowing for the identification of tensions between different values. The combination of these perspectives translates these insights into design strategies and recommendations for further implementation, ensuring that identified values are reflected in the system's functionality and user experience on long-term. These stages interact dynamically, allowing for continuous refinement and adaptation as insights emerge (Friedman & Hendry, 2019). Over time, VSD has been successfully applied in diverse domains, including web security (Friedman et al., 2002), renewable energy technologies (Oosterlaken, 2015), AI system design (Umbrello & van de Poel, 2021), and music copyrights (Nerko et al., 2024).

3 Methodology

3.1 A method for Value Sensitive Design

To explore the human values and design principles relevant to the development of a virtual reality learning environment for fostering communication skills, the VSD approach was adopted (Friedman, 1996). The study was conducted through two experimental workshops involving students, teachers, and professional trainees, utilizing the ethical matrix (Van der Stappen & Van Steenbergen, 2020) as a structuring tool for gathering and analyzing data (see figure 1). The ethical matrix is used to identify possible harms and benefits of the technical subject on its direct and indirect stakeholders, by creating a discussion between creators and users to foster transparent conversations for the development of the technology.

In the conceptual research, a systematic literature review was conducted to identify and categorize human values relevant to AI-driven VR learning environments based on other cases. The review followed the structured approach outlined by Fink

(2014), covering values applicable to educational, professional, and commercial contexts, ensuring a broad perspective. The selection criteria included peer-reviewed studies that (a) examined the role of digital learning environments in communication skill training, (b) discussed ethical and human value considerations within these training technology contexts, and (c) provided empirical insights into AI and VR implementation in education and professional training. The identified values from this literature review were not discussed during the empirical research to prevent participant biases.

Table 1: The ethical matrix template

	Value 1	**Value 2**	**…**
Stakeholder group 1	Harms and benefits	Harms and benefits	
Stakeholder group 2	Harms and benefits	Harms and benefits	
…			

Source: Van der Stappen & Van Steenbergen, 2020

The empirical phase involved two experimental VSD-workshops, each designed to elicit insights from three stakeholder groups: students, teachers, and professional trainees. The objective was to examine how these groups perceive the benefits and potential harms of the AI-driven VR training program to their specific roles and to identify values that should be considered in its development and implementation to adapt to the stakeholders' intrinsic values.

3.2 Research phases and data collection

Each VSD workshop, conducted by two independent researchers, consisted of three phases:

Introduction and Familiarization: Participants were introduced to the AI-driven VR training program and the study's objectives. The AI tool was shown, a conversation took place between the creator and the program and afterwards, questions were answered. They were briefed on the ethical matrix as a tool for structuring their reflections and the definitions used within these methods for specific intrinsic values.

Ethical Matrix Exercise: Participants independently identified potential harms and benefits of the VR learning environment based on their role, writing these aspects down on post-it notes. These post-its were either written on green notes identifying the benefits, where harms are written on red notes. Harms were defined by the risk or potential damage the software could have in its implementation context, where benefits represented the potential positive impact.

Focus Group Discussion: A facilitated discussion followed, where participants elaborated on their identified concerns and values, engaging in a structured dialogue to refine their perspectives, where open, non-steering questions were used such as: 'Why does this seem like a harmful aspect to you?' or 'Why could this be a benefit and why is this important to you?'. Audio recordings were made to aid in the translation from the ethical matrix towards the intrinsic values. The combination of both audio recordings and the filled ethical matrix as outcome of the workshops were then used to summarize the most-noted values and quotes, highlighting the specific harms or values from which the values were derived. The conversations held in both groups were facilitated by researchers with deep understanding of VSD and the Ethical Matrix. One of these researchers conducted the decoding of the data of both conversations to the paper's findings. Another researcher checked the paper findings.

3.3 Participants and privacy

A total of 18 participants were recruited across the three stakeholder groups, with six representatives from each category, ensuring balanced perspectives in the further discussions. Ethical approval was obtained from the University of Applied Sciences Utrecht Research Ethics review board, and all participants signed an informed consent before participation. The audio recordings were deleted after having been used as a check to the notes made during the workshops. Furthermore, in VSD terminology, participants were referred to as 'stakeholder', due to the nature of their relationship to the product, where for this study the term 'participant' is used.

4 Findings

4.1 Introduction

This chapter presents the findings derived from i) the literature study on values before the stakeholder meetings ('workshops') were held; ii) the stakeholder analysis based on various key values as discussed during the beforementioned VSD-workshops. Each value is briefly defined based on our literature study, followed by an overview of both positive and negative perspectives from different stakeholder groups.

4.2 Conceptual

Based on the literature review, we identified fourteen key values: efficiency, autonomy, human connection, competency, quality, accessibility, flexibility, adaptability, authenticity, safety, inclusion, enjoyment, effectiveness, and ethics. As outlined in the methodology section, these values stem from a wide range of studies on digital learning environments in different contexts (Yulian et al., 2022, Kent, 2021, Lenca et al., 2023). Importantly, the process required translating reported harms and benefits in these studies into overarching values — a subjective exercise that involved interpreting the intended meaning from each source. Consequently, these values cannot be directly attributed to any one specific tool or platform. Nonetheless, they serve as a useful framework for comparing and contextualizing the focus group findings, offering an initial, exploratory sense of how broadly applicable those findings might be. These values illustrate significant trade-offs in deploying VR technologies: while they enhance efficiency and autonomy, they can simultaneously raise issues such as increased cognitive load or reduced interpersonal interactions.

Many of the values identified in the literature were associated with both advantages and drawbacks. For instance, didactic quality can be enhanced through technology's ability to present material in innovative ways or support diverse teaching strategies. Yet, the same quality can be compromised if technological solutions are rigid or fail to account for individual learner differences or contextual nuances. Similarly, human connection may be strengthened by promoting peer interaction and collaborative learning but could also suffer from reduced teacher-student engagement. Autonomy is another value that shows duality: while technology can empower learners to independently explore content, it may also foster dependency on these digital tools. Interestingly, four values were consistently described in the literature as offering only benefits: safety, enjoyment, effectiveness, and inclusion. Inclusion was noted in the context of voice-user interfaces, enabling better access for students with difficulties using keyboards or traditional search engines. Safety was highlighted as learners could practice skills without real-world repercussions, helping them feel more secure and confident before applying those skills in actual settings. Enjoyment was linked to increased student engagement, particularly when technology introduced novel ways of presenting content or offered greater diversity in learning activities. Lastly, multiple studies reported that educators observed clear learning gains among students using these digital learning tools (McLaren et al., 2017. Wang & Lieberoth, 2016).

4.3 Empirical

Multiple core values – relating to the virtual reality learning environment – were recurring within the two workshop groups. Although the values were labelled differently by each of the workshop groups, they were clustered based on their given definitions on the harms and benefits, resulting in the following outcomes:

As shown in the Ethical Matrix, the value Reputation is a crucial factor in how the tool is perceived in terms of credibility and professionalism. Trainers, teachers, and learning coordinators emphasized that the tool must maintain a serious and polished appearance, avoiding any design elements that could make it look cheap or unprofessional. This concern was mirrored by students, who expressed worries that using the tool might impact how seriously they are taken in their learning environments. Furthermore, the perception of professionalism ties directly into the effectiveness of the tool, as users are more likely to engage with a system they deem reliable.

Beyond its Reputation, the participants mention that the tool offers New Learning Experiences, which were recognized as a key advantage. Trainers, teachers, and learning coordinators highlighted its ability to introduce engaging and innovative learning concepts that go beyond traditional methods, using a broad scala of even the most recent information. Students found the experience novel and stimulating, while trainees, professionals, and users appreciated how it allowed for further research into evolving learning experiences. However, it was also emphasized that the novelty of these experiences must be balanced with ensuring that the tool does not feel gimmicky or lack depth in its educational offerings.

Table 2: The combined ethical matrix outcome of the two workshop groups

	Reputation	New Learning Experiences	Safety	Human Connection	Scalability & Impact	Quality	Accuracy	Transparency	Ease of Use	Sustainability
Trainer / Teacher / Learning Coordinator	Should appear serious, should not look cheap	Concept is interesting and offers new learning experiences	Must be well secured, safe practice with new behaviour	Need for face-to-face moments	Ability to reach a broader target audience	Realistic view is important, constant support and updates are crucial	I'm afraid the tool might work against me	Black box: can it be explained?		Already uses a lot of energy
Student	Not taken seriously as a student	New experience	students feel vulnerable and can feel unsafe in practice	Reduction of human interaction	Student feedback: does it really work?	Should align with existing teaching methods	AI does not do exactly what I mean (loophole)			A lot of data — how do we store it?
Trainee / Professional / User		Research into learning experiences				Effectivity should be scientifically proven to make sure to receive consistent results over time			Why feedback only later? Prefer immediate feedback	Criteria: sensitivity and selection rules

Source: data collection

Participant: "The conversations look really well and in-depth, but I do see this uncanny valley form with these AI avatars looking really fake and creepy. I doubt people will take this seriously in the long term unless we move out of this uncanny valley."

Safety, both in terms of data security and emotional comfort, was another major consideration of the participants. Distinct views can be distinguished. Trainers, teachers, and learning coordinators underscored the importance of ensuring a well-secured system that provides a supportive environment for practicing new behaviours. Students however reported feeling vulnerable while using the tool, with some expressing discomfort in how it handled their interactions. This highlights the tension between innovation and user comfort—while the tool provides novel learning opportunities, it must also ensure a sense of security to encourage full engagement.

A discussion between participants showed both positive and negative impact on the value of safety through this digital learning environment:

Participant 1: "Usually, when there are training actors involved, one student stands in front of the group to do the exercise. The rest of the group learns from the observation of this as well."

Participant 2: "Yeah, so there is safety in being able to watch from the sidelines for the first time."

Yet other participants also highlighted the secondary effect on safety:

Participant 3: "But there is also safety in being able to practice on your own at home, instead of in the presence of your peers."

This discussion shows the ethical challenge of both the positive and the negative implication on Safety, throughout the creation of a time and place independent learning environment. This conversation fueled other values later described.

In the discussions, the balance between Personal Interaction and Digital Automation within the learning process was a recurring theme. While trainers, teachers, and learning coordinators stressed the necessity of maintaining face-to-face moments in education, students voiced concerns that the tool might diminish Human Interaction, making learning feel less personal. This contrast underscores a key challenge: while automation can enhance accessibility and scalability, it must not come at the cost of meaningful human engagement.

Participant: "There is value on being able to practice on your own. But on the other side, I do see that people do not act collectively anymore. Even learning is now individualized."

Speaking of Scalability & Impact, trainers, teachers, and learning coordinators saw great potential in reaching a broader audience through the tool. However, students were more sceptical, questioning whether the tool's approach would be as effective in real-world learning environments. This divide raises an important point about implementation—while scalability is advantageous, it must be paired with adaptability to ensure effectiveness across different user groups.

When it came to quality of the virtual environment, stakeholders placed high importance on the tool's Effectiveness, Realism, and Reliability. Trainers, teachers, and learning coordinators insisted on a realistic interface with consistent support and updates. Meanwhile, students emphasized the need for alignment with existing teaching methods, and trainees, professionals, and users highlighted the necessity of scientific validation and long-term consistency. However, ensuring high quality may present challenges in terms of Accuracy, which was another significant concern which came up during the workshops. While a realistic interface is essential, trainers, teachers, and learning coordinators were wary of the potential for misleading or incorrect outputs:

Participant: "A lot of these AI-assistants don't seem to provide consistent results over a longer conversation. They start dreaming and moving out of bounds of the prompted instructions. This could become an issue as the tool starts to respond differently."

Students similarly noted inconsistencies in AI-driven functionalities, which sometimes failed to behave as expected or misinterpreted their inputs. Thus, while striving for quality, developers must also prioritize precision to avoid user frustration and misinformation.

Similarly, Transparency emerged as a crucial consideration. Trainers, teachers, and learning coordinators voiced concerns that the tool might function as a "black box," making it difficult for users to understand how it arrives at its conclusions. This concern ties closely with accuracy—if users cannot comprehend the logic behind the tool's outputs, trust in its accuracy may diminish. Therefore, providing explanations for how decisions are made could enhance both trust and engagement.

Another major factor was Ease of Use, particularly regarding accessibility and responsiveness. Trainees, professionals, and users expressed frustration with delayed feedback, stating a preference for immediate responses that could enhance their learning experience. This need for efficiency further reinforces the demand for accuracy and transparency. Furthermore, quick feedback must also be correct and clearly explained.

Finally, Sustainability was discussed in terms of both environmental impact and data management. Trainers, teachers, and learning coordinators noted that the tool already consumes significant energy, raising questions about its long-term viability:

Participant: "Every day more datacentres are being built for all this AI. I saw that they use a lot of energy and water, is this not something we need to account for when we want to broadly implement these tools?"

Students questioned how large datasets should be stored efficiently, while trainees, professionals, and users emphasized the importance of establishing clear criteria for data selection and storage to ensure responsible management. While sustainability may seem like a separate issue, it is closely tied to the tool's long-term effectiveness—without efficient data handling and energy-conscious design, its usability and credibility may be compromised over time.

5 Conclusion

This study enhances the transparency of discussions on ethical values regarding v-learning context of an human-AI communication technology to incorporate ethics by design on the development of this technology.

The outcomes of both the literature and the empirical perspectives, revealed that participant values regarding this v-learning context, such as safety and inclusion, are foundational to user acceptance. Safety, encompassing both emotional comfort and data security, was consistently highlighted as crucial, particularly given the vulnerability participants felt when interacting with AI avatars. Inclusion, exemplified through accessibility features like voice-user interfaces, is important as well as it ensures that learners of all backgrounds and abilities can participate meaningfully. Enjoyment and effectiveness were also prominent: stakeholders noted that when learning tools are engaging and demonstrably effective, they foster deeper learning and motivation.

However, the current study also highlighted the inherent duality of certain values. For instance, while autonomy and flexibility are beneficial in promoting independent learning, they risk reducing human connection and collaborative learning experiences. Similarly, scalability and automation, though valuable for reaching larger audiences, may inadvertently diminish the personal touch and lead to perceptions of detachment or reduced educational quality.

Caution is therefore needed when balancing these values. The tension between realism and accuracy was particularly evident. While stakeholders appreciated realistic interfaces, they cautioned against inconsistencies in AI outputs that could undermine credibility. Transparency is another area requiring careful design; without clear explanations of system decisions, users may lose trust in the technology. Moreover, concerns about environmental sustainability and data storage were raised, highlighting that technological innovation must not come at the expense of long-term viability.

This study, while rich in qualitative data, was limited in scale, with only 18 participants. Broader quantitative research would provide stronger validation of these findings. Additionally, the study focused on perceptions prior to full-scale implementation; longitudinal studies are needed to assess how these values evolve with prolonged use. Finally, cultural factors and disciplinary differences were not deeply explored and may influence value prioritization.

Future research could address these limitations by expanding participant diversity and employing longitudinal study designs to observe how perceptions on harms and benefits, and even values, can change during the process. Furthermore, more research can be conducted to explore adaptive interfaces that dynamically balance competing values such as autonomy versus guidance, or scalability versus personalization. Practical implications of this study include incorporating adaptive feedback mechanisms, embedding transparency features to clarify AI decision-making, and developing emotionally responsive design elements to address user comfort.

Furthermore, given the identified risks such as manipulation and cognitive impact, a comparison with other methods such as Value Based Engineering (VBE) could provide more insight into the risks of specific values in these contexts.

The VSD methodology using the ethical matrix showcases the overview that can be created based on stakeholder values, providing information on priorities towards the development of v-learning technology. Using these values as a roadmap for further development and policy development regarding aspects as ethics, autonomy and more could provide a significantly more suitable practical v-learning environment than without the VSD approach.

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