Integrating Virtual Reality into SE Classrooms: Practical Educator and Researcher Insights

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Abstract—Preparing SE students for professional SE practice increasingly calls for developing their capacity for inclusive software design, yet traditional teaching methods struggle to convey the lived experiences of people with diverse needs, such as people with disabilities (PwD), in ways that meaningfully supports understanding of accessibility in software design. Virtual Reality (VR) offers a promising way to address this gap by immersing students in first-person perspectives of PwD that can reveal real-world accessibility barriers. Yet, VR's integration into SE classrooms remains limited and little is known about how SE educators navigate the practicalities of VR use in authentic classrooms settings. To address this gap, we investigated seven, 2-hour classroom implementations of a software accessibility-focused, VR lesson in a Human-centric SE (HCSE) course and then conducted post-hoc educator interviews to understand the encountered facilitators and barriers when integrating VR lesson and VR Headsets (HMDs). Through a qualitative analysis of the interviews, we found that the educators' utilized VR simulation as an experiential learning tool that can deepen understanding, foster empathy and enhance engagement. We also identified that the capacity to facilitate VR while managing health, safety, and diverse student needs is critical to successful integration. The paper also contributes practice-based educator recommendations and researcher insights for enhancing VR lesson delivery and integrating VR into HCSE education, including strengthening logistical planning, refining pedagogical framing, and improving training and support for both educators and students.

Keywords–Virtual Reality, Educators' experiences, Human-centric software engineering, VR Experiential Learning

1. Introduction and Related Work

Preparing SE students to design inclusive technologies is an increasing priority in Human-centric Software Engineering (HCSE) education [1], [2], as it fosters equity, drives innovation, and ensures that future IT professionals create, implement, and manage technologies with a human-centred focus [3], [4]. However, traditional teaching methods often struggle to convey the diverse needs of people [2], [5] with different physical, sensory, cognitive abilities, such as people with disabilities (PwD) in a meaningful, impactful way.

Virtual Reality (VR), a technology that can support the creation of 3D spatial environments representing real or non-real situations [6], offers a promising way to address this gap. By placing students in an interactive digital simulation of an environment, it provides students a first-person perspective of users [7], such as PwDs to better understand their experiences and the real-world barriers they face [8]. This enhances empathy [9], [10], awareness, and critical thinking [11], [12] that are the key attributes for ethical and inclusive practice in IT [1], [13]. Owing to VR's unique affordances, such as immersion and digital presence [14], its use in education [15], [16], including SE areas such as system development, software processes [17], [18] and supporting accessibility and inclusion in software design [8], [19] has been gaining attention.

Despite VR's promising potential, its integration into higher education [20], [21], including HCSE classrooms remains limited [22], [23]. Multiple barriers such as high costs, technical glitches, cybersickness have been identified more generally [16], [24]. Beyond technological constraints, factors such as instructor confidence, institutional support, and the perceived VR pedagogical value [25] that influence VR adoption are known. However, most studies either prioritize student experiences or system evaluation [26], [27], focus on educators' attitudes and beliefs [24], [25], [28], or other aspects (such as VR video generation [29]) rather than how educators navigate VR implementation in real classrooms which has been underexplored in literature [30], [31].

In this context, there is a need to better understand the practicalities, contextual barriers, and facilitators educators encounter when integrating VR into real classroom settings [23], [29], particularly through discipline-specific SE education studies [22], [30]. To address this gap, this paper presents insights we gathered from SE educator interviews on what worked and what hindered their delivery of a VR-based lesson on accessibility in software development and integration of VR Head Mounted Displays (HMDs) in their classrooms.

2. Research Questions

Our study answers the following four research questions(RQs):

1) RQ1. What impacts on **student learning** do SE educators perceive from the VR-based learning experience?
2) RQ2. What aspects act as key **facilitators** for SE educators in integrating a VR HMDs into their classroom practice?
3) RQ3. What **barriers** do SE educators' encounter when integrating VR HMDs into their classroom practice?

TABLE I
PARTICIPANT DEMOGRAPHICS AND PRIOR VR EXPERIENCE.

ID	Age (yrs)	Gender	Teaching Experience (yrs)	Prior VR Use	Prior VR use in Teaching
P1	55-64	Man	10+	Yes	No
P2	55-64	Woman	4-7	Yes	No
P3	18-24	Undisclosed	1-2	Yes	No
P4	18-24	Man	1-2	Yes	No
P5	18-24	Man	1-2	Yes	No
P6	35-44	Man	7-10	Yes	No
P7	25-34	Man	7-10	Yes	No
P8	55-64	Woman	10+	No	No
P9	35-44	Woman	2-4	Yes	No
P10	35-44	Woman	1-2	No	No
P11	35-44	Man	10+	No	No
P12	55-64	Woman	10+	No	No
P13	35-44	Woman	4-7	Yes	No

4) RQ4. What **recommendations** do SE educators' make to improve integration of VR HMDs and VR-based lesson delivery in future iterations?

3. Study Context

3.1 Course Context

The VR-based learning experience was delivered across seven, two-hour classes in an IT professional practices course at an Australian university over one 'VR week' (Week 9 of a 12 week semester) focused on SE accessibility and inclusion (Section 4-B). The course had 390 undergraduate students and 15 teaching team members of the course (including the course lead, Teaching Associates (TAs), learning designers - referred to as educators collectively in this study). Each class had 50-60 students and a team of 3 to 5 educators from the teaching team. VR research team observed the in-class delivery (Section 8) and assisted with technical support if needed.

3.2 VR Equipment and VR Simulation Content

The study employed 20 HTC Vive Focus3 HMDs (each with two handheld controllers) loaned through a university-based VR lab. As a part of VR lesson, students watched a 4-minute Youtube 360° VR simulation, '*A Walk Through Dementia*' (developed by Alzheimer's Research UK) [1] immersively through the HMD, interacting via head and body movements. We selected this VR simulation for its ease of access and cost-effectiveness compared to custom-built simulations. This first-person simulation depicts a PwD struggling with everyday tasks, offering a credible, research-informed resource on accessibility needs of a PwD.

4. Study Method

4.1 Ethics

Firstly, we received an ethics approval for the study from the university institutional review board and informed the participating educators of the research aims with participation being entirely voluntary.

[1]VR experience: https://youtu.be/R-Rcbj_qR4g?si=0EtQMdtkBrSoGncu

4.2 VR Session Planning with Course Team

We began with a planning session with the course examiner and learning designers to organise VR loan from a university-based VR lab and ensure alignment of the VR lesson with course learning outcome to ***'prepare future IT professionals to understand accessibility and empathize with diverse user needs in inclusive technology design'***. We co-prepared a lesson plan (Section 4-E) outlining structure and instructions for VR use, supporting coordination and teamwork during in-class facilitation.

4.3 VR Training for Educators

Prior to in-class VR lesson, all fifteen educators completed a basic 1-hour training session (Figure 1) run by the research team covering headset fitting, controller use and basic troubleshooting. They familiarized themselves with the VR lesson briefing and reflection questions. They were also provided access to the VR experience (Section 3-B) as a video alternative resource for students who opt out of VR.

Figure 1. VR Educator Training Session with HTC Vive Focus3 HMDs

4.4 Demographic Questionnaire

We then administered a short 5-minute questionnaire to gather educators' demographic information and prior VR experience in teaching. Amongst the thirteen consenting educators from the course teaching team, three educators were aged 18-24, one aged 25-34, four aged 35-44, and five aged 55-64 years. The group comprised six women, six men, and one participant who preferred not to state their gender. In terms of teaching experience, three educators had 1-2 years, two with 2-4 years, two with 4-7 years, two with 7-10 years, and four with more than 10 years. Though some educators (7 of 13) had some prior VR experience through VR research study participation, VR games or cinema experience, none had previously used VR in their teaching. Refer to Table I for participant details.

4.5 VR-based Lesson Plan and Delivery

The key components of the VR-based lesson delivery were:

1) **Briefing** Teachers introduce the session, outline learning objectives for accessibility and inclusion, and explain both activities. They provide guidance on VR station use, safety protocols, and reflection expectations. Resources such as headset fitting guide & overview of VR simulation are

shared, and students are informed that participation in VR is voluntary, with video alternatives available if desired.

2) **VR Experience** VR simulation experience (Section 3-B) runs at dedicated VR stations (Figure 2) with assigned headsets and facilitators to ensure safety and smooth operation. TAs coordinate roles, deciding who manages VR facilitation and who supports the accessibility learning activity. Technical support is available from the research team as needed. Students choose to sit or stand while experiencing the VR simulation and engage with the simulation using head and body movements, wearing a HMD. They are informed that participating in VR experience is voluntary and they can pause or stop the simulation at any time or request educator assistance.

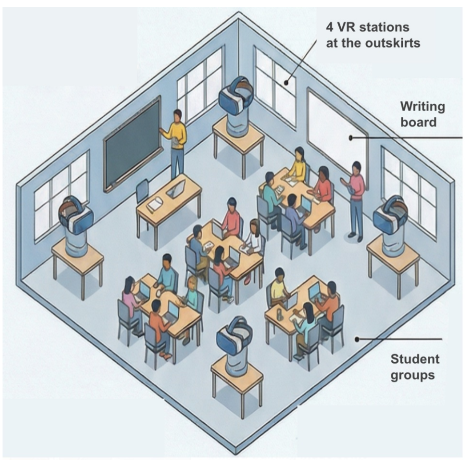

Figure 2. Graphical Image to show VR Station setup at Classroom outskirts

3) **Post-VR Reflection** Students engage in group discussions and then whole-class debrief guided by reflection questions related to: **a)** identifying accessibility needs for PwD, **b)** technology needs for diverse users, **c)** inclusive software design considerations and **d)** implications for professional SE practice to help consolidate learning.

4.6 VR-based Lesson Delivery Workflow

The session begins with a tutorial introduction outlining diversity and inclusion learning objectives, followed by a VR briefing that explains participation, safety, and use of the scenarios. Both activities are introduced, and students are assigned to either VR stations or an activity reviewing a website for accessibility issues, based on headset availability. Classes run with team teaching, where TAs allocate roles amongst themselves for VR facilitation and learning activities, with technical and facilitation support from the researcher team. Teams rotate through VR stations , with TAs monitoring correct headset use and sanitization, and student safety. Following VR experience, teams discuss post-VR reflections and a whole-class debrief links VR insights to IT professional practice and inclusion.

4.7 Post-VR Implementation Educator Interviews and Interview Questions

After the conclusion of the *VR week*, we conducted 13 semi-structured post-hoc interviews (audio-recorded) with consenting educators. During these 45-60 minute online (Zoom) **interviews**, we asked the following questions:

> For **RQ1**, we asked: **Q1)** *In what ways did the VR-based lesson impact students' learning experience?*, **Q2)** *What potential learning benefits did you perceive from using a VR-based lesson?* and **Q3)** *What potential negative impacts did you perceive from using a VR-based lesson for student learning?*. For **RQ2**, we asked: **Q4)** *What things went well with integrating VR-based lesson in your classroom?*. For **RQ3**, we asked: **Q5)***What challenges did you actually encounter or observe in integrating VR-based lesson into your classroom?* and **Q6)***What strategies would you suggest to overcome these challenges? and **Q7)** What suggestions do you have to improve the delivery of VR-based lessons in the future?*. For **RQ4,** We asked: **Q8)** *What type of support or resources do you feel would be helpful to more effectively integrate VR into your future teaching?* and **Q9)** *What type of support or resources do you feel would be helpful for students to more effectively learn with VR lessons?*

5. Data Analysis

5.1 Researcher Positionality

Our analysis was led by the primary analyst (first author) with 15+ years of teaching experience in human-centered SE, and the other two researchers with research expertise in data science and software engineering contributed as interpretive collaborators. Our disciplinary perspectives shaped our analytic lens and interpretation of educators' experiences. While familiar with educational technologies in our teaching and research contexts, we were relatively new to VR motivating our focus on practical considerations in integrating VR HMDs and delivery of VR-based lesson in authentic classroom settings.

5.2 Data Analysis Procedure

We used Braun and Clarke's relexive thematic analysis approach for data analysis [32], following their six steps: familiarisation, coding, theme development, reviewing, defining, and reporting. The first author (primary analyst) transcribed all interviews, manually checked the accuracy against the audio, engaged in repeated transcript reading to build familiarity and noted initial impressions. The primary analyst then began systematic coding in NVivo 12.0, following a reflexive approach, capturing underlying ideas and assumptions. The four overarching **themes** - **Facilitators**, **Barriers**, **Student impact** and **Recommendations** were developed deductively based on the study's research questions (RQ1-RQ3), while responses to individual interview questions were coded **inductively** to capture nuanced insights. Specifically, responses to Q4 were

Figure 3. VR Implementation Study Design

coded as *Facilitators* (RQ1), Q5 as *Barriers* (RQ2), Q1–Q3 as *Student Impact* (RQ3), and Q6-Q9 as *Recommendations*. The primary analyst coded reflexively, with other two researchers as **interpretive collaborators**, offering disciplinary perspectives to enrich understanding. We met regularly to review codes, discuss interpretations, and refine the structure, while final decisions remained grounded in the primary analyst's reflexive judgement.

Our analysis generated 15 preliminary **codes** for facilitators, 18 for barriers, a set of 5 positive and 2 negative student impact and 5 recommendations. We then iteratively reviewed and refined the codes, with similar codes clustered into broader **code categories** F1-F10 and B1-B7, within the overarching **themes** (See Summary Tables II and III). For example, *teaching method variety*, *VR reuse intent*, and *VR pedagogical value* were consolidated into the code category Facilitator F6 *Educators' positive perceptions of VR's value* listed in Table II. Similarly, technical issues codes such as *blurry content, boundary setting issues, equipment confusion, controller pairing, equipment fragile, headset battery, internet connectivity* were combined into the code category B1 *Technical issues and equipment fragility* listed in Table III.

6. Study Findings

6.1 Perceived Impact on Student Learning (RQ1)

Educators perceived the following **learning impacts** for students from the VR-based learning experience:

Emotional engagement Educators described a '*stronger emotional response*' that connected them [students] personally with the topic [P12]. P7 felt that by stepping into the perspective of someone with dementia, students were able to experience challenges firsthand, which '*promoted empathetic thinking*' and improved understanding of these conditions. P12 recalled a student saying, '*Gosh, what would that be like for me?*' P11 said students mentioned they found the activity '*more involving than they anticipated*' and educators reported [P7, P12] that students appreciated engaging with the affective dimension of the subject, fostering deeper reflection and discussion on accessibility and inclusion.

Enhancing Awareness of Diverse Human Needs Educators observed that students gained '*a first hand and first person experience*' [P1] which allowed them to '*better understand the life of a person*' to '*relate and be more empathetic*' [P10]. P11 reported a student exclaiming '*I could really feel I was in the shoes of that person*' [P11], and reflecting how the experience linked to accessibility considerations in professional practice [P11, P2]. P12 remarked VR gave them an '*out of your range experience*' [P12], promoting empathetic thinking and awareness of the needs of others [P13], giving them 'a better opportunity to understand accessibility issues' by engaging 'in an immersive environment' [P9].

Increased Student Engagement and Motivation with Lesson Content Educators described that students were '*quite excited*' [P1, P7], further noting it made them '*forget their current environment and just be concentrating on what's happening in the VR experience*' [P1]. The novelty of using VR technology, particularly for IT students, contributed to '*more active discussions*' and '*better turnout'* [P7], while some students who were initially reluctant ended up participating [P9]. They observed that students were generally curious and open to trying something new [P12], with many expressing a preference for VR '*over being a silent observer*' [P10], and that it enhanced their attention and encouraged exploration of the topic [P2, P5, P7].

Enhanced Immersion and Focus Educators observed that students who engaged with the VR activity were 'fully involved' [P1] and found it 'very immersive' [P1, P5], with many noting that it 'just made them forget their current environment and just be concentrating on what's happening in the VR experience' [P1]. The headset removed external distractions, as 'awareness of everyone around them is not there' [P2], allowing students to feel completely 'in their own world' [P6]. P7 felt that this level of immersion enabled students to experience situations firsthandwhich is more effective than passively watching a video and contributed to 'solidifying their learning' [P4].

Exposure to Emerging Technology and Career Relevance Educators viewed the VR lesson as a meaningful way to introduce students to innovative technology - '*a hands on experience of an implementation based on current research, real world application of a technology for inclusion*' [P2], while linking it to community awareness and professional preparedness [P6, P8, P9]. P7 also felt it '*led to more active discussions*', as students reflected on '*what you felt, and how you think you might be able to actually improve the situation, and how you might actually be able to use this technology*'.

Varied Reception and Challenges in Relatability Educators also perceived some challenges, for example, they reported mixed reactions from students while some were engaged, '*many students...didn't find it very useful...they were confused* *of why in the first place*' [P1] and as a result, chose not to take up the experience. Technical issues also affected their experience [P1].

Challenges in Relatability and Professional Relevance While the VR-based lesson engaged students, some educators felt that some students found it challenging to relate the experience to their own lives or future professional roles. For example, educators P1 and P11 made the following remarks: '*young people can't really relate to the old person's experience because they're so young*' [P1], and while the dementia scenario was valuable, it '*for most, unlikely to become a challenge in their professional life*' [P11].

Others highlighted a disconnect from the immersive experience, observing that students '*still know that we've got a headset on, and we can just remove it anytime*' [P6], which limited the sense of full immersion. Thus, educators [P7, P10, P11] emphasized *linking VR experiences more closely to students' professional contexts*.

Despite these differences, all educators commented that the VR-based activity prompted student discussion and reflection, with educators P10, P7 and P11 commenting that connecting it explicitly to learning outcomes required additional guidance.

6.2 Facilitators: Integration of VR HMDs (RQ2)

The post-hoc interviews with the teaching team identified the following aspects that worked well in integrating VR HMDs in their classroom practice (**Facilitators F1-F10**):

F1) More than half of the educators (n=7) commented on ***'adequate'* availability of VR headsets** [P13], describing the quantity as '*sufficient*' [P5], '*more than enough*' [P10] and having '*all the equipment that I needed*' [P3]. P9 admitted, getting sufficient quantity '*seemed like a big bottleneck at the start of the semester*' and P13 agreed that having '*one headset per group*' and '*..was really good...helped a lot because it really gave the opportunity to everyone*'.

F2) All educators (n=13) found **technical support** helpful, calling it '*120%*' [P9], '*guide to help them*' [P5], '*help reduce downtime..fix bugs quicker*' [P4] and that their familiarity with '*hardware and software makes it run much more smoothly*' [P3], particularly as some teachers did not have experience with VR [P3] and some [P1, P5, P11] feeling they were '*not trained for it*' [P1]. P3, 7, 9 and 13 also discussed the VR lesson was positively received by students, including '*adapting to using a VR headset, even those that hadn't used it before*' [P3], nearly all students in their class taking up the activity [P7] and no reports of dizziness, discomfort or students leaving the experience midway [P9].

F3) Eight educators found '*big classrooms*' [P9], '*a lot of space*' [P6], '***layout of the classroom***' [P5] favourable to the '*setup of 3-4 different [VR]stations*' [P5] for student VR use 'on the outskirts' [P4] that were '*well distributed in the space*' [P13] and '*spacious enough for students without jumping into each other*' [P10]. P12 compared it to a smaller classroom and found it 'chaotic' and as if '*students were yelling on top of all other people, tutors included*' [P12].

F4) Educators also commented positively on the ***workflow i.e. 'organizationally working out how to cycle through students'*** [P11]. This '*set up each headset in one specific place*' [P3] '*around the [student] tables*' [P3] or '*outskirts..or edges around the room*' [P5] felt '*separate, but focussed*' [P12] as students could come to '*experience VR there, discuss their experience...and then they would go to their tables*' [P11] without the need to '*set up the boundary over and over again*' [P3]. The **multiple VR stations** also allowed educators to '*continue running the experience*' even if there were issues with some stations that had to be stopped to fix the issues [P13], '*flowed well*' without '*a huge demand of people just waiting*' [P6].

F5) P9 commented that some tutors who had the '*technical know-how...would have helped out more*'. Some educators described themselves as a 'fairly technical person' [P7] and having a '*fair bit of VR experience in the past*' [P4] and expressed **self-efficacy** to '*figure it out and get them working*' [P7], reported '*no trouble with the students with the technology*' [P2] and '*for standalone headsets, you can turn them around pretty easily*' [P3]. P2. P7 and P11 also remarked on the **improvement of the flow** i.e. being '*a well-oiled operation*' after the lesson ran for a day or two [P11], increased **confidence** - '*a lot more confident with the headset*' [P2] and doubted '*additional support would be needed*' if the same activity was run with the same technology next time [P5].

F6) Another facilitator was the **positive perceptions towards VR, its potential or application in the course** that most educators (n=11) expressed. Educators described VR as 'new learning for students' [P8], 'empowering students..for the future' [P6], 'good thing before they go out in the workforce' [P2], 'convey things like experience that you cannot really teach' [P13]. Nine of these educators believed VR added a **new teaching method** that is '*a little bit different*' [P6]and more '*engaging*' [P1, P13] particularly compared to less engaging long assignments [P1], traditional teacher delivery for students to listen [P10] or written assignments such as writing email about accessibility issues [P9].

P9 saw it as a '*great opportunity to introduce accessibility in this* ***immersive manner***' and P8 considered it as '*a new technology..and ..caring about our community*' [P8], based on its '*physical interaction*' aspect [P4], its **experiential** affordance where '*students need to feel rather than just learn the concept*' [P10] which also makes it **AI-immune** ('[Students] *cannot use AI to get their answers. They have to experience it to answer the questions*' [P1]).

F7) Several positive pedagogical aspects were noted by the educators. Most educators (n=11) talked about the **alignment with the topic** of accessibility as a positive - '*[VR] gave them a first hand experience...that's a good think about using VR especially for this topic*' [P1], experience gave the students...awareness..building that empathy' [P13] and '*did help understand the needs of people with accessibility issues*' [P3]. P11 also discussed its **relevance** to '*students who are interested in multimedia design, game design, VR*' and students getting '*a* ***hands on experience*** *of an implementation based*

TABLE II
FACILITATORS: THEME, CODE CATEGORIES & CODES

ID	Code Categories	Code(s)
F1	Adequate VR headset availability	headset availability
F2	Readily available tech support	tech support helpful
F3	Multi-VR station class layout	class layout for VR
F4	VR station worklow effective	class workflow; multi-station delivery
F5	Educators' VR self-efficacy	VR support self-efficacy; educator confidence
F6	Educators' positive perceptions of VR's value	teaching method variety; VR pedagogical value; VR reuse intent
F7	VR alignment with topic	curriculum alignment; professional relevance
F8	Parallel lesson for engagement	parallel accessiblity lesson
F9	Supportive lesson briefing	VR briefing clear
F10	Debrief fostering reflection	post-VR reflection

on current research, real world applications of a technology for inclusion' making it a '*really memorable week for them*'.

F8) Eight educators found **running an accessibility-related lesson in parallel with the VR activity** effective. This approach mitigated disengagement during wait times, as P13 remarked, *'Why students would be possibly get bored, or just if they're not doing anything?'* It further allowed students to incorporate their VR experience into reflective tasks, as noted by P5, and enabled teachers to distribute responsibilities by alternating between VR facilitation and oversight of the complementary activity, explained by P2.

F9) P3, P4, P6, P9, and P11 commended the **briefing for the VR lesson**, which included *'a trigger warning..for sensitive topic'* [P11], keeping participation *'not mandatory'* [P3], and allowing students to *'take off the headset at any point if they felt uncomfortable'* [P4]. The briefing also addressed risks such as *'dizziness'* and emphasised *'staying close to the student'* while providing avenues to *'speak about the experience..particularly if they have a similar situation at home or close.'*

F10) Educators P7 and P11 further observed that students often *'would discuss their experience or how they felt'* [P11] after VR immersion, which led to *'more active discussions'* fostering *'empathetic thinking'* and when considering reflection on its application in *'professional settings'* such as *'how to incorporate technology to support these kinds of people and their experiences'* [P7].

6.3 Barriers: Integration of VR HMDs (RQ3)

Our educator interviews identified the following aspects that did not work well (**Barriers B1-B7**) in integrating VR HMDs into their classroom practice:

B1) Educators encountered several **technical issues with the VR headsets** and the simulation rendering. They key issues were internet connectivity and buffering issues (n=10), blurry content (n=5), boundary setting issues (n=3), limited battery (n=1) and controller pairing issues (n=3). P1 recalled a student describing the VR buffering as, *'blurry, slow and..stopping a lot of time*'.

B2) Educators' noted issues with **facilitating students' VR use** such as fitment **customisations** required for students due to '*different head shapes, some people wear glasses..'* [P3], *'people's hairstyle'* [P5], hygiene [P6] which required *'a lot of playing around with the head*' [P7]. This combined with educators '*not knowing how to fix problems*' [P13] and the '*inability to see what the user is seeing'* inside the headset meant educators having to ask students to take off the headset several times [P7] and put it on themselves to **diagnose issues** that *'contributes to a higher workload'*[P3].

Educators also raised **safety concerns** about '*risk of someone dropping [the headset]*', as headsets are '*fragile..they've got a lot of moving parts,..lenses..everything's quite precise*' and requires ensuring that '*transportation isn't rough or potentially damaging*' [P5].

B3) Without much prior planning, educators found themselves **planning for VR stations in an ad-hoc manner** [P1] such as finding space between furniture and student bags to setup stations, or having to move the stations [P2, P7] or students [P1] around. They found some classrooms were easier to setup than others [P12, P2], however, it got very **noisy** with multiple (up to 3) stations running in class along with the other learning activity [P7, P12].

B4) Educators [P1, P8, P10, P11] reported **low self-efficacy**, describing themselves as not feeling 'hands-on with VR' [P11], relying heavily on technical support [P1, P10], and **needing additional training** [P1, P8]. One educator [P10] also mentioned experiencing VR sickness, a personal **reluctance to use VR** and thus, feeling under-prepared to facilitate meaningful discussions after the VR activity, particularly when they had not personally experienced the full simulation, which limited their confidence in guiding reflection or connecting it to professional practice [P10].

B5) Seven educators described the VR-supported learning activity as a '*resource-intensive activity*' [P1] and '*logistical challenge*' [P11] due to **resource constraints** of not having '*a headset per person*' [P5]. They discussed the **pedagogical challenges** to '*keep other students engaged while some other students are performing this VR lesson*' [P1], implying VR lesson couldn't be the '*focal point*' i.e. '*everybody do it [VR], everybody debrief at the same time*' [P11]. P3 described VR immersion as '*mostly singular activity*' as '*they [students] can't really collaborate & all experience it at the same time*'.

B6) Regarding the **alignment of VR scenario with the learning objectives** of teaching accessibility and inclusion, P11 remarked, '*We had to tweak the learning outcomes to make the VR experience fit*'. Educators felt that the VR experience represented '*one specific type of special need for users*' [P1] and '*it wasn't probably the most **ideal scenario** to go through*' as it was '*not necessarily something that we focus on within **IT professional practice***' [P7].

B7) Some educators further indicated being **unclear about learning objectives** which led to **insufficient framing** leaving students confused about the purpose of the VR activity whether it was meant to teach about disability [P1, P11, P12] or demonstrate VR [P1, P4]. Educators [P1, P3, P4, P6]

TABLE III
BARRIERS: THEME, CODE CATEGORIES AND CODES

ID	Code Categories	Code(s)
B1	Technical issues and equipment fragility	blurry content; boundary setting; equipment confusion; controller pair; equipment fragile; headset battery; internet connectivity; other tech issues
B2	Fitment, hygiene, visibility issues	limited headset fitment accessibility; limited visibility inside student HMD
B3	Ad-hoc, multi-station VR	ad-hoc setup and noisy VR use
B4	Low educator confidence, reluctance to use VR	low confidence;limited training; discomfort or reluctance to use VR
B5	Limited headsets restrict VR to individual use	VR capacity constraint; VR scalability issue
B6	Inconsistent lesson framing across classes	briefing missing, inconsistent or unclear; task management conflict; team objectives alignment
B7	Inconsistent VR debrief	weak or rushed debrief across classes

noted that the activity felt poorly '*packaged*' with **inconsistent briefing**, and missed opportunities to link the VR experience to reflection exerrcise. Additionally, educators described challenges in managing or **scaffolding whole-class debriefs**, noting that transitions were rushed, inconsistently delivered across classes, or constrained by time and differing teaching approaches [P11, P13].

6.4 Educator Recommendations (R1-R5) for Future VR Integration and Lesson Delivery (RQ4)

Educators proposed the following **recommendations (R1-R5)** to improve the integration of VR HMDs and VR-based lesson delivery in the future iterations:
In response to barriers **B1** and **B2**, five educators [P3, P4, P5, P6, P12] discussed readiness aspects for more effective VR integration such as '*how reliable the technology is*', '*how comfortable the facilitators are with the technology*' [P6], equipment that is '*predictable*' i.e. doesn't keep '*stopping or starting*' or '*freezing*' [P12]. P13 suggested more '*intuitive*' headsets such as Meta P4 wondered if using '*less headsets might help with the controller pairing thing*' and P12 considered if it could have '*headstraps that are easily removed and applied*' and less clunky to '*avoid the risk of 'risk of someone dropping something*'.

> **Recommendation R1: Assess and strengthen readiness for effective VR integration.** Educators emphasised the importance of reliable and intuitive equipment, smoother setup processes, and ensuring facilitators feel confident and comfortable with the technology. They also noted that choosing simpler, higher-quality headsets and reducing technical friction would support more seamless classroom use.

Based on issues noted in barrier **B3**, three educators [P6, P7, P10] recommended exploring the possibility of bookable '*separate smaller rooms on campus*' [P7] as **VR 'mini labs'**, '*fully VR friendly learning environments*' [P10], or '*designated rooms*' [P6], where students could experience VR 'outside of the classroom' [P6]. P10 also added that having access to a **VR resource person** or tutor to maintain equipment, '*run these things and then give support to teachers*' to '*smoothly run it*' [P10] would remove the need to carry equipment between classrooms and minimise overhead tasks of charging and fixing VR equipment. Five educators [P2, P3, P4, P5, P7] suggested '**casting**' i.e. projecting the VR inside-headset view to a standalone laptop or monitor [P3] as that would allow for better '*control*' to '*see what they [students] are seeing*' [P5], '*control remotely through the computer*' [P7], '*help troubleshoot issues*' [P5], i.e. '*diagnose it [VR] with the student without putting the headset on*' [P7]. P4 remarked it might allow students to watch it in group and 'g*et enough of an idea of what it's like without experiencing it*'. P6 also considered **flexible VR learning** for **students with own devices** who could potentially download and engage with the VR simulation independently, outside the classroom setting.

> **Recommendation R2: Explore alternative configurations for delivering VR learning.** Educators recommended exploring dedicated VR-friendly mini-labs, or support assistance from dedicated personnel. They suggested trying more flexible delivery modes such as casting the headset view to a shared screen for easier troubleshooting.

To address challenges faced by staff in barriers **B4** and **B5**, educators P8 and P13 spoke of **in-class support for teachers**, such as a 'support team' [P13] that knows 'how to use it' and 'help the students if any problems come up' [P13]. P11 recommended developing '*expertise in at least some of the teaching team members*' and '***distributing that expertise***' resonating with P9 who remarked having '*at least two or three tutors who feel comfortable...confident in the use of VR*' in each class to address the challenges and reduce '*reliance on external support*'. Nine educators expressed the need for **more staff training** including setting up VR headsets [P5, P13], adjust focus, volume [P9], resolving technical issues and glitches [P7, P9], practising it multiple times to build confidence [P9] and **guiding students** to lead facilitator or support services in cases of severe discomfort with VR [P11], including **written documentation** or article [P7] to navigate different types of classrooms and headsets [P9] and set up, run and fix issues [P13].

> **Recommendation R3: Improve support for staff.** Educators recommended building internal expertise within teaching teams so that multiple educators feel confident using and troubleshooting VR without relying on external assistance. They also emphasized the need for more comprehensive staff training, including setup, technical diagnosis, and clear documentation to help staff navigate different VR equipment controls.

Reflecting on **B6** and **B7** barriers affecting students, almost half of educators (n=6) recommended further *VR* **onboarding support for students** i.e. *some kind of pre-class activity to get an understanding of what the technology does'* [P7] such as a brief tutorial [P2], video demo [P8] or tooltips in VR showing which buttons to press [P5]. They suggested resources on *'how to properly wear the headset'*, *'set the IPD or inter pupillary distance'* [P3], adjust clarity or sound [P8], and *'make the necessary adjustments or comfort level'* [P7] to reduce repeated instructions for every student [P2]. student accessibility issues- Four educators [P2, P5, P7, P9] recommended including ***'content warnings'*** [P2] such as *'a rundown of potential disclaimers'* [P5] for students who may experience *'balance issues, vertigo..'* [P5], *'dizziness'* [P9], or find the material depressing [P7, P2], especially if connected to a *'similar situation'* [P9]. An option of *'speaking to somebody else can be helpful'* was also suggested [P9]. While P5 noted this could address **health and safety** concerns, P9 cautioned that stressing *'too much that the content is..disturbing'* might *scare* students when the educator felt it was not *'that discomforting'*. In that context, two educators [P6, P9] called for **student agency** to engage with VR, as students could have '*personal reasons for not wanting to engage with VR*' or other '*'very legitimate reasons'* and should also be offered to *'leave it in the middle*' or '*talk through*' it with their teachers if they '*feel uncomfortable*' [P9].

Recommendation R4: Improve support for students. Educators recommended providing stronger VR onboarding for students, such as brief tutorials on headset operation and comfort settings to reduce repeated troubleshooting and ensure smoother learning. They emphasized the need for clear content warnings alongside careful lesson framing to protect student wellbeing, as well as alternative participation options when VR is unsuitable for some learners.

In relation to the improving the learning experience for students, educators discussed strategies such as better '***labelling***' [P1] and **framing** of VR lesson [P1, P11 and P12] in the context of the learning objectives, attaching the VR lesson to an assessment [P6, P12] or making it mandatory [P4] rather than opt-in activity might **enhance student engagement** and integration into the course. Almost half of the group (n=6) suggested **'tightening' post-VR discussion** or reflection through structured class discussion to integrate their feelings, thoughts and reflections [P12] or an open poll to post their thinking [P11], better educator facilitation through questioning and key points sharing [P13] or get students to think how these experiences could be '*applied to inclusive web design*'. Educators suggested trialling custom-made [P11] or teacher-made **VR scenarios** [P10] incorporating '*a very wide range of needs and diversities*' [P1], a more interactive experience [P4] or setting different scenarios at different stations [P6] for better alignment with course objectives.

Recommendation R5: Refine pedagogical aspects In response to the student learning challenges, educators recommended potentially linking the VR lesson to assessment or required participation to strengthen student engagement. They also emphasized the value of structured post-VR reflection and guided class discussions to help students make sense of the experience and link it better to their future IT professional practice.

7. Discussion and Implications for Educators

Our study examined the implementation of a VR-based accessibility lesson in a university SE professional practice course to explore the practicalities of VR use and lesson integration in HCSE education. Consistent with earlier studies, educators perceived VR as a powerful experiential and immersive tool that supported empathy, engagement and reflection on accessibility and inclusion related learning outcomes [8]–[10]. Our study also extends prior work by foregrounding educators' situated experiences of implementation in real classrooms. For example, facilitators such as adequate headset availability, strong technical support, effective spatial layouts, and structured workflows echo known institutional and logistical enablers of VR adoption [15], [25], while educator self-efficacy and confidence developed through repeated use reflect findings on instructor readiness influencing sustainability of VR integration [24], [28]. Unlike studies that focus mainly on attitudes or system evaluation, our findings show how these aspects interact in practice within authentic classrooms, especially when VR supports discipline-specific goals like accessibility and inclusive technology design, shaping realistic approaches of VR integration in HCSE education [1], [2].

Implications for Educators: The first implication is that VR integration in HCSE needs to shift from a technology-centred approach to human-centred facilitation prioritising educator self efficacy and pedagogical alignment of VR-based lessons. Secondly, facilitators such as readily available technical support and effective orchestration in authentic classrooms show that institutions need to invest in building educator capability. Thirdly, barriers such as troubleshooting, technical issues of blurry content, fitment issues, and equipment fragility and logistics work highlight the need for systematic workflows that reduce educator burden. Fourthly, adopting structured, inclusive lesson designs with content warnings, voluntary participation, and video alternatives can support accessibility in teaching. Finally, the effectiveness of VR-based lesson on learning depends on explicitly linking immersive experience to professional practice so students view VR not as a novelty but as a meaningful tool for developing inclusive software design capabilities.

8. Researcher Insights (RIs) and Implications for VR Researchers

We share the following researcher insights (RI1-RI4) to highlight the practical realities of VR integration that are often invisible in controlled studies:

RI1) Running VR sessions required substantial work - charging and configuring headsets, loading simulations, pairing controllers, and constant in-class troubleshooting. Educators described this load as '*a big responsibility... that it doesn't get damaged'* [P1] and noted that setup would have been *'a fairly extensive additional workload'* without shared support. **Implication for VR researchers:** We recommend explicitly documenting the operational labour of VR integration and examining how workload and coordination shape feasibility and sustainability of VR integration in SE classrooms.

RI2) We found that VR integration depended less on VR headset quantity but how the experience was orchestrated i.e. rotations, facilitation, and reflective framing. Educators highlighted time pressure,'*we have restricted amount of time... you cannot fit so many students'*[P13] and operational friction, *'redo the zones... swapping over the headsets... adjusting'*[P7] that shaped lesson flow. **Implication for VR researchers:** We encourage treating VR integration as an orchestration challenge and studying workflow design, facilitation strategies, and reflective scaffolds, not just hardware availability.

RI3) We observede that educators varied in their comfort with VR, noting *'not all of us are in the same level of managing the equipment'* [P10] and *'low initial confidence'* [P4]. Hands-on support was described as *'super necessary'* (P1, P6, P9, P13). **Implication for VR researchers:** We suggest embedding capability-building into study designs to support educator confidence and long-term ownership.

RI4) Across sessions, we noted that VR integration became smoother and more confident. Educators described the process as *'more manageable'* [P4, P9], eventually running like a '*well-oiled operation'* [P11], with some anticipating less need for support next time [P5]. **Implication for VR researchers:** Based on our experience, we advocate for iterative research that captures how VR practices evolve and how repeated cycles of refinement support sustainable VR classroom integration.

9. Limitations

As a first iteration, our VR-based lesson delivery study was exploratory and the sample size of 13 educators limits the generalizability of our findings. The second limitation is that we did not examine how demographic factors (e.g., experience level, gender) related to educators' in-class experiences, which presents an avenue for future work. However, it offers rich educator insights, identifying 10 key facilitators, 7 barriers, 7 learning impact areas and 5 recommendations spanning technological, pedagogical, and support aspects that shape the integration of VR-based lessons in authentic class settings. While not exhaustive, this initial categorization of aspects influencing VR integration in classrooms highlights an opportunity for future research to extend and refine these areas as VR adoption grows across broader disciplinary settings.

10. Future Directions and Conclusion

Future research should explore: **a)** how educators' conceptions and approaches to teaching with VR evolve over time, particularly as they gain experience, and in varied classroom conditions. **b)** Likewise, research involving educators with more varied familiarity and attitudes toward VR may offer additional insights. **c)** Studies that foreground students' experiences with VR learning would also offer important complementary insights. **d)** In addition, examining behavioral patterns and learning experiences across different demographic groups (e.g., gender, age, prior VR experience) might reveal meaningful differences in engagement and accessibility for both educators and students. Such work can show which challenges diminish and what new issues arise as VR becomes more integrated into HCSE education. The study's insights into facilitators, barriers, and recommendations for VR integration can help educators optimize VR-based experiential learning. In addition, the practical implications offer evidence-based guidance for VR researchers to design and conduct studies that are grounded in and sustainable within SE classrooms.

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