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# The Perceptions of University Students as to the Benefits and Barriers to Using Immersive Virtual Reality in Learning to Work with Individuals with Developmental Disabilities

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**Abstract:** The aim of this study is to understand the experiences of university students who took part in a pilot program for an experiential learning opportunity in immersive virtual reality (iVR). Experiential learning opportunities are essential for students who will be expected to apply their knowledge in a professional setting. Head-mounted display devices were distributed to university students and individuals with developmental disabilities at a partnering community organization. The university students met community partners in a virtual world and interacted with them to learn about their partners' self-selected goals related to communication and job skills. A mixed methods analysis of survey responses and journal entries was conducted. Students reported an overall positive experience with iVR and indicated an interest in pursuing future opportunities to include iVR in their learning.

**Keywords:** educational technology; higher education; immersive virtual reality; teacher training; special education; applied disability studies

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## 1. Introduction

Graduate students in university require immersive experiential learning opportunities to thrive beyond their academic studies. Experiential Learning Theory (ELT) suggests that learning is most effective when students engage directly with experiences [1]. Hands-on experiences and reflections can lead to profound changes in judgment, feelings, and skills [2]. Virtual reality (VR) technology, particularly immersive VR (iVR), has evolved to offer transformative educational experiences [3]. iVR distinguishes itself from non-immersive VR by providing fully immersive environments projected onto a head-mounted display (HMD), allowing learners to interact with 3D entities in real time [4]. In contrast, non-immersive VR typically involves a 2D virtual environment on a computer screen with keyboard and mouse interactions [5]. iVR aims to replicate sensorimotor engagement akin to real-world experiences, facilitating real-time communication and interaction with virtual objects and individuals, thereby creating a compelling sense of presence that mimics real-world scenarios [6,7].

In recent years, iVR technology has garnered substantial research support for its efficacy in education and training [8]. iVR simulations are instrumental in enabling learners to practice skills, make mistakes, and iterate—a cornerstone of experiential learning [9,10]. iVR environments offer unique experiential learning opportunities that are often inaccessible in traditional settings. They allow students to take risks safely and engage in repeated practice without fatigue or external demands [9,10]. Moreover, research indicates that skills acquired in iVR environments can be effectively transferred to real-world settings, showcasing the practical utility of iVR technology [11–14].

The capacity of iVR to promote generalization through diverse scenarios and characters further enhances its educational value. Students can practice, for example, CPR in a moving ambulance and on a sidewalk in the middle of town, or they can complete a simulation as the foreman of a construction crew or as the roofer. The iVR technology is not only effective but also cost-effective and accessible, potentially reaching rural areas through telehealth initiatives [15]. By leveraging iVR, educational institutions can reduce overall training costs compared to traditional methods, making skill development more efficient and widely accessible [16].

In recent years, VR has emerged as a leading technology to foster skill development among graduate students, enhance accessibility to hands-on learning experiences, and improve safety in high-risk training scenarios [16]. iVR has demonstrated maturity in teaching procedural and application-based knowledge across various disciplines, including fire safety [17], surgical skills [18,19], earth science education [20], and nursing skills enhancement [21].

However, the educational potential of iVR remains underexplored in graduate education, warranting further research to maximize its impact in educational settings. Hamilton et al. [22] concurred that there is a scarcity of research associated with the use of iVR that emphasizes the learning outcomes, intervention characteristics, and associated assessment measures. The authors found that iVR can correctly be utilized to its full potential if the implementation of the technology can be enhanced based on theoretical and experimental evidence. Di Natale et al. [23] stressed the need for higher institutions to conduct assessments of students' pre-existing levels of familiarity with IVR technology and their expectations regarding the use of the technology in the course in question. This exercise, according to the authors, can enable course content to be well-tailored and ensure the maximum educational benefits of iVR. Thus, this study explored how university students rated their interactions with an iVR-based experiential learning opportunity while learning to work with individuals with developmental disabilities and how they reported their intentions or beliefs in relation to using iVR in the future.

This paper is structured as follows: Theoretical Frameworks, Research Questions, and Materials and Methods, including participants, procedures, and data analysis. Finally, we review both results from the survey and the reflective journal entries and follow that with a discussion of our findings.

## Theoretical Frameworks

In this study, the theory of planned behavior (TPB) theoretical framework was adopted to analyze the data generated from this research. Kivunja [24] asserted that the theoretical framework encompasses the thoughts of experts in the field of research and provides a specialized lens to examine data, perform the data analysis, interpret the findings, and discuss them.

The TPB provides a valuable framework for understanding individual behavior change and intention, particularly concerning the adoption of immersive virtual reality in educational contexts. TPB delineates three core constructs: (a) attitudes, (b) subjective norms, and (c) perceived behavioral control, which collectively influence individuals' behavioral intentions [25]. Attitudes reflect individuals' overall evaluations of a behavior, encompassing perceived benefits and drawbacks. Subjective norms capture social pressures and expectations from significant others. Perceived behavioral control reflects individuals' beliefs about their capability to engage in the behavior and the perceived ease or difficulty of doing so [26].

Students' perceptions of the iVR experience not only shape their engagement but also influence its overall effectiveness in teaching and learning. In the context of nursing education, graduate students have reported benefits, such as reduced stress, enhanced skill acquisition, and increased convenience with iVR technology; however, they also note that the experience feels artificial [21]. Similarly, preservice teachers generally find IVR enjoyable to use and recognize its potential benefits, but concerns such as access to technology and lack of experience hinder their intentions to integrate IVR into the classroom [27]. These findings underscore the importance of considering both students' and teachers' perspectives and addressing their feedback to enhance the efficacy of iVR in educational contexts. By incorporating feedback from both groups and iteratively improving iVR experiences, educators can maximize the potential of this technology to facilitate immersive and effective learning environments.

Research questions

(1) How do university students perceive their interactions with an iVR-based experiential learning opportunity?
(2) What are university students' intentions in relation to using iVR in the future?

## 2. Materials and Methods

### *2.1. Participants*

Participants in this study were recruited after taking part in an immersive learning experience as part of one of their second-year graduate courses. The graduate program was in an applied disability studies department and focused on training in applied behavior analysis (ABA) skills for analysts who would be working in schools and clinical placements. Students did not always have access to practical settings where they could interact directly with different types of children and clients, and they needed repeated opportunities to practice their skills before using them in the real world. iVR gave them opportunities to practice, access to diverse experiences, and provided them with a safe learning environment. The course was a required component of the program in which they were completing either a diploma or thesis-based master's degree in a large university based in the southeastern region of Canada. The first author taught the course four times in the fall or winter semester over two consecutive years to four different groups of students (N = 85). Participants were mostly Canadian citizens and were studying in the graduate program with the intention of working in Canada after graduation, likely in clinical or educational settings. All the participants had completed a three- or four-year undergraduate degree as a condition of their acceptance into the program. Most of the participants had undergraduate degrees in psychology, education, or related fields. This secondary data analysis study was cleared by the university research ethics board before consent was obtained. Thirty-six participants were recruited after they had completed the course and consented to their data being used for this study (42% of students). Participants ranged between 23 and 39 years of age ($M$ = 28.3, mode 26) and predominantly identified as female (94% female, 3% male, 3% nonbinary).

### *2.2. Procedures*

The immersive learning experience varied slightly from term to term but consisted of repeated opportunities to use iVR headsets (which were provided) to engage in synchronous meetings with clinical staff and clients in a VR environment. Participants had to learn basic elements, as most had never used a wireless iVR headset before (https://www.picoxr.com/global, accessed on 27 July 2023). These skills included learning how to use the hardware (Figure 1 below is an image showing how the iVR headset is fitted when mounted), access the software platform (https://engagevr.io/, accessed on 27 July 2023), meet one another in the virtual synchronous space at a pre-arranged time (see Figure 2), create an avatar and how to navigate the virtual environment using their avatar, and interact with others using their avatars.

Most participants completed a series of ten learning modules (designed by the course instructor), which required them to master more basic elements of the immersive learning environment before they could move on to more advanced aspects. For example, participants had to complete a brief literature review and successfully meet with a peer and the instructor in iVR before they were allowed to meet with a client. Participants were required to complete three meetings with clients successfully and to set and meet their own learning goals, as well as assist their partnered clients to set and meet their goals throughout the project. Completion of the 10 modules offered students one way to meet 75 h of the

150-h practicum requirements for the program. Other students chose to participate in a less intensive iVR experience that was provided during class and totaled approximately 10 h of contact with iVR. Some students chose to access an additional software program that allowed them to engage in asynchronous lessons on "soft skills", such as listening or interviewing (https://bodyswaps.co/, accessed on 27 July 2023). This less intensive experience did not count toward practicum requirements. No aspect of the iVR experiences, including the surveys or journal entries, was counted toward the students' grades in the course. Nor was any student required to participate in any iVR experience if they did not wish to do so.

**Figure 1.** A wireless VR headset.


**Figure 2.** A scene from the ENGAGE platform with avatars.

During the learning experience, participants were asked to write reflective journal entry assignments. They were prompted to write about their experience with iVR and they were asked to speculate about what types of uses iVR might have in their clinical work or other areas of education (see Table 1). Some participants were asked to complete two reflective writings, one early in the experience and one at the end. Other participants were asked to complete only the reflective assignment at the end of the course. A total of 30 journal entries were collected from the participants who consented for their data to be included in the study (83% of participants). Six participants did not complete their journal entries; therefore, they were not included in the analysis of the journal entry data (17% of participants).

**Table 1.** Reflective Journal Entry Prompts.

| Prompt | Description |
|---|---|
| Prompt 1 | Write 50–150 words reflecting on your experience so far in this project. What do you think it will be like to work with clients in this virtual space? What are you worried about? What are you excited about? Any other thoughts? |
| Prompt 2 | Write 1–3 paragraphs reflecting on your experience in this project. Write about what you think about the equipment, what you think about using VR in ABA, and one idea that you have for writing a behaviour-analytic program for skill acquisition in VR. |
| Prompt 3 | Consider your own learning process in this course. Reflect on what you've learned, what you feel you still need to learn, and how you'll take what you've learned into your own professional practice. How did you feel about using virtual reality (VR) in this class (e.g., the headset, ENGAGE, and Bodyswaps)? How can you incorporate your understanding of diverse cultures and settings into your professional practice? Write 100–250 words. |

Reflective assignments were modeled after Matheson et al.'s [28] Guided Reflection Forms (GRFs). Educational theory, particularly that based on John Dewey's ideas, has long acknowledged the value of reflections on the students' advancement [29]. Prompted reflections are believed to provide sufficient structure to guide the student but also allow for personalized responses that will contribute to the growth of the student. There is some evidence that reflective prompts can elicit more focused responses and help the students stay on topic [30]. Reflective assignment prompts in this study were designed to contribute to the students' growth while giving the researchers an opportunity to gain insight into the intentions, beliefs, and attitudes of the students in relation to their iVR experience.

All participants were also asked to complete an anonymous survey on Qualtrics (https://www.qualtrics.com/, accessed on 27 July 2023), which measured their prior knowledge and experience with iVR, asked if they liked their iVR experience, asked about how they thought iVR could be used in clinical settings, and asked whether they thought they would be interested in doing something like it again (see Table 2 for a sample of survey questions). Survey questions were a combination of open-ended questions where students could write in their responses, multiple-choice questions, or Likert-scaled questions (1–7 or 1–5). There were a total of 16 questions posed in the survey. A total of 61 responses were collected from the survey data in Qualtrics (72% of students). Upon review of survey responses, those that were incomplete, without consent, were completed by students who had not participated in the VR experience, or completed by students who reported very little interaction with VR were removed. A total of 36 survey responses remained and were subjected to analysis for this study (59% of surveys).

Survey questions were adapted from Watson and Rockinson-Szapkiw's survey [27], which focused questions on TPB constructs (attitude, subjective norms, and perceived behavioral control). Additional survey questions about equipment ease of use and usefulness were adapted from Davis [31]. Both surveys have been validated for construct and content elements and have been used in prior studies to understand participants' intentions and beliefs, particularly in relation to technology and its use in educational settings [31]. They have been shown to be reliable for predictive use when researchers are interested in understanding the users' intentions in relation to the use of technology [26]. Survey responses were triangulated with reflective journal entry assignments to understand better the experiences, beliefs, and intentions of the participants in this study.

**Table 2.** Selected Survey Questions.

| Domain | Selected Survey Questions |
|---|---|
| Level of Participation | How much interaction did you have with the experiential education opportunity?<br>What reasons did you have for not trying the experiential education opportunity?<br>Was this your first time trying VR?<br>Did you like using VR?<br>Rate your overall experience. |
| Equipment | If you used VR again, what would you change about the experience?<br>If you used VR again, what would you keep the same about the experience?<br>Do you think VR is a useful tool in a school course?<br>Rate your equipment experience. |
| Experience | What did you dislike about this experiential education opportunity?<br>What did you like about this experiential education opportunity? |
| Application | Do you think you would use VR to run ABA therapy/treatment sessions?<br>What do you think are some of the best uses for VR?<br>What would you like to learn about ABA and VR? |

Data Analysis

Data from the survey were collected in Qualtrics and subjected to summary statistical analyses using Qualtrics' tools for querying results. Qualtrics allows for a wide range of analytic queries but can be limited by the way the researcher structures the surveys they create or the analytic reports they run after the data are collected. In this study, the researchers chose to limit their analysis to quantitative measures on some response types and to qualitative measures on other response types in a way that they believed would best allow them to answer the research questions at hand. The percentage of responses to "yes/no" questions was calculated from the total, the percentage of responses to Likert-scaled questions was calculated from the total, the percentage of responses to multiple-choice questions was calculated from the total, and responses to open-ended questions were analyzed for thematic content. Quantitative measures were calculated to provide insights into how participants rated their interactions with iVR technology [32]. Qualitative measures were triangulated with the thematic analyses on the reflective journal entries.

Data from the reflective journal entries were entered into an analytic software program that was designed to produce different types of analyses. This allowed for more nuanced answers to the research questions posed in this study. The Linguistic Inquiry and Word Count (LIWC-22) software program was used to automate the procedure of comparing words written in the journal entries to a standardized lexicon of words characterized by emotion, thinking style, or social concerns. The LIWC standard dictionary has undergone significant editing through multiple versions of the software and has been used in over 8800 studies for its predictive capability (https://www.liwc.app/, accessed on 27 July 2023). LIWC-22 output variables are produced by calculating the number of words used in the sample that fall into a particular category or definition as a percentage of the total words counted in the sample. For example, a sample text might contain 2.05 focus_future. This means that 2.05% of the sample contained words falling into the definition of future-focused words. Research results suggest a strong predictive validity of the LIWC analysis [33,34]. Reflective journal entries were analyzed across all standard categories currently available in the LIWC software. An initial analysis of percentages across all categories was conducted, and then the Tone variable (composed of both positive and negative tone dimensions), the Emotions variable, the Affect variable, and the Time variable were specifically interrogated. This was done to seek predictive information answering both research questions. Tone, Emotions, and Affect variables are all related to interaction experiences as well as intentions and beliefs [34]. Time variables seemed to relate most closely to future intentions. This process was consistent with prior research [35].

## 3. Results

### *3.1. Survey Results for Research Question 1 and Research Question 2*

Survey results were calculated for 36 participants. A total of 22 participants reported "a great deal" of interaction with the iVR project (61%), and 14 reported "a lot" of interaction (39%). A total of 78% of participants reported this project as being their first experience with iVR. A total of 86% of participants reported liking iVR either a "great deal" (56%) or "somewhat" (31%) (see Figure 3). A total of 78% reported iVR as "fun", 81% identified it as "unique", and 67% said it was "very immersive". A total of 50% did report "unpleasant side effects", and 1% identified iVR as "difficult to use". All participants reported feeling that iVR was a "useful tool in a school course", with 81% rating it "extremely" or "very" useful. A total of 92% recommended that other students should use iVR in future courses, and 92% of participants responded "yes" or "maybe" when asked if they would use iVR in their professional settings. A total of 81% identified "staff training", 72% "desensitization", and 69% "life skills" as the three most likely professional uses for iVR. Qualitative analysis confirmed consistent thematic findings from the reflective journal entries, indicating an overall positive tone, use of positive emotion words, and a focus on the experiences they had rather than on future use. Overall, survey data quantitative results suggest that interactions with iVR were generally rated high and participants reported high intentions to use it in the future or recommended that others use it in the future in both school courses and in professional settings.

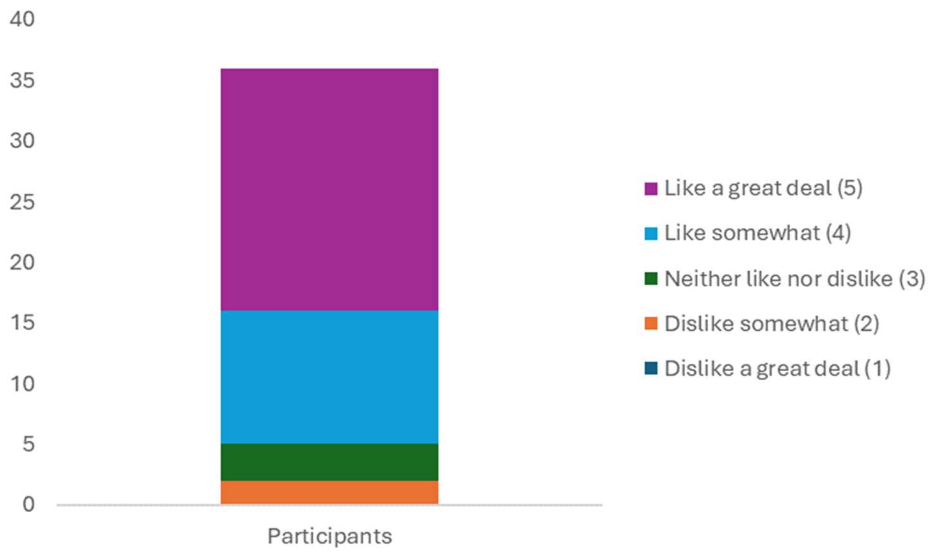


**Figure 3.** Participants Survey Results for Liking iVR.

### *3.2. Reflective Journal Entries-LIWC-22 Results for Research Question 1*

Reflective journal entries were analyzed for 30 participants using LIWC-22 software. Journal entries ranged from a total of 134 words to 685 words, with an average of 354 words per entry. LIWC-22 dictionary variables for Tone, Emotions, Affect, and Time were evaluated. The Tone variable was calculated as a single summary variable comprised of both positive and negative tone dimensions. Tone calculations ranged from 17.6 to 95.68%. The average tone calculation was 62%, and 77% of participants' tone calculations were above 50, which is considered an overall positive tone (see Figure 4).

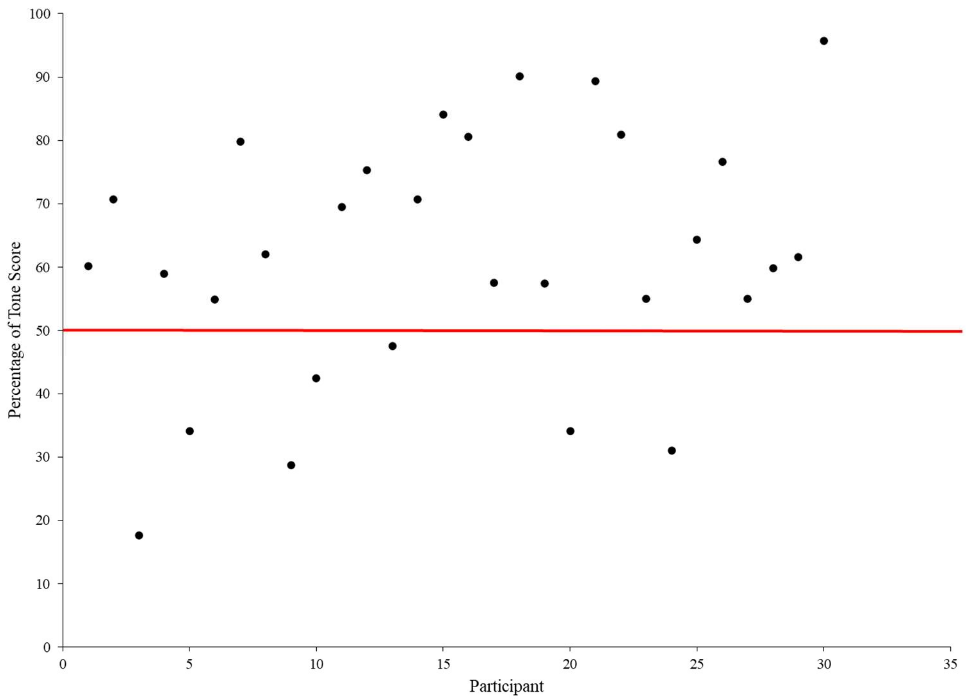


**Figure 4.** Tone Variable Analysis for Participants' Journal Entries. Note. Tone scores above 50 are considered positive.

The Emotions variable was analyzed for both positive and negative emotion word use. Participant use of emotion words ranged from 0.25 to 3.66% and averaged 1.374% of total words used. Positive emotion words comprised 0.874% of total word usage (range, 0–2.42%), while the negative emotion word use average was 0.397% (range, 0–1.23%). When students used emotion words they used mostly positive emotion words in their journal entries (see Figure 5).

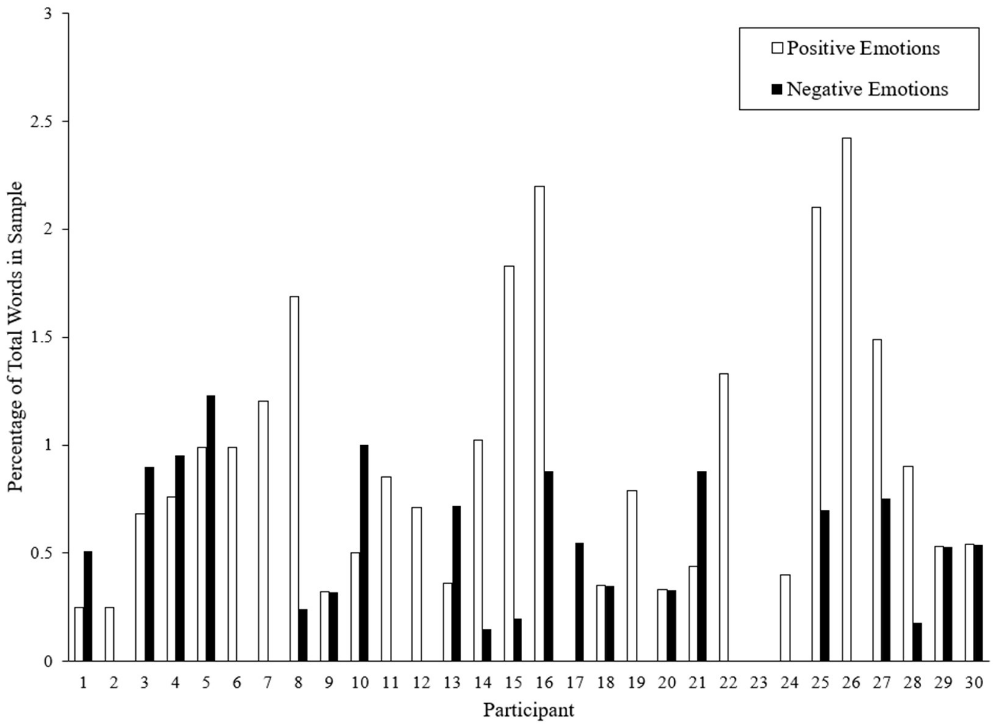


**Figure 5.** Emotion Word Use Analysis for Participants' Journal Entries.

The Affect variable was analyzed for both positive and negative tone word use. Participant use of affect words ranged from 2.24% to 8.11% and averaged 4.595% of total words used. Positive tone words averaged 3.62% (range, 1.81–7.03%), while negative tone words averaged 0.882% (range, 0–2.04%) of total word use. Of the affect words used in their journal entries, students used mostly positive tone words (see Figure 6).

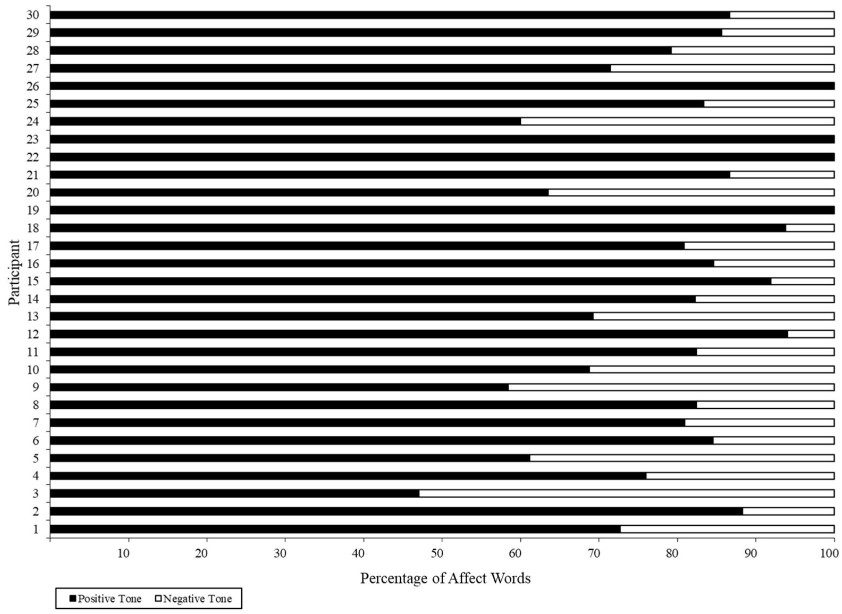


**Figure 6.** Affect Word Use Analysis for Participants' Journal Entries.

The Time variable was analyzed for both total word use and for future-focused time words. Participant use of time words ranged from 0.53% to 4.24% and averaged 2.57% of total words used. Future-focused time words were used with an average of 1.42% (range, 0–5.22%) of total words used. Past-focused time words were used an average of 3.79% (range, 0.75–7.93%), and present-focused time words were used an average of 3.23% (range, 0–6.29%) of total words used. Of the time words used in their journal entries, students used predominantly past-focused time words (see Figure 7).

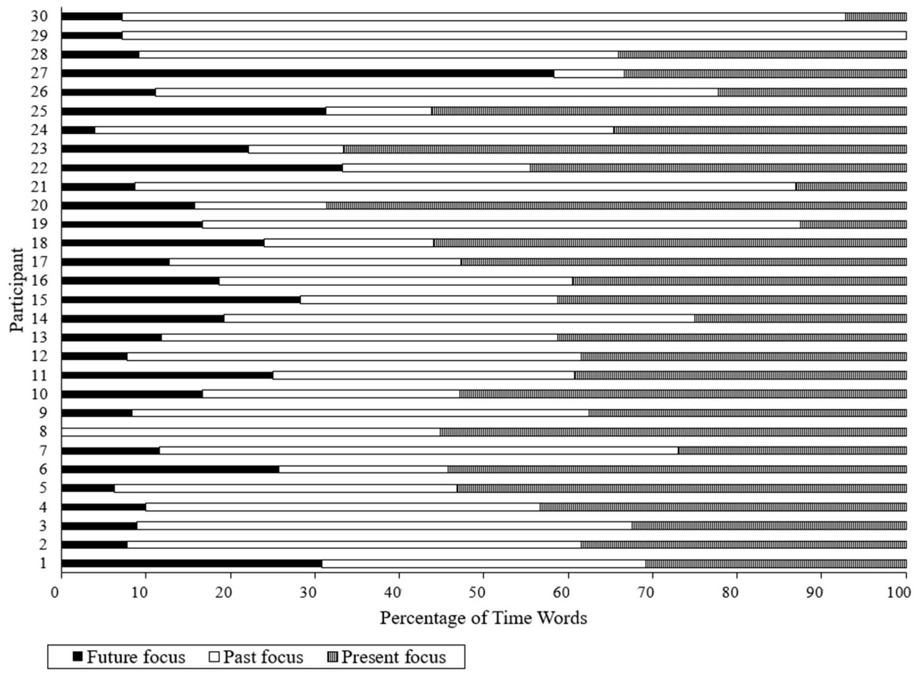


**Figure 7.** Time word use analysis for participants' journal entries.

## 4. Discussion

The results of this study suggest that university students rated their interactions with an iVR-based experiential learning opportunity favorably. They thought it was "fun", "unique", and "very immersive". They felt it was extremely useful, and they reported that they would do it again if given the opportunity. Survey findings were consistent with the analysis of words used in their journal entries. Students had a positive experience. Tone, Emotion, and Affect terms were all more positive than negative in value.

More than 90% of survey respondents reported intentions to use iVR in the future, but journal entries contained more past-focused words than future-focused words. This discrepancy may be explained by the controlling variable of the journal entry prompt, which asked participants to reflect more on their past experience, while survey questions asked more future-focused questions about participant intentions.

Survey respondents reported unpleasant side effects, and this was corroborated by references to headaches, nausea, and limitations to physical endurance in journal entries. In Glaser et al. [35], researchers found that their participants all reported some symptoms of cybersickness but remained in the study despite their symptoms and found the experience to be positive overall. We found the same with our participants. While cybersickness is a concern, there is motivation to tolerate it and methods to overcome it. Kaufeld et al. [36] found that providing participants with chewing gum that they could chew while in iVR reduced symptoms of visually induced motion sickness. Rebenitsch [37] recommended that developers provide options for changing settings of iVR hardware and software in the areas of field of view, speed, movement, and position to give users the ability to modify the iVR environment to their liking and comfort. Further research is needed to understand the effects of cybersickness and to mitigate them.

Future directions in this area of research could also include several other areas of focus. The proficiency of the instructor with iVR could be a critical component of the success of using iVR in a teaching context. The instructor needs to have knowledge of both the hardware and the software and be able to problem-solve when challenges arise. Both instructors and students must be persistent in the use of iVR. The level of persistence might be a critical factor to understand when evaluating the use of iVR in a classroom. Additionally, significant resources are needed for iVR in a classroom. While not critical, institutional support would be very helpful. There is time required for planning, implementation and management, and financing is required to purchase headsets, software, and internet access.

More research is needed in this area but iVR seems to offer an immersive medium that produces emotionally laden experiences very like those in real life and should be seriously considered when integrating technological advances into the training of teachers. Preservice teachers need opportunities to learn about a range of educational events. The more prepared they are, the better able they will be to handle the challenges of a real-world teaching environment after completing their training in university.

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