Investigating the Role of Virtual Reality to Support Community Engagement

Iman Alshathri
University of Maryland Baltimore County, USA & King Saud University, Saudi Arabia, *alshath1@umbc.edu*

Anita Komlodi
University of Maryland Baltimore County, USA, *komlodi@umbc.edu*

Ravi Kuber
University of Maryland Baltimore County, USA, *rkuber@umbc.edu*

Virtual Reality (VR) interfaces are known to provide users with immersive experiences to support tasks such as training or developing an understanding of topics in various domains. However, research relating to using VR to learn about unfamiliar settings and supporting attitudes towards these settings, particularly through lower-cost VR technology is limited in nature. In this article, we describe an exploratory study to investigate low-cost VR technology use on attitudes toward community engagement activities. We selected the issue of homelessness, due to the prevalence of this issue in the city where the study took place. We focused on the experiences of conducting community engagement activities as part of the study. Ten participants experienced becoming homeless through an immersive VR application. In order to investigate the impact on attitudes, a community engagement instrument along with perspective-taking subscale were presented to participants prior to and after the VR experience. Statistical analysis revealed significant differences in both the attitude and behavior subscales, suggesting a positive change in intention to participate in their community and to make a difference based upon the VR experience. Implications from the work relate to the design of a procedure which can be used by educators and researchers alike, to determine the attitudinal impacts of VR environments, along with providing awareness of the benefits and practicalities of utilizing low-cost VR technologies within a classroom environment.

Keywords: community engagement, homelessness, perspective taking, service learning, virtual reality

INTRODUCTION

Virtual Reality (VR) applications provide an immersive experience for users, exposing them to a range of environments. These technologies can be used for purposes of education and training, to help build skills or to develop knowledge. Additionally,

recent work suggests that VR can be used to modify attitudes toward social issues significantly more than non-immersive interventions (Nikolaou et al., 2022). In this article, we investigate how VR technologies can be designed to influence attitudes and behaviors among students regarding social issues. We specifically focus on community engagement activities where students may learn about issues that they have limited familiarity with.

In educational environments, VR has been used to encourage active participation and self-directed learning among students (Fabris et al., 2019). In their review, Kavanaugh et al. (2017) suggest that studies examining exposure to VR within the educational field have led to positive findings, including impacts on motivation among students (Cheung et al., 2013), and deeper learning and long-term retention of information (Huang et al., 2010; Rizzo et al., 2006). Higher education institutions and organizations offering professional development courses have identified the merits of these technologies, and are beginning to include virtual reality content within their curricula and training practices (Fagan et al., 2012; Wang, 2015; Mentzelopoulos et al., 2016).

Virtual technologies can be used to support learning by stimulating new ways to think about social issues, and build cultural understanding of the community and prepare learners for community-based engagement (Huttar & BrintzenhofeSzoc, 2020), making these tools valuable for educational environments, Studies also show that these technologies can play a pivotal role in exacting both attitudinal and behavioral change regarding perspectives relating to social issues. Examples include utilizing VR treatments to impact attitudes towards social issues such as disability (Chowdhury et al., 2019), race and culture (Chen et al., 2021), and mental health (Sri Kalyanaraman et al., 2010). VR interventions could help support students with diverging perspectives to better empathize with the experiences of other groups or communities, improving the likelihood of encouraging greater participation in community engagement activities at the higher education level. Reasons relating to alternative perspectives may be attributed to limited exposure and education regarding specific social issues and/or communities. This may particularly impact individuals who have lived their lives outside of their current country of residence (i.e., international students resident at US universities). Our study described in this paper, specifically investigates the role that VR can play to support attitudinal change among international students relating to community engagement activities.

Although VR has been used in educational environments for some time, adoption has not been as widespread as originally envisaged, due in part to the limitations to both the technologies themselves, and the costs and logistics required to deploy them (Kavanaugh et al., 2017). Furthermore, difficulties are faced recruiting participants, particularly if the technology is tethered to a specific location. Recent developments in VR have offered potential for remote studies through the design of consumer-grade portable virtual reality technologies (e.g., the Meta Quest (Meta Quest, 2023), Meta Quest 2 (Meta Quest 2, 2023) and mobile phone VR headsets (Android Authority, 2023)). As a lower-cost alternative, Google Cardboard enables the user to access VR by inserting their smartphone into a fold-out cardboard viewer to facilitate interaction with VR applications. Lower-cost tools can offer the means to make technology

available to a wider range of potential users, aided by their ease of set-up. However, there can be challenges faced including a limited range of content available via these tools, and hardware limitations. Researchers have begun exploring these tools as methods to support learning within a classroom setting (Oigara, 2019), and to support instruction (Oigara, 2018). However, VR presented through these lower-cost tools, has yet to be exploited for purposes of attitudinal change within an educational setting.

Researchers have identified that higher educational institutions are actively recruiting international students to participate in community engagement activities, as levels of participation are lower than for their domestic counterparts (Alshathri et al., 2024). However, anxiety can be faced due to concerns regarding working with unfamiliar communities and groups (Kusek et al., 2015). By participating or getting involved within communities, there is potential to reduce stereotypes, facilitate cultural and social understanding, and help to support a sense of social responsibility (Alshammari et al., 2023). International students have been selected for our study due to reasons of cultural distance and difference (Peng & Wu, 2019). Given that virtual reality interventions can be used to support attitudinal change to social issues, our study described in this paper focuses on investigating how community engagement activities can be supported in higher education settings by international students, and how attitudes can change as a result of an intervention using lower-cost virtual reality tools. More specifically, we focused on their understanding and perception of homelessness (RQ1), the impact of VR technology on their attitude/motivation towards service-learning (RQ2) and how the experience influences their abilities to understand the homeless perspective. We examined changes in perspective taking and attitudes, identified through both pre- and post-task questionnaires and through interviews (described in more detail in the Method section).

From a review conducted examining prior work in the field, we have identified a research gap relating to uptake of community engagement among international students and the need for using technology to widen interest within these activities. Furthermore, researchers have yet to deeply examine attitudinal change through the use of low-cost virtual reality technologies. This study aims to bridge the gap between these areas of research by providing a deeper understanding of the role that VR can play and its impact on motivating behavior in the context of community engagement. More specifically, this study aims to examine how virtual reality technologies can be applied to motivate and prepare international students for community engagement at both the university and school level. We present details about assumption pre- and post-intervention, along with the impacts of VR on perspective-taking. Insights from our study have aimed to offer guidance to designers and researchers aiming to utilize lower-cost VR for purposes of attitudinal change within higher education settings.

Related Work

Virtual Reality vs Traditional Media

A range of tools have been used to promote attitudinal change among users. These include the use of text, video and audio which can be presented to offer an insight into social issues. Researchers have most commonly focused on comparing and contrasting

the performance of video with virtual reality simulations to determine which type of technology offers the greatest potential (e.g., Ahn et al., 2016; Breves & Schramm, 2021; Bujić et al., 2020; Filter et al., 2020; Fonseca & Kraus, 2016; Kim, 2019; Ma, 2020; Steinfeld, 2020). Nikolaou et al. (2022) conducted a meta-analysis on a range of studies and suggested that VR interventions have a significantly stronger positive effect on attitudes compared to traditional media interventions. Virtual environments elicited larger degrees of attitudinal change regardless of whether these were measured with self-reports, behavioral intention, or actual behavior in the literature identified. The researchers note that there were differences in how treatments were administered and in the immersiveness of VR applications presented (Nikolaou et al., 2022).

VR has been selected for the study described in this article for a range of reasons. These technologies are gaining more popularity in educational settings, as these can offer engaging, memorable and impactful experiences for students. These are thought to improve learning outcomes (Setyowati et al., 2023), and help students build important interpersonal skills such as empathy, collaboration, and social skills needed for the future (ClassVR, 2023), in addition to supporting cognitive processes, such as selective attention (Amprasi et al., 2022). Empirical evidence from various fields of study including education, healthcare, and entertainment demonstrates that VR experiences lead to positive attitudinal and behavioral outcomes (Kim & Biocca, 1997; Mania & Chalmers, 2004; Suh & Lee, 2005).

Virtual reality offers considerable promise to users. The increasing usability of head-mounted VR technologies combined with decreasing prices of some models has expanded their availability to captive audiences. For example, Google Cardboard technology (Google Cardboard, 2023) offers several solutions costing under $20, while more sophisticated head-mounted displays can be obtained for well under $1,000. This has resulted in a rapid increase in new users utilizing these technologies.

Conducting Virtual Reality Studies Remotely

The benefits afforded by portable VR technologies include the ability to widen access to a range of participants, as studies are no longer constrained to a university lab environment which may be difficult to access (e.g., Berti, 2019; Fabola et al., 2015; Loetscher et al., 2023; Malinchi et al., 2017; Mottelson & Hornbaek, 2017). The COVID-19 pandemic inevitably forced researchers to rethink study design relating to virtual reality technologies, with an increased number of studies being conducted remotely. Lower cost technologies, such as Google Cardboard, have been successfully used in remote studies, as products such as these offer an easy-to-use and affordable solution to experience VR (Berti, 2019; Fabola et al., 2015; Malinchi et al., 2017). However, guidance is still be needed to ensure that the technology is set-up appropriately to support study design.

The Importance of Perspective-Taking

The term 'perspective-taking' can be defined as looking at a situation from a viewpoint that is different from one's usual viewpoint (Underwood & Moore, 1982). Prior research shows that taking the perspective of or imagining what it would be like to be

someone else, can be an effective method of motivating prosocial behaviors (Batson et al., 1988; Batson et al., 1997; Cialdini et al., 1997), and can result in feelings of inclusion (Cialdini et al., 1997), reduce bias and lower negative stereotypes (Todd & Galinsky, 2014), help create and maintain social bonds (Galinsky et al., 2005), and facilitate social interactions (Krauss & Fussell, 1991). According to Herrera et al. (2018), perspective-taking is strongly connected to feelings of empathy, as it can effectively increase the empathy a viewer feels for a specific social target. It does not only increase empathy for specific people but can increase empathy toward entire stigmatized groups (Batson et al., 1997).

As studies have yet to deeply focus on the experiences of modifying attitudes through the use of low-cost technologies for VR, an exploratory study conducted remotely has been proposed.

Selection of the Saudi Arabian Context

For the study described in this article, we specifically recruited participants hailing from Saudi Arabia who are temporarily studying in the United States. This group is of interest to study, as community engagement courses may not have been taken as part of their prior studies at the high school and university level. Researchers have highlighted that emphasizing social responsibility, community participation, and sustainable development, through the incorporation of service-learning principles into the curriculum, can offer promise in Saudi Arabia, particularly as the country works to promote sustainable development (Alshammari et al., 2023). The social issue of homelessness was selected for study, as it has been suggested that homelessness is not as common in Saudi Arabia, with only a small portion of Saudi Arabian nationals living in inadequate housing (Office of the High Commissioner for Human Rights, 2015). In contrast, the Annual Homeless Assessment Report reported an increase of 1,996 people experiencing homelessness between 2020 and 2022 in the US (Office of Policy Development and Research, 2023). For many Saudi nationals temporarily resident in the US, this study may be one of their first experiences directly relating to the social issue of homelessness, and one of the first opportunities to learn about community engagement in an educational setting.

METHOD

Aim and Research Questions

The aim of the study was to determine how attitudinal change could be supported through the use of a VR experience via lower-cost VR technologies within a higher education setting. More specifically, international students (Saudi nationals temporarily resident in the US) were selected to participate.

We selected the social issue of homelessness, as it was the most commonly selected topic among community engagement experts in a study by Alshathri et al. (2023), which focused on selecting virtual reality to prepare and motivate international students to volunteer. This issue was particularly poignant, as levels of homelessness are high in and around the city of Baltimore (Maryland, USA), near where the study took place (Mayor's Office of Homeless Services, 2023). The study was conducted in 2021,

during when lockdown measures associated with the COVID-19 pandemic were in effect. The Maryland Interagency Council on Homelessness published a report in 2021 highlighting that historical drivers of homelessness were exacerbated by the COVID-19 pandemic. As a result of rising unemployment and lost income, a growing number of households are falling behind in rent across the state. For this particular project, we use the definition of homelessness to include individuals who are in sheltered housing, transitional housing, emergency shelters, and those in unsheltered housing.

More specifically, we focused on determining participants' understanding and perception of homelessness (RQ1), the impact of VR technology on their attitude/motivation towards service-learning (RQ2) and how the experience influences Saudi Arabian students' abilities to understand the homeless perspective (RQ3). We adopted a mixed-methods approach to help address the research questions above, using a combination of quantitative data gathered through questionnaires, along with qualitative data gathered through interviews (described in detail in the Procedure section). The mixed methods approach has been found to be beneficial for determining social ability among students (Junaidi et al., 2022) and to investigate learners' attitudes toward the relevancy of science (Boda and Brown, 2020).

Table 1
Participant demographics

ID	Age	Identified Gender	Educational institution	Major	Prior VR experience	Volunteering experience	Experience working with homeless pop.
P1	45	M	University	CS	Yes	Yes	No
P2	17	M	High school	HS	Yes	No	No
P3	32	F	University	EE	No	No	No
P4	30	F	University	Math	No	No	No
P5	35	F	University	HCC	No	No	No
P6	29	F	University	CS	Yes	No	No
P7	31	F	University	CE	No	Yes	Yes
P8	16	M	High school	HS	No	-	No
P9	17	M	High school	HS	Yes	Maybe	Yes
P10	17	M	High school	HS	Yes	No	No
P11	45	M	University	CS	Yes	Yes	No
P12	17	M	High school	HS	Yes	No	No
P13	32	F	University	EE	No	No	No
P14	30	F	University	Math	No	No	No

Participants

Participants were recruited through flyers and mailing lists sent to students at our partner organizations. In terms of inclusion criteria, Saudi nationals aged 16 and above who identified as international students (i.e. lived the majority of their life outside the US, and were on a temporary visa to study in the US), and who were studying STEM-related majors, were selected. No exclusions were made on the basis of prior exposure to virtual reality or experience working with homeless populations.

Ten participants, aged 16-45, were recruited at our partner high school catering to international students (4), and from our own research university (University of Maryland Baltimore County) (6). Six members of the group had some prior experience with virtual reality technologies for purposes of gaming, while the majority had no experience with volunteering or working with homeless populations. All had mobile devices compatible with the Google Cardboard device. Participant demographics are shown in Table 1.

Procedure

Due to the lockdown measures associated with the COVID-19 pandemic, in-person studies presented a greater challenge. As a compromise, a remote study was conducted enabling us to work with a range of participants in differing locations. Virtual sessions were set-up with participants through WebEx to assist in the set-up of a Google Cardboard device which had been mailed to participants' homes. In the session, participants were asked to install the virtual reality application selected for the study. Technical support was provided in instances where the app was not working effectively.

Virtual meetings were scheduled with each participant after signing a consent form. One meeting was arranged prior to accessing the VR application, and the second one after using it. Participants completed the demographic form, pre-task questionnaires, and post-task questionnaires using Google forms. These included a questionnaire relating to demographics, followed by the Perspective-Taking subscale, obtained from the Interpersonal Reactivity Index (IRI) (Davis, 1983). The latter had been validated in prior studies (e.g. Peck et al., 2013). A 7-point Likert scale community engagement instrument (Doolittle and Faul, 2013) was then presented to participants to capture experience and attitudes towards community engagement activities. The open-ended survey questions focused on the participants' perceptions of people who are homeless; the social issue selected for the study. After experiencing a virtual reality experience relating to homelessness, the open-ended survey, perspective-taking subscale and community engagement instrument were again completed to determine outcomes. Findings from these post-experience questionnaires would be compared with findings from the pre-experience instruments to capture any changes in participants' perception, attitudes and assumptions.

A VR application developed by the Virtual Human Interaction Lab at Stanford University was selected for this study (Asher et al., 2018) (Figure 1), and permission was secured to utilize it. It was chosen from a pool of other applications, as it provided rich information relating to the social issue, was compatible with Google Cardboard technology, and had been successfully used in the past by other researchers within an educational setting (Herrera et al., 2018). In the immersive virtual reality experience, participants were able to spend the day-in-the-life of an individual who becomes homeless. More specifically, the individual attempts to save their home and protect their belongings, while facing the challenge of living with diminishing resources.

The study itself took 60 minutes to administer. For participants younger than 18, parents/guardians were also asked to be present while conducting the study. Participants received $20 for their time, and were invited to keep the Google Cardboard

technology. Participants were then approached three months after the intervention to discuss the impact of the experience. Open-ended questions were presented, to determine whether attitudinal change had taken place. Participants could either respond by email or meet with the researchers via online conferencing technology.

Figure 1
Screenshot of VR application selected for the study depicting homelessness

Data Analysis

In order to analyze the data from pre- and post- questionnaires, a Wilcoxon Signed Rank test was conducted using SAS software. This statistical test was conducted as it is often used to compare two sets of scores from the same participants, and does not assume normality in the data (Laerd Statistics, 2023). Scores were examined for perspective taking and community engagement (attitude and behavior).

To study perceptions of homelessness, data was collected through open-ended survey questions both prior to and after the VR experience. Notes taken by the researcher were first coded to identify preliminary concepts of interest. The content of the open-ended question responses were coded through inductive coding (Boréus & Bergström, 2005) using Nvivo. After conducting open coding, used to create our codebook, axial and selective coding were then undertaken to identify relationships between themes (Merriam & Tisdell, 2016).

FINDINGS AND ANALYSIS

Quantitative Analysis and Findings

To address the third research question on whether students are able to understand the homeless perspective, we measured their perspective taking before and after the VR experience. The before and after measurement of perspective taking was taken on a scale, where 0 = this does not describe me well to 4 = describes me very well, using the IRI perspective-taking subscale (Davis, 1993). Findings are presented in Table 2. The Wilcoxon Signed Rank test showed that exposure to a virtual reality experience did elicit a statistically significant increase for ratings relating to imagining feelings of others prior to criticizing (which would provide answers to Q1), understanding others by imagining from their perspective (Q3), looking at both sides of an issue (Q4), looking at everyone's side of a disagreement prior to making a decision (Q6), and putting yourself in the shoes of others when upset (Q7) ($p<0.01$). Although not

statistically significant (p>0.05), it was interesting to see a decrease in the mean ratings for Q2 (listening to arguments of others) and Q5 (seeing things from others' point of view). Further study would be warranted for exploring these areas to better understand the reasoning for the decrease post-experience.

To address the second research question related to the impact of VR technology on students' attitude and motivation towards service-learning, we used a community engagement instrument. The community engagement instrument was administered prior to and after the VR experience to help determine changes in attitudes. This scale examines both attitudes and intention behaviors. Attitude can be defined as the personal beliefs and feelings that individuals have about their involvement in their community, with a view to perceptions of making a difference in that community (Doolittle & Faul, 2013). Behavior can be defined as the actions that people take to actively engage and make a difference in their community (Doolittle & Faul, 2013). The scale shows the level of agreement or disagreement ranging from 'never' to 'always' with 14 items to rate levels of participation on a 7-point Likert scale.

Table 2
Perspective taking scores

Question	Pre-Test Mean and SD	Post-Test Mean and SD	Significance (* = p<0.01)
1. Before criticizing somebody, I try to imagine how I would feel if I were in their place.	M:1.9 (SD:0.88)	M:3.7 (SD:0.48)	0.0020*
2. If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.	M:2.8 (SD:1.14)	M:1.9 (SD:1.73)	0.3125
3. I sometimes try to understand my friends better by imagining how things look from their perspective.	M:1.7 (SD:1.16)	M:3.2 (SD:0.63)	0.0039*
4. I believe that there are two sides to every question and try to look at them both.	M:1.4 (SD:0.97)	M:3.7 (SD:0.48)	0.0020*
5. I sometimes find it difficult to see things from the "other guy's" point of view.	M:1.9 (SD:0.88)	M:1.2 (SD:1.75)	0.3008
6. I try to look at everybody's side of a disagreement before I make a decision.	M:2 (SD:0.94)	M:3.8 (SD:0.42)	0.0020*
7. When I'm upset at someone, I usually try to "put myself in his shoes" for a while.	M:0.6 (SD:0.97)	M:3.6 (SD:0.7)	0.0020*

Table 3
Community engagement – attitude scores.

Question	Pre-Test Mean and SD	Post-Test Mean and SD	Significance (* = p<0.01)
1. I feel responsible for my community.	M:3.1 (SD:1.1)	M:5.9 (SD:1.52)	0.0039*
2. I believe I should make a difference in my community.	M:3.1 (SD:0.99)	M:6.1 (SD:0.88)	0.0020*
3. I believe that I have a responsibility to help the poor and the hungry.	M:5 (SD:0.47)	M:6.7 (SD:0.48)	0.0020*
4. I am committed to serve in my community.	M:2 (SD:0.82)	M:6.4 (SD:0.52)	0.0020*
5. I believe that all citizens have a responsibility to their community.	M:2.6 (SD:0.97)	M:6.4 (SD:0.7)	0.0020*
6. I believe that it is important to be informed of community issues.	M:1.9 (SD:0.74)	M:6 (SD:1.15)	0.0020*
7. I believe that it is important to volunteer.	M:4.4 (SD:1.07)	M:6.9 (SD:0.32)	0.0020*
8. I believe that it is important to financially support charitable organizations.	M:4.6 (SD:1.26)	M:7 (SD:0)	0.0020*

Findings for attitude relating to community engagement are shown in Table 3. The Wilcoxon Signed Rank test showed that exposure to a virtual reality experience did elicit a statistically significant increase for ratings for all questions answered (Q1-8) (p<0.01). More specifically, increase in ratings relating to feeling responsibility for your own community, commitment to serving within the community, responsibility to helping others in need, keeping informed of community issues, the importance of volunteering and supporting charitable organizations.

Table 4 shows the mean ratings for behavior relating to community engagement. The Wilcoxon Signed Rank test showed that exposure to a virtual reality experience did elicit a statistically significant increase for ratings relating Q1-6 (p<0.01). These included increases in ratings relating to desire to being involved in volunteering and working with others, interest in helping the community and staying informed of community events, along with intention to participate in discussions relating to social issues and to contribute to charitable organizations within the community. Although these relate to intended behaviors, a follow-up was conducted three months after the task was completed to determine whether intentions had indeed translated into actions.

Table 4
Community engagement – behavioral scores

Question	Pre-Test Mean and SD	Post-Test Mean and SD	Significance (* = p<0.01)
1. I will be involved in structured volunteer position(s) in the community.	M:2.3 (SD:1.16)	M:6 (SD:0.82)	0.0020*
2. I will work with others; I will make positive changes in the community.	M:2.9 (SD:1.2)	M:6.4 (SD:0.7)	0.0020*
3. I will help members of my community.	M:4 (SD:0.94)	M:6.6 (SD:0.52)	0.0020*
4. I will stay informed of events in my community.	M:2.4 (SD:1.07)	M:6 (SD:0.82)	0.0020*
5. I will participate in discussions that raise issues of social responsibility.	M:1.3 (SD:0.67)	M:5.9 (SD:0.99)	0.0020*
6. I will contribute to charitable organizations within the community.	M:4.5 (SD:1.27)	M:6.9 (SD:0.32)	0.0020*

Qualitative Analysis and Findings

The analysis of the qualitative responses helped address the first research question about our participants' understanding of and perceptions about individuals who find themselves homeless.

Assumptions prior to the VR experience

Participants described holding largely negative assumptions about individuals who find themselves homeless prior to participating in the VR experience. The most commonly-identified assumption related to exhibiting aggressive behavior. Seven participants suggested that people who find themselves homeless could be dangerous, could scare others, and may threaten or would likely steal from them to obtain money. "I think of the homeless as "[people] who scare tourists, people who walk on the street, and drivers in the areas of our cities" (P5). Participants such as P6 also associated levels of aggressive behavior with prior criminal history, such as "stealing and breaking windows to find a place to live". Other commonly-identified assumptions included associating

individuals who are homeless with issues of substance abuse, and mental health-related issues. They were often thought to be unemployed, which in turn was attributed to lack of education or family support. Finally, challenges were thought to be faced obtaining work due to the lack of having a fixed address.

Assumptions after the VR experience

After experiencing the VR simulation, eight participants stated that their assumptions had changed regarding people who experience homelessness. Participants highlighted additional factors which may contribute to the situation, including sexual harassment, domestic violence, difficulties paying expensive hospital bills, and lack of financial support particularly for veterans. "Absolutely yes, before I think all of them have issues with alcohol and drug addiction, but right now I think not all of them. Everyone has their problems and issues regardless of their gender or age" (P2). Participants described beginning to feel that each situation regarding homelessness was nuanced, and highlighted feeling sympathetic to the characters in the virtual reality experience. After listening to their stories using VR, they described that the experience had them rethink their assumptions.

Only two participants mentioned that they still held the similar beliefs even after exposure to the VR experience (e.g., concerns about individuals who are homeless being dangerous). They mentioned they were experiencing greater levels of empathy towards them, as many external factors may contribute to this behavior. "My assumption is the same with some minor changes. I think it is not their choice to be homeless, other external circumstances lead them to this situation and they do not have any other options" (P5). Findings are presented in Table 5.

Table 5
Responses prior to and after VR experience

Before VR Experience		After VR Experience	
Assumptions leading to homelessness	No of participants	Assumptions leading to homelessness	No of participants
Have an aggressive behavior	7	Change their assumption and feel more empathy toward them	8
Addicted to alcohol	4	Have an aggressive behavior	2
Poverty	2		

Factors leading towards homelessness and changing the situation

As previously described, additional factors leading to homelessness were identified by participants post-experience (Table 6). These included domestic violence, physical disability, and lack of skills. Participants began to describe that issues could be interconnected. For example, P9 suggested "not getting enough education that could help them get a financial return, and they maybe didn't have a family to help them in their hard times". Limited financial resources were thought to pose challenges especially in larger cities where the cost of living could be higher. This could result in difficulty finding adequate housing to fit the constraints of individuals with lower levels of stable income. Other issues mentioned included depression caused by the situation,

which made it more difficult to end the cycle of homelessness. P3 stated "losing hope, faith and having the feeling that they can't change their personality and situation".

Responses regarding the ability of homeless individuals to change their own situation prior to the virtual experience appeared to vary from findings after conducting the post-experience questionnaires. Seven participants recommended starting out small, rather than being too idealistic. Examples included searching for small jobs, saving a set amount of money per week, completing their education (if unfinished), and attempting to learn new skills with the aim of locating higher paid employment in the future. Five participants suggested other entities which could improve the lives of people who find themselves homeless. These included lobbying the government providing affordable housing, obtaining interest-free loans to help cover expenses, and the government building pathways towards training for higher-paid jobs. Participants empathized with difficulties ending the cycle of poverty and homelessness.

Even after experiencing the VR simulation, four participants referred to 'internal' factors, stating that it is still the person's own responsibility to change their homelessness situation. However, there was a greater degree of understanding exposed. As an example, P2 said "After hearing others' stories and I knew it is not because of the alcohol and drugs. I think it is easier for them to change their situation because once they have a job they can find a house and a place to live. If they have issues with alcohol or drug addiction, it would be hard for them to change their situation because it is difficult to leave or cut drugs without help from the hospital" (P2).

Table 6
Responses prior to and after VR experience

Before VR Experience		After VR Experience	
Factors leading to homelessness	No of participants	Factors leading to homelessness	No of participants
Lack of support (family support, lack of skills, and lack of education)	9	Lack of support (family support, lack of skills, and lack of education)	6
Poverty	8	Poverty	9
Not having a job	4	Not having a job	7
Mental illness	3	Mental illness	4
Alcohol	4	Physical disability	2
Gambling	1	Domestic violence	3

What did participants learn from the experience?

Most of the participants were very excited to experience VR technology, thinking it would be a fun and engaging experience providing an opportunity to learn about a topic in a different way to how they were used to learning within a classroom environment. Many hoped that this experience will give them the chance to explore more about people experiencing homelessness and other social issues. After experiencing the VR application, the majority of participants began to challenge their assumptions, highlighting that not all homeless people are criminals, and that assumptions should not be made about a situation without knowing the facts. Participants also described a desire to volunteer more in the future and donate to different charities to help mitigate homelessness.

Findings from a follow-up three months later, revealed that participants still held similar beliefs to those post-task. However, in terms of actionable changes, some had made informal inquiries regarding volunteering to support different social causes (such as homelessness). Participants were yet to translate intentions into actions. This was thought to be in part attributed to the ongoing lockdown situation. There was also uncertainty among participants who were due to graduate soon and return to their country of origin, whether time should be invested in voluntary activities.

DISCUSSION

Findings from the study have shown the promise associated with integrating virtual reality into the field of community engagement in education, as the intended behavior and attitude of participants were positively impacted through the use of an application depicting the experience of becoming homeless. Findings highlighted that participants changed their views and perspectives toward others, especially people who are homeless. For these reasons, educators may be interested in the benefits of utilizing virtual reality technologies in the classroom, to educate students on social topics where views and perspectives may vary, and stereotyping may be present.

The Impact of the Experience on Participants

In response to the research questions relating to how the VR experience impacted Saudi Arabian students' understanding and perception of homelessness (RQ1), findings from our study showed that attitudes toward people who find themselves homeless were positively impacted through the use of the VR application depicting the experience of becoming homeless. Our quantitative findings from the perspective-taking questionnaire showed changes in perspective ($p<0.01$), while qualitative findings detailed how the characteristics of these attitudes changed, as participants were able to begin to see the nuanced nature of situations leading to homelessness, and could understand that the complex sometimes-interconnected factors that may have impacted individuals' situations.

These findings confirmed the results of prior research that showed a significant difference among perspective-taking ratings after participants interacted with VR applications. As an example, in a study undertaken by Herrera et al. (2018), the researchers conducted perspective-taking tasks with different levels of immersion (traditional vs. desktop computer vs. VR). Findings showed that participants who performed any type of perspective-taking task reported changes in perspective-taking and connected to people experiencing homelessness, more than the participants who only received information about homelessness in the control condition. However, participants who experienced the VR system signed a petition to address homelessness in much larger numbers than participants in the other conditions.

Findings from our study suggested that VR had an impact on attitude and motivation towards service learning as well (RQ2). Evidence towards this impact was identified by increases in ratings relating to participants' commitment to serving within the community, responsibility to helping others in need, keeping informed of community issues, interest in being involved in volunteering and working with others, along with

intention to participate in discussions relating to social issues and to contribute to charitable organizations within the community. However, while findings from the follow-up seemed hopeful, it is difficult to determine whether these intentions to help would eventually translate into actions further down the road. Our findings appeared to slightly contrast with other studies. For example, Gürerk & Kasulke (2021) identified that behaviors modified in the long-term, with participants offering donations provided to social causes after completing the tasks.

In respect to the research question relating to how does the VR experience influence Saudi Arabian students' ability to understand the homeless perspective (RQ3), findings showed that assumptions were found to change, and that empathy could be developed. Other studies have also highlighted the development of empathy through the use of VR (Bujić et al., 2020). Although not specifically mentioned by participants in our study, participants in prior studies focusing on homelessness (e.g., Buch & Harden, 2011) began to see individuals who find themselves homeless as individuals with whom they had a lot in common with. Further work examining how VR can help users identify commonalities with characters encountering social issues could offer considerable promise to researchers.

Insights from the Study and Implications of the Work

For reasons described in the prior section, educators may be interested in the benefits of utilizing virtual reality technologies in the classroom, to educate students on social topics where views and perspectives may vary, and stereotyping may be present. As our results show VR technologies can help prepare students for service learning experiences through informing them about the target communities and start building empathy toward and understanding of these communities. For educators with limited exposure to VR technologies, low-cost tools such as Google Cardboard can offer a cost-effective way of enabling the dissemination of apps to a wider range of users within each class. The fidelity offered using these tools can help as a first step towards changes in perspective, in addition to supporting the development of empathy. International students, in particular, are known to experience challenges with cross-cultural assimilation (Peng & Wu, 2019), so may benefit from experiencing virtual reality apps to encourage them to partake in community engagement style activities. The procedure undertaken using pre– and post-task questionnaires could also be replicated by educators, to determine the merit of each type of virtual reality application presented to their students. The mixed method approach, also advocated for by Junaidi et al. (2022) and Boda and Brown (2020) for gathering both quantitative and qualitative data was particularly beneficial for both identifying attitudes and determining the reasoning, which could be useful for other educators/researchers to employ.

Researchers suggest that remote VR studies offer considerable promise to researchers and educators, as they can address three key challenges: homogenous sampling of settings, small and homogenous samples of volunteers, and measuring changes over time (Draschkow, 2022). However, practicalities can be faced when attempting to set-up VR environments. In our study, some participants were observed needing more support than others to ensure that the application was correctly installed and viewable

using the VR device. Creating an installation guide, and scheduling a virtual session to set-up and troubleshoot prior to the study proved fruitful, as well as constant checks throughout the tasks that technology was working appropriately. Although low-cost VR devices offer considerable potential, they are known to have their limitations. Our findings suggest that technologies such as using a mobile device in concert with Google Cardboard provide the level of fidelity needed to create an immersive virtual experience that can provide a first step toward attitudinal change.

CONCLUSION

This article describes a study undertaken to understand the impact of immersive VR experiences on attitudes towards issues related to community engagement. Findings highlighted the merits of integrating VR as a tool to impact attitudes, as participants were able to adopt different perspectives, and also showed the benefits of using low-cost VR tools which could be set-up remotely in participants' own homes. In this work we have established the important role that a remotely VR experience attached to an affordable VR tools can play an important role in building empathy in users towards populations (people who are homeless) that were previously unfamiliar to them. While this application of VR can play an important role in community engagement, it can also reach students beyond the bounds of these experiences, and help them gain skills in cross-cultural understanding and communication. It enables participants were able to "learn what it is like" to be something different than themselves.

At the same time, further work is needed to identify the long-term benefits of integrating VR into the process. For example, follow-ups can be conducted with the same participants over longer-term periods to determine whether intentions to volunteer or to support community activities translated into actions. Similarly, further study could also investigate whether greater levels of exposure to virtual reality environments where social issues are presented can impact user attitudes and longer-term behaviors. Our long-term goal is to support educators, researchers and designers interested in integrating virtual reality with community engagement courses, and to better serve the needs of international students who may enroll but may have limited or differing exposure to the social issues covered.

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