



Work Zone Traffic Control Refresher Virtual Reality Pilot

Virtual Reality for Work Zone Traffic Control
Inspections - Project Summary

Workforce Development, Human Resources Division

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Introduction

Virtual Reality (VR) provides employees the chance to gain on-the-job training in a risk-free, immersive environment. The Workforce Development (WFD) Section in the Human Resources Division partnered with the University of Missouri and the University of Texas at Arlington to create VR training for the Texas Department of Transportation's (TxDOT) Work Zone Traffic Control Refresher course. The materials represent a new way to deploy and conduct training that is both a physical experience and a simulation of work zone reality. The goal is to train people in a new way to get them back to work faster, but with the same results we would expect from traditional training methods.

Background & Overview

Like other large organizations, TxDOT has seen the rise of Virtual Reality (VR) and Augmented Reality (AR) training continue to evolve since at least 2015. This project represented TxDOT's attempt to evaluate the possibility of exploring VR options for the largest segment of the workforce, the maintenance and operations employees. We selected Work Zone Traffic Control as the basis for our experiment because comparable VR experiences had already been developed for the Missouri Department of Transportation (Aati, Chang, Edara, & Sun, 2020), Work Zone safety is a critical area of focus related to TxDOT's organizational strategies, and the audience for this training provided a wide variety of use cases and multiple levels of technological adoption among our employees.

This project started in Summer 2021 under the program management of the Civil Engineering department of the University of Texas at Arlington, who subcontracted project tasks to the Department of Civil and Environmental Engineering at the University of Missouri. TxDOT worked with partners and internal stakeholders to re-develop the existing Missouri materials for Texas and worked closely with our Traffic Safety Division to ensure all materials were in compliance with the Texas Manual on Uniform Traffic Control Devices and TxDOT policies at the time. During the development of materials, the Human Resources Division procured multiple one-time use VR goggles designed to fit most current mobile phones. Upon completion of course material development in Fall 2021, the Human Resources Division distributed goggles with access instructions to employees.

Of note, TxDOT purposely did not plan or execute an organizational change management process as part of this project. As an outgrowth of our audience analysis, we wanted a clear understanding of how this new modality would be received by employees in their current state with no unique efforts to "sell" the new technology or otherwise prime the participants for this experience. By Winter 2022, we closed the project and completed this report.

Methodology

To kick off this project, TxDOT subject matter experts met to provide TxDOT specific, work zone traffic control scenarios to the programming team at the University of Missouri. This project included a work zone traffic control set-up using a mix of multiple TxDOT standards. The standards were used as a basis for the work zone, and common issues (deficiencies) were added that included:

- Flagger set-up per TCP(2-2b)-18 (*Traffic Control Plan 2-2b-18*)
- Transition road from two-lane/two-way (one lane each direction) to four-lane/two-way (two lanes in each direction)
- Two lane closure per TCP(2-4b)-18
 - Flagger Station common issues:
 - Turned and not facing traffic, in lane
 - Flagger not tending stop/slow paddle
 - Flagger tending paddle with proper stance per TMUTCD (*Texas Manual on Uniform Traffic Control Devices*) and making eye contact with driver
 - 3 reflective cone station per TCP(2-2b)-18
 - Hand signaling per TMUTCD flagging procedures
 - Stop/slow paddle per BC(4) (*Barricade and Construction Sheet (4)*)
 - Workers are not protected behind channelizing devices/barricades with a TMA (Truck Mounted Attenuator) present
 - Missing/damaged signs
 - Channelizing Devices: knocked down, faded type 3 barricade (not reflective), missing (spacing distance)
- TCP(2-4) Two Lanes Closed:
 - Incorrect taper distance
 - Arrow board (lights off)
 - Missing signs
- TCP(6-4a) Exit Ramp Closed:
 - CMS (Changeable Message Sign) (Mounting Height/Message)
 - TMA locations (distance from work zone)



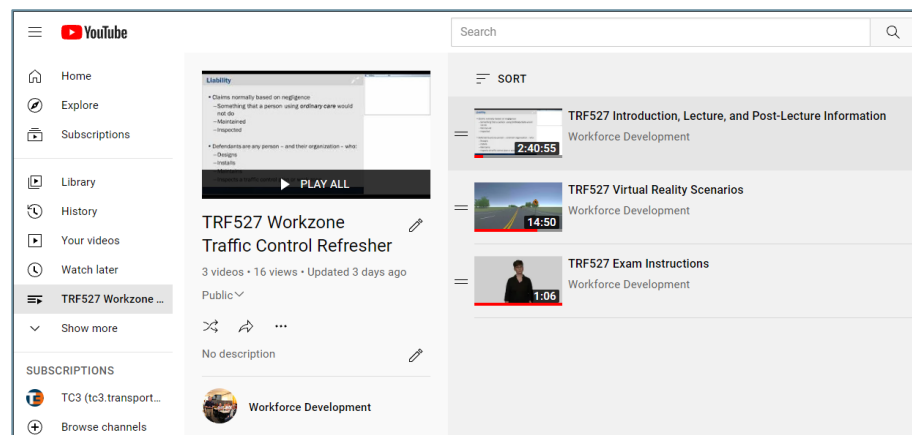
The work zone traffic control scenarios were designed from a driver's point of view to reflect the typical employee experience of driving through a work zone. The VR platform placed participants in a simulated TxDOT Ford F-150 truck that drove through a construction work zone where participants were tasked with identifying deficiencies. Three VR video scenarios in the training progress from simple to complex were intended to give participants a “crawl-walk-run” progression.

In addition to the development of the VR video scenarios, three additional videos were prepared by TxDOT that included the following:

- An **introduction and welcome video** welcomed participants to the VR training course. The introduction video provided an explanation for what to expect in the VR training and included the following components for the participants to be aware of:
 - The training consisted of 3 separate training items:
 - The first was the introduction video, followed by a recorded work zone traffic control refresher lecture of about one hour.
 - The second part was a VR video of about 20 minutes.
 - The third part was the end-of-course exam delivered by an online survey platform.
 - Participants were told they could slow down, speed up, stop, and even repeat the videos at any time and needed to take the end-of-course exam for formal credit in the learning management system.
 - The training package included a current copy of TxDOT's *Traffic Control Plan (TCP) and Work Zone (WZ) Reference Guide*, an American Traffic Safety Services Association (ATSSA) *Work Zone Traffic Control Quick Reference Guide*, and one version of the VR goggles.
 - Participants were also told the training could be taken online or via phone even without unique VR goggles.
- A **lecture** video was prepared and recorded through the WebEx platform by an instructor of TxDOT's instructor led Work Zone Traffic Control training course. The lecture reviewed content related to proper work zone traffic control processes and procedures.
- A **post-lecture exam instruction video** provided participants with instructions for accessing the videos and for assembling VR goggles that provided detailed instructions for accessing Wi-Fi, setting up their mobile phone and navigating it through the VR video, and finally viewing the VR video

After video production, the edited videos were packaged, uploaded, and published to TxDOT's public YouTube site. The published training course was assigned the course number **TRF527** – *Work Zone Traffic Control Refresher* to ensure participants who completed the training receive credit through the learning management system. The final order of videos is shown below as an image of TxDOT's WFD YouTube site:

1. Title: **TRF527 Introduction, Lecture, and Post-Lecture Information.** Description: This video welcomes participants to TRF527. This video is an introduction to the course. It includes the introduction, WebEx recorded lecture, and post lecture instructions. Note: Participants use a QR code to access the video (shown above). Web link to video: <https://youtu.be/GxKFZrzKT6Q>
2. Title: **TRF527 Virtual Reality Scenarios.** Description: This video contains a VR experience that takes participants through 3 different work zones with all the components that are reviewed during the lecture. Note: Participants use a QR code to access the video as provided via a job aid or when visible at the end of the video. Web link to video: <https://youtu.be/LAMI5bo8KJk>
3. Title: **TRF527 Exam Instructions.** Description: This video contains the exam instructions, and the QR code for completing the exam that is visible at the end of the video. Web link to video: <https://youtu.be/FD9BPbH2qbl>



In addition, TxDOT created stickers that contained instructions and QR codes to be used as part of the training package distributed to participants. Participants access the VR training through their mobile phone with the use of these QR codes or could choose to complete the training on a computer. The first QR code took participants to the introduction video with lecture, the second QR code took the participants to the VR video, and the third QR code took participants to the Exam. The sticker and VR goggles are shown in the next images.

Work Zone Traffic Control Refresher – Virtual Reality

This course reviews basic and updated work zone traffic control information. It addresses areas of concern while working in and around a work zone. This course is a series of videos followed by an online test.



TRF527
training@txdot.gov
512-416-2000



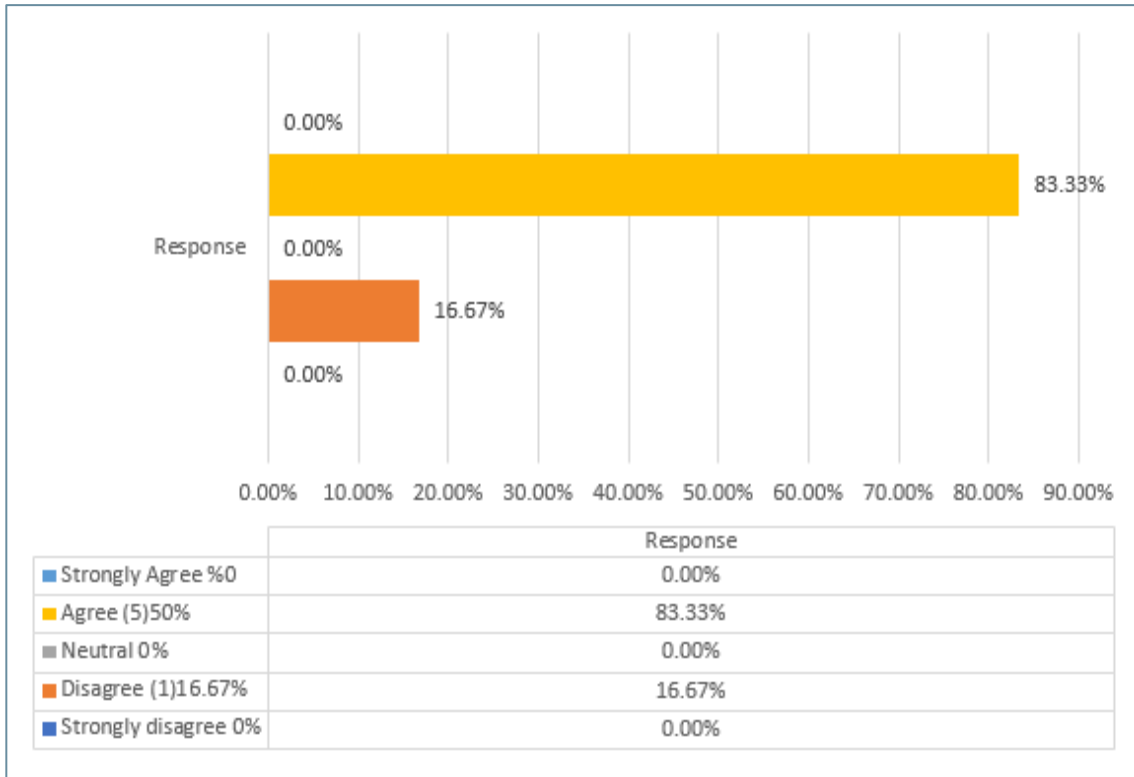
The Human Resources Division approached several different diverse large group gatherings for the distribution of this pilot training package. Two hundred of the training packages were handed out to employees at the TxDOT Traffic Conference in 2021, which served as the first pilot for this training course. For the second pilot of this training course, approximately 40 training packages were handed out at TxDOT's Maintenance Leadership conference in 2022. For the third pilot, approximately 30 training packages were handed out at TxDOT's Area Engineer training class in 2022.

For the pilots, The University of Texas at Arlington developed the pre and post exams (Level 2 evaluation) with the use of the QuestionPro online platform. As noted earlier, participants used a QR code to access and complete the exam. The Web link for the exam can be found here: <https://work-zone-traffic-control-check-survey.questionpro.com>. An end-of-course survey was also created to capture participant reaction (Level 1 evaluation) to the training: <https://www.surveymonkey.com/r/G9CRM5P>

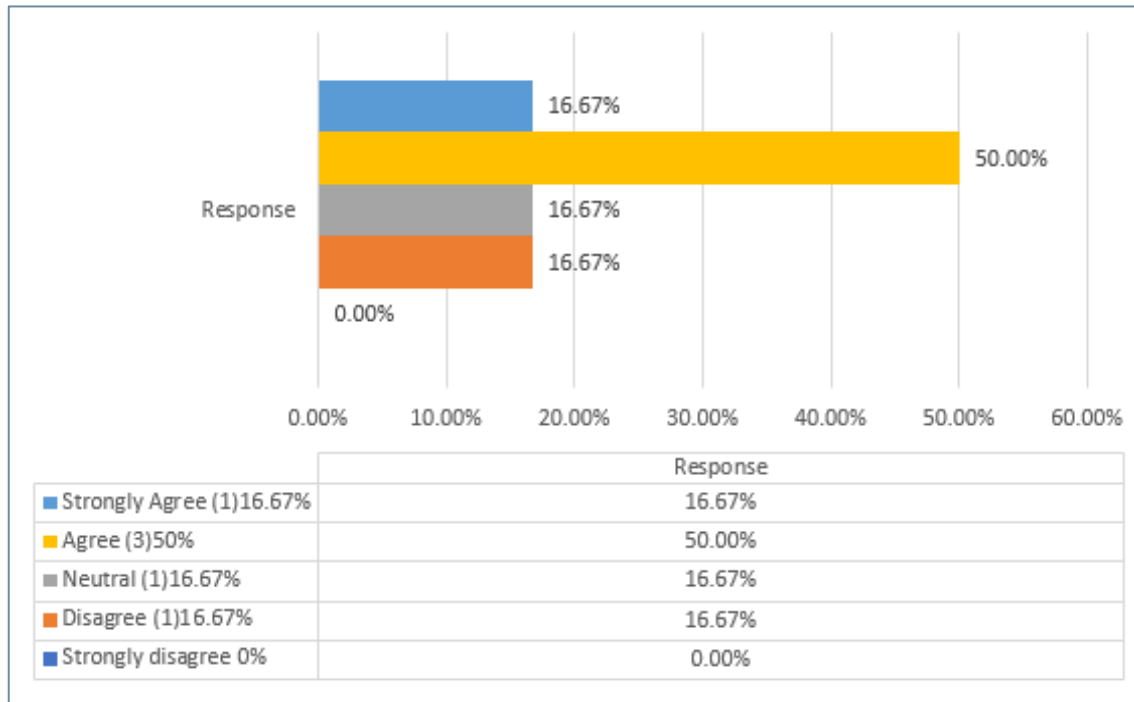
Evaluation

Each aspect of this training met varying levels of success. While TxDOT did solicit almost 300 participants for the pilots, data shows that only 6 participants completed the training course (finished the final exam for credit). Participant responses to the Level 1 evaluation indicated overall favorable opinions of this new training platform, but not enough responses were received to draw substantive conclusions. The questions and results are shown on the following pages as anecdotal evidence related to the project.

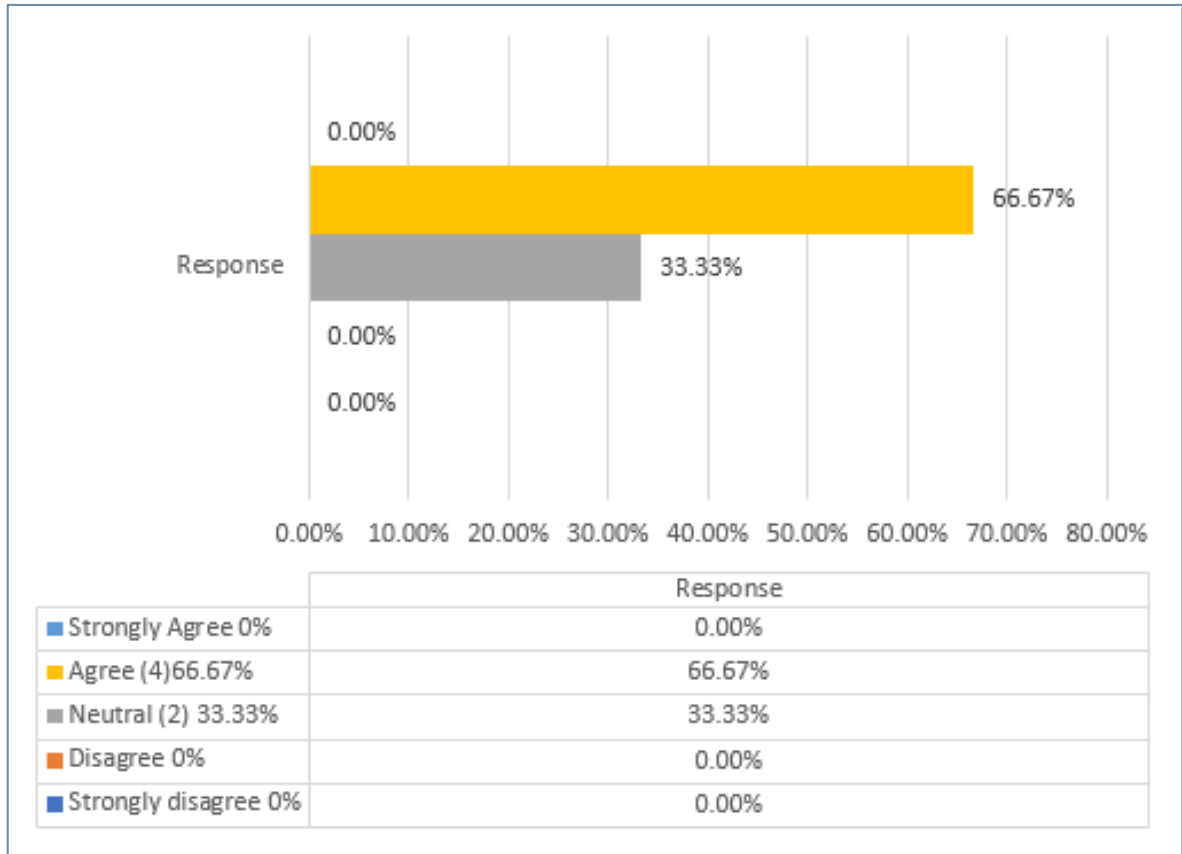
1. I believe the virtual reality module provided a realistic representation of an actual work zone. Note: () = number of participant responses, with a total of 6 responding.



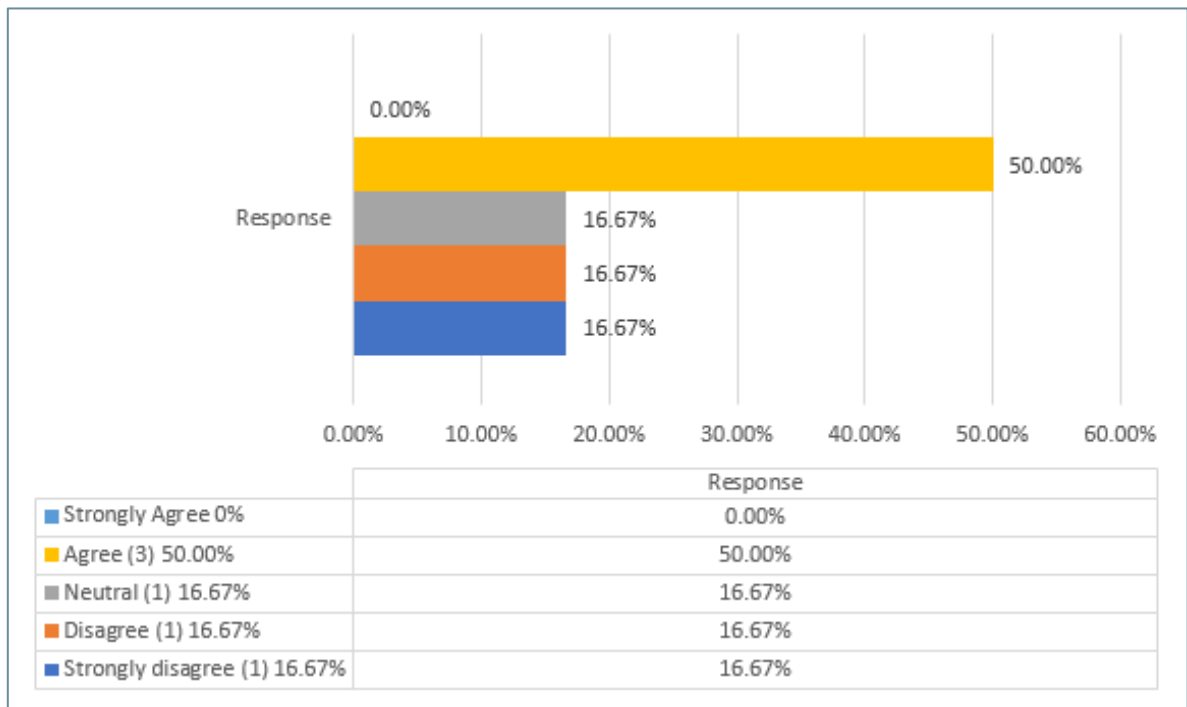
2. I was able to distinguish between good and bad signage in the work zone:



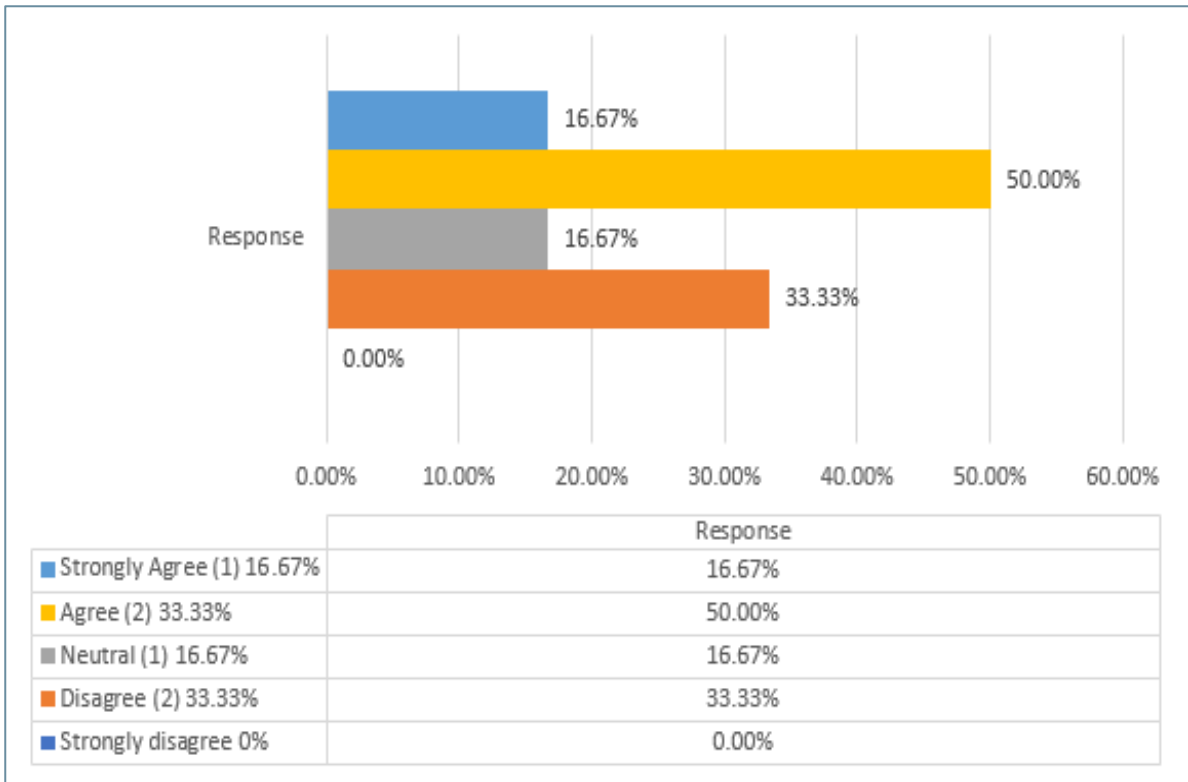
3. I did not find the virtual reality module to be challenging:



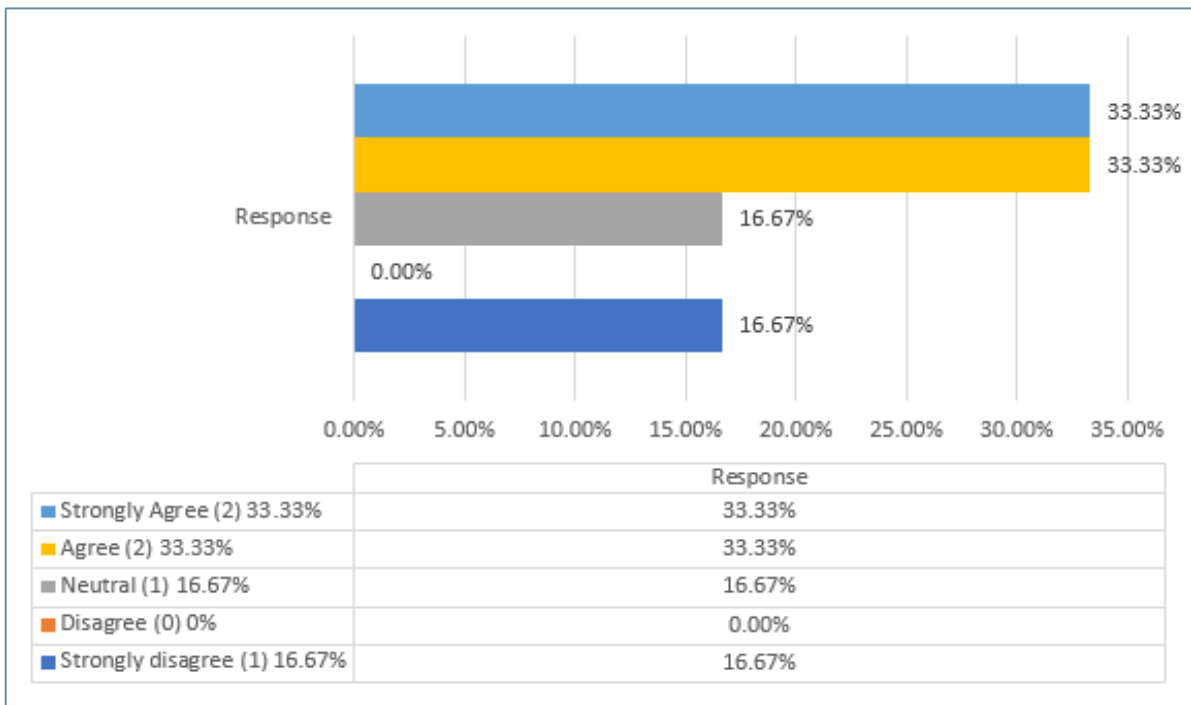
4. I had enough time to read the work zone signage:



5. I had sufficient time to notice any concerns in the work zone:



6. Overall, I believe that the virtual reality module is useful for training staff that inspect work zones:



Conclusions & Implications

This 2021-2022 project was TxDOT's attempt to explore VR training for the largest segment of our workforce using a topic of critical importance to transportation safety. While 300 participants were directly involved in pilots, a completion record of approximately 2% indicated TxDOT was not prepared for a self-service VR training model, necessitating an intentional change management plan for future VR implementations. The benefits of VR training remain similar to those of other virtual or remote methods, with the added benefit that a VR experience anecdotally appears more realistic and engaging than traditional in-person training or videos. The increasing capabilities of VR devices and the continued support for online VR settings through publicly accessible online platforms like YouTube make VR an option to replace existing static or video content, but does not yet replace the training event that typically houses such content. To that end, this content can also be used as a performance intervention during routine safety meetings, tailgates, and even contract kick-off meetings with any group involved in work zone traffic control in Texas.

References & Resources

Aati, K., Chang, D., Edara, P., & Sun, C. (2020). Immersive work zone inspection training using virtual reality. *Transportation research record*, 2674(12), 224-232.

Texas Department of Transportation (2022). Texas Manual on Uniform Traffic Control Devices (TMUTCD). TxDOT.gov. <https://www.txdot.gov/business/resources/traffic-design-standards/tmutcd.html>

Texas Department of Transportation. (2022). *TRF527 Introduction, Lecture, and Post-Lecture Information* [Video]. YouTube. <https://youtu.be/GxKFZrzKT6Q>

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