TRUCK WISE

VIRTUAL REALITY INTERACTION

Truck Wise Final Report

CITY OF GREATER BENDIGO | DEAKIN UNIVERSITY | [redacted] | TAC | BENDIGO TECH SCHOOL

Road Safety is a shared responsibility

Executive Summary

In October 2018, the City of Greater Bendigo were awarded funding by the National Heavy Vehicle Regulator, or NHVR, under Round 3 of the Heavy Vehicle Safety Initiative funding to undertake Truck Wise, a pilot project aiming to increase awareness about safe interactions between light and heavy vehicles amongst younger drivers using Virtual Reality.

In May 2019, Deakin University's VR Lab was appointed as the lead contractor for the Truck Wise pilot project. Deakin enlisted Bendigo-based marketing and communications company SASI as a sub-contractor to undertake the project's marketing and communication activities. In the early stages of the project, it was decided that Truck Wise would take a bottom-up co-design approach where stakeholders, subject matter experts and end-users would provide feedback at critical points throughout the project.

The first stakeholder meeting was held in late May to plan out the project and involved a diversity of stakeholders including, City of Greater Bendigo, Bendigo Tech School, the Transport Accident Commission (TAC), Deakin University, SASI marketing and Agri-Trans.

During the workshop, stakeholders endorsed the project's four main goals. These were to —

- Educate using 360-video, social media and the Hub website.
- Engage through a fully interactive VR experience.
- Amplify through media channels, marketing and on road advertising.
- Evaluate using a formal research design and report methodology.

The workshop resulted in agreement to —

- Narrow the project's primary audience to those aged 16-18-years.
- To focus on building empathic VR experiences rather than simply showing examples of right and wrong.
- To develop road safety awareness as opposed to driver training.

Between June and October 2019 pre-production activities took place and involved —

- Research into the current state-of-the-art in using virtual reality for empathy.
- A focus group workshop with heavy vehicle subject matter experts to better understand common challenges and issues.
- Research design for evaluating the VR experiences including obtaining ethics approval.
- Development of storyboards for both the 360-video and interactive VR experiences.

- Development of a creative marketing plan that included Truck Wise branded designs, social media assets and schedule.
- Design of site map for the Hub website.
- Exploration of options for the Roadshow roll-out.

In late October 2019, a Materials Testing Workshop was held with project stakeholders to review the work undertaken by Deakin and SASI during the pre-production phase of the project. The presented materials were well received and endorsed by project stakeholders.

Production of the Truck Wise materials occurred between November 2019 and March 2020 which saw the development of —

- 360 videos and VR experiences.
- The Hub website.
- Marketing materials.

Production included the 3D scanning of Truck Wise ambassadors, Marla Stone and Damien Powers, by Mark Ruff. Mark is known for his special effects work on several Hollywood movies including the Matrix. The 3D scans of both Marla and Damien were turned into virtual avatars by Deakin and play a key role in the Truck Wise 360-video and interactive VR experiences.

In March 2020, the first Truck Wise interactive VR experience (*Season 1 – We need our space*) was tested by students at a local Greater Bendigo Secondary College. The experience was well received by students who gave a rating of 8.8 out of 10 with 82% of the participants reporting an increase in knowledge about safe interactions with heavy vehicles (see Virtual Reality Development Evaluation section). Feedback suggested that students enjoyed the experience of being a passenger in a truck, as well as listening to the truck driver and seeing their perspective. They also suggested valuable improvements, including increasing realism and quality of graphics and adding more user interactions and ability to drive the vehicles. The activity attracted TV and radio media attention providing valuable promotion for the project.

In April 2020 the COVID-19 pandemic and accompanying restrictions meant that the project team needed to consider what impact COVID-19 would have and how to best proceed with the remainder of the project activities. The project team continued to closely monitor the situation and came to the realisation that face to face activities were going to be increasingly difficult, if at all possible, and that an alternate approach was required.

The project had focused on two versions of Truck Wise VR experiences. A 360-degree video version able to be access via a web browser, and an interactive VR experience designed for face to face delivery with groups of students. Although COVID-19 presented challenges to undertaking an in person launch and Roadshow with students. The 360-degree video of the experience was designed to have wide reach and could be made assessible from anywhere – a design feature making it an ideal medium during the COVID-19 era and beyond.

In October 2020, the project team and project stakeholders met to discuss the refined direction and agreed to develop an education resource pack. As a result, schools can now access the education resource pack on request and take advantage of the educational material developed including unique 360-videos and VR experiences.

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Overview

Overview

Truck Wise is an innovative pilot project that uses Virtual Reality (VR) technology to help generate greater awareness of safe interactions between light and heavy vehicles. While risks are related to a range of different heavy vehicles the Truck Wise pilot project focused on interactions with trucks due to their common presence on Australia roads. The pilot targets 16 to 18-year-old leaner and novice drivers to support them in making safe choices when sharing the road with heavy vehicles. Truck Wise took the approach of focusing on increasing awareness and empathy to communicate challenges and risks unique to truck drivers as opposed to driver training. By increasing empathy, it is intended that an improved an awareness of safe interacts with heavy vehicles on the road can be achieved.

The Truck Wise pilot project includes research and evaluation activities that helped guide both design and development of VR experiences and disseminate the project outcomes to add to the body of knowledge on road trauma prevention using virtual reality technologies. These VR experiences intend to foster awareness and empathy around heavy vehicle drivers and the challenges they face on our roads. The project received ethics approval from Deakin University, Department of Education and Training Victoria and Catholic Education.

The Truck Wise pilot project was conceived, designed and led by the City of Greater Bendigo (CoGB).

The Truck Wise project —

Figure 1. Virtual Reality Development Evaluation with local Bendigo secondary college.

- Is an alternative to commonly metro-centric road safety initiatives.
- Employs the latest in immersive technology.
- Involves Deakin University's CADET VR Lab, a high-profile research and development group.
- Applies the latest in behavioural science and research, in collaboration with the TAC and education experts.

Inception

In late 2017, the City of Greater Bendigo (CoGB) completed the Bendigo Freight Study: How goods are moved around Greater Bendigo in order to better understand freight issues and increase robustness, productivity, and responsiveness to innovation and change. The study also aimed to provide guidance on improving sustainability of the sector and achieving a safer, cleaner and more efficient city. Road safety was identified as an important issue with freight operators involved in the study highlighting the need for urgent attention. Freight operators felt that other road users appeared to not adequately understand the road rules applicable to their interaction with heavy vehicles and were concerned that safety related challenges such as the ability for a truck to stop quickly or the extent of blind spots were not appreciated.

Figure 2. Material Testing Workshop (held on 23rd October 2019).

Discussions with accredited driving instructors, the Australian Trucking Association (ATA), and the Transport Accident Commission (TAC) confirmed these concerns. There is limited educational material and practical instruction on how to improve driving skills, develop good habits and improve driver awareness around heavy vehicles. While government agencies and industry bodies across Australia have established road safety regulations and programs designed for heavy vehicle drivers, there has been far less effort on light vehicle drivers and their interactions with heavy vehicles.

The Truck Wise project proposal was developed in response to this gap in educational material. Funding was sought from the NHVR under Round 3 of the Heavy Vehicle Safety Initiative (HVSI). The funding was secured in October 2018, to the total value of $250,000. This funding was for a Pilot Project to be led by CoGB and delivered in Greater Bendigo in 2020. The City also secured monetary and in-kind State Government contributions towards the pilot via the TAC, and in-kind contributions from Bendigo Tech school (BTS), Deakin University and the freight industry.

Project Contributors

The Truck Wise pilot project is a collaborative effort that harnesses the expertise and resources of all three levels of government, secondary and tertiary education providers and the freight and logistics sector.

Led by the City of Greater Bendigo, the pilot was delivered in partnership with a number of organisations, including the TAC, who provided monetary contributions; as well as latest, evidence-based expertise in road safety education.

Deakin University's CADET VR Lab, experts in virtual reality training as Lead Contractor, designed and developed the virtual reality experiences.

The BTS provided access to their facility and their well-established networks with Greater Bendigo secondary schools in Greater Bendigo region key to the, thus being critical to the testing and refinement of the VR experience with local students. BTS also developed a Truck Wise inspired educational program that promotes road safety through the use of emerging technologies such as augmented reality and virtual reality.

Key stakeholders from the freight and logistics industry have also come on board. Victorian Livestock and Rural Transporters Association, Agri-Trans and Power's Country Express have all made in-kind contributions and provided invaluable real-life expertise.

Road Trauma in Australia and Regional Communities

In Australia, on average, 100 people die every month as a result of road trauma and over 30,000 people are seriously injured (BITRE, 2018). Despite a downward trend in heavy vehicle related deaths, 2020 was the first time in 20 years to have recorded an increase in the number of heavy vehicle driver fatalities on Australian roads. In more than 80 percent of serious crashes involving heavy vehicles and cars the heavy vehicle drivers are not at fault (NTARC, 2020).

Significantly, two out of three road fatalities occur on rural and regional roads (BITRE, 2019). Road trauma is therefore an extremely serious issue affecting regional communities. Most government led road safety initiatives have a metro-centric focus. The Truck Wise pilot project however constitutes a concerted effort by a regional municipality to address road safety issues affecting regional and rural communities.

Road Trauma and Young Drivers

More than one in five drivers that died on Australian roads in 2016 were aged between 17 and 25 years old (BITRE, 2018). One in four drivers seriously injured also belonged to this age group (BITRE, 2019). Road trauma is one of the leading causes of death among young people. Drivers are at their highest risk of being involved in a crash during their first year of solo driving. Most learner permits are held by those aged between 16 and 18. The Truck Wise pilot focused on 16 to 18-year-olds, particularly leaner drivers, as this provides the opportunity to influence awareness before driving behaviour and attitudes are fully formed.

Need to Test New Approaches to Road Safety Education

Although the number of casualty crashes among young drivers has been dropping since the introduction of the Graduated Licensing System in 2007, young drivers are still over-represented in road trauma. Truck Wise aims to build upon current road safety initiatives that target young drivers using techniques beyond just —

- Giving out information to make young people *'aware'*.
- Driving skill programs such as off-road tracks or circuits.
- Using fear and shock tactics.

The Potential of Virtual Reality (VR) in Road Safety Education

Virtual Reality (VR) can facilitate access to scenarios and environments that may be difficult, if at all possible, to access otherwise. VR technologies are continuing to evolve into high-quality, relatively in-expensive, consumer grade technologies. Using virtual reality, it is possible to embody the user within a virtual character or experience, and the research literature suggests that this can increase empathy. Research also suggests that embodiment through virtual reality can be a powerful tool for helping to change behaviour (see Virtual Reality Empathy and Changing Behaviour section).

Truck Wise Objectives

In focusing on the following objectives Truck Wise aims to address the limited practical and effective information available to younger light vehicle drivers that would prepare them for everyday encounters with heavy vehicles on our roads and help to reduce the likelihood of collisions between them.

1. Enhance

Enhance awareness of the physical constraints and challenges heavy vehicle drivers face

2. Improve

Improve understanding of safe behaviour when interacting with heavy vehicles

3. Foster

Foster empathy for heavy vehicle drivers and the challenges they face

4. Raise

Raise the freight and logistics industry profile

Truck Wise Design Activities

Stakeholder Planning Workshop

A project planning workshop was held with stakeholders on May 29th, 2019, at the Bendigo Tech School (BTS). Project partners and stakeholders provided input to support a revised project plan.

OUTCOMES OF WORKSHOP

Outcome 1

The age demographic had initially been specified as 16 to 25-year-olds. It was suggested that this age range would span too large a range of levels of maturity and driving experience. Group consensus was that project outcomes would be improved if the primary age demographic was narrowed to 16 to 18-years-olds, i.e. learner drivers.

Outcome 2

The group considered different project parameters including objectives, resources, capabilities of VR technology, timeframes etc., and agreed that focusing on awareness would be more strategic than focusing on driver training or a call-to-action.

Outcome 3

The project focuses on short experiences for young drivers. It was acknowledged that driver training requires significantly longer experiences typical in an on-road environment. As such, it was affirmed that it was not the project intension to focus on driver training.

Outcome 4

There was general consensus across the group that VR technology and its use in the project would be well suited to fostering empathy related to driving heavy vehicles and the drivers themselves. For instance, using VR, a young light vehicle driver could be placed in the shoes of a heavy vehicle driver and actually experience the challenges associated with driving a heavy vehicle and interacting with other vehicles on the road, something that typically would not be possible

Outcome 5

The group acknowledged that, although there was not a great deal of resources around heavy vehicle safety for young drivers, it was important for Truck Wise to complement rather than duplicate, any existing driver educational information and programs.

Stakeholder Material Testing Workshop

A stakeholder material testing workshop was held on October 23rd, 2019 at the Bendigo Tech School (BTS). In the workshop stakeholders reviewed the project planning and development undertaken during the pre-production phase of the project. The presented materials were well received and endorsed by project stakeholders. The TAC also invited the project team to a guided tour of the "Road to Zero: Road Safety Experience" at Melbourne Museum sharing important information about the development of both the VR experiences and broader educational programs it runs.

REVIEW

Project Plan Review

- The production phase would involve development of the Hub an online website and the VR experiences.
- The seed phase would consist of advertising and promoting the project, launching the program via social media, communication with schools and traditional media, and testing and refining of the VR experience.
- The launch phase would consist of a high-profile event, Roadshow to select schools in Bendigo, live activation of the Hub website and potentially, Truck Wise presence at a local youth event.
- The reporting phase would consist of producing a final report that included project outcomes, evaluation and future recommendations.

Creative Marketing Plan

- Approximately 40 marketing activities were presented in the proposed Marketing Plan.
- Communication objectives were to be interlinked with project objectives (*enhance*, *improve*, *foster* and *raise*).
- The presented creative marketing plan included key elements around re-branding project name to Truck Wise, marketing collateral and brand design, suggested project ambassadors (Marla Stone and Damien Power), target schools for Roadshow, youth event at Groovin' the Moo, website design for *the Hub*, high-profile launch options, social media schedule and assets and media communication protocol.

Virtual Reality (VR) Storyboard

- Production of the VR experiences would undertake a co-design approach with different stages of testing before reaching the final version.
- Eye tracking VR technology would be used to extend existing research and investigate its capability to foster empathy in the VR experiences.
- Contextual scenes to be developed introducing virtual avatars to provide users with background stories to increase their familiarity with heavy vehicle drivers.
- A regional highway and CBD setting would both be used to form the basis for two separate VR experiences covering leaving a safe braking distance and the challenges of tight turns and the need to use two lanes.
- Both scenes would include a viewpoint of the situation from both a light and heavy vehicle driver's perspective and this would be an innovative use of VR.

Evaluation Methodology

- A Focus group with heavy vehicle Subject Matter Experts (SMEs) would be undertaken to investigate common challenges and issues.
- The baseline level of knowledge about heavy vehicles by the target demographic, i.e. 16 to 18-year-olds, would be determined by surveying target end users.
- The evaluation would include consideration of what users enjoyed about the experiences, suggested improvements, and their acceptance of the technology using the Technology Acceptance Model (TAM) (Davis, 1985).
- Eye tracking would be used during the planned *Roadshow* to assess user's empathy arising from the use of the VR experiences.

Review of the Literature and Current Practice

To ensure that the project was advancing existing road safety programs and that it was informed by the latest research and current best practice extensive background research was undertaken. This section provides relevant information including the process young drivers undertake to obtain their licence in Victoria, current programs and educational content for young drivers, young driver awareness campaigns, age demographics for licence acquisition in Victoria, and cutting-edge virtual reality research into empathy and behaviour change.

VICTORIA'S GRADUATED LICENSING SYSTEM (GLS)

Graduated licensing is a proven approach to reducing young driver road trauma and involves progressively lifting restrictions as experience and maturity increase (VicRoads, 2019). Research studies across different jurisdictions indicate that graduated licensing significantly reduces young driver crashes. Following extensive investigation of the available evidence, Victoria introduced an enhanced Graduated Licensing System (GLS) from 2007. The GLS has evolved in response to community need and current evidence. Currently under this system the following applies —

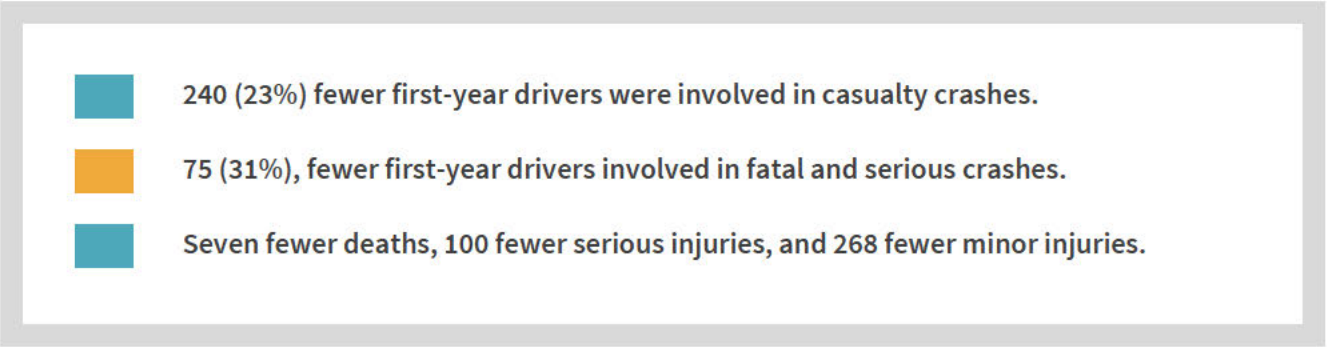
The Graduated Licensing System

In Victoria a learner permit can be obtained from the age of 16 and requires applicants to pass driver knowledge and eye tests. The minimum age a learner driver can progress to a probationary licence is 18 years old. Learner drivers under the age of 21 are required to have held a learner permit continually for 12 months and have logged at least 120hrs of supervised driving (including at least 20hrs of night driving) logged before undertaking the Drive Test for their probationary licence. Learner drivers aged between 21 and 25 are required to have held their learners permit continually for a minimum of 6 months, without the need required to log driving hours before applying for their probationary licence. In the case of those aged over 25 years old, this period reduces to a minimum of 3 months.

Drivers who obtain their probationary licence before the age of 21 are required to hold their probationary licence for 4 years before progressing to a full licence. Probationary drivers over 21 only need to maintain their probationary licence for 3 years. There are two probationary licences, P1, or red and P2 or green. P1 is a requirement for probationary drivers under the age of 21 and needs to be held for a minimum of 12 months. All probationary drivers (excluding overseas drivers) are required to be on a P2 licence for 3 years before progressing to a full licence, other requirements include —

- Zero blood alcohol limits apply for all stages and there are tougher penalties.
- P-Plate drivers require a good driving record to progress to the next stage of licencing.
- P1 drivers are subject to a peer passenger restriction and cannot tow or use a mobile phone at all whilst driving (even with hands free).
- There are restrictions on the type of vehicle P1 drivers can drive.

A VicRoads evaluation of the updated GLS was undertaken in 2012 (VicRoads, 2017) and found that each year since the introduction of the GLS the following crash reductions were shown to have occurred —



There are stringent enforcement measures in place to target high risk driving, these include —

Enforcement Measures

- Installation of traffic safety cameras.
- Drink and drug driving enforcement measures such as interlocks and random roadside testing.
- Vehicle impoundment laws (approximately 65% of vehicle impoundments since the laws were introduced in 2006 have been young drivers).

Figure 3 provides an overview of young driver crash statistics and highlights that the greatest level of risk for young drivers is during their first year of driving solo. The figure also shows the reduction in casualty crash rate for drivers in Victoria since the introduction of the Graduated Licencing System (GLS) in 2007. There is a significant reduction in casualty crash rates especially for first year probationary drivers who recorded a 40% reduction between pre- and post-GLS (VicRoads, 2017). This reduction is largely impacted by two major changes that were introduced as part of the updated GLS. The first is the requirement to complete 120hrs of supervised driving whilst on a learner's permit before being able to apply for a probationary licence. The second is the introduction of the additional P1 licence restrictions, such as the peer passenger restriction specifying that first year probationary drivers under the age of 21 are only allowed to have one passenger between the age of 16-22 in the vehicle.

Pre-GLS vs Post-GLS

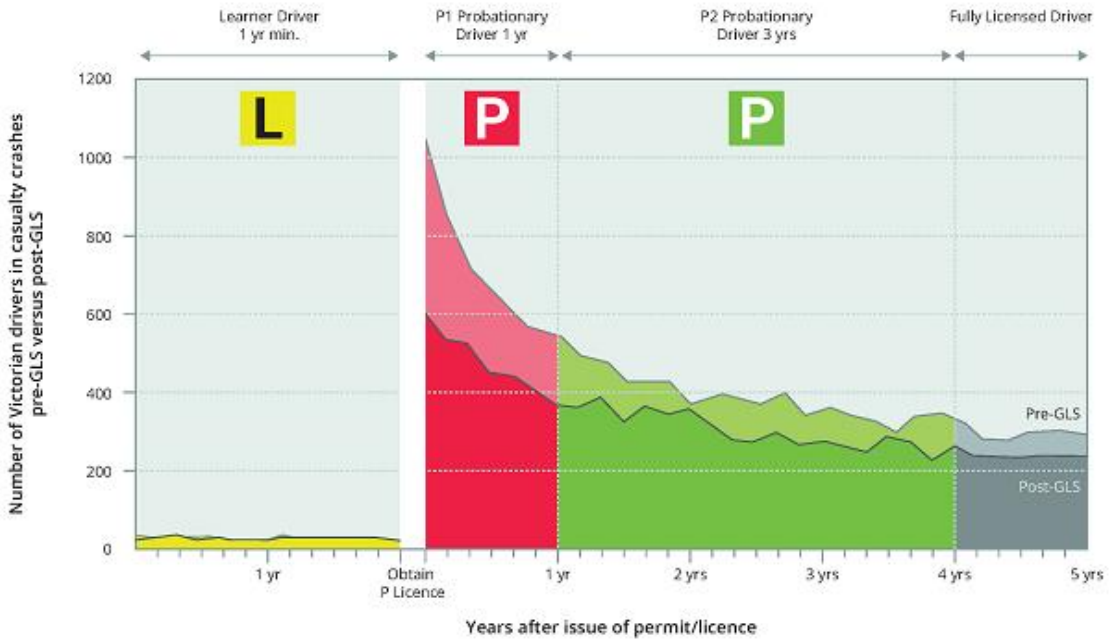


Figure 3. Number of casualty crashes in young drivers comparing results between learner, probationary and full licence drivers (VicRoads, 2019).

GRADUATE LICENSING SYSTEM (GLS) SUPPORTING CONTENT

DriveSmart is a free online training program provided by the TAC. The program was developed to support novice drivers to improve their hazard perception and concentration skills. DriveSmart was initially released on CD-ROM in 2000 based on research undertaken by MUARC (Regan, Triggs, & Godley, 2000) and in 2014 moved to an online version. In 2017 the DriveSmart program had over 70,000 users, and due to its success, the decision was made to under-go a redevelopment of the program to include a series of online video-based scenarios and challenges and it was released in early-2019 (Chapman & Wallace, 2018). The DriveSmart website includes 100 video challenges and 14 simulations, aimed at learner drivers with either 20+ or 50+ hours of driving experience. Despite providing an extensive set of resources, including 10 video challenges that feature trucks, the program doesn't have significant coverage on interactions with heavy vehicles.

The myLearners website is an online resource supporting the VicRoads myLearners app. The myLearners app is a digital logbook where users can log and track supervised driving hours to keep track of their progress towards solo driving.

The content on myLearners website aligns with the four stages of learning to drive, shown in Figure 4, that is loosely based on the number of hours of driving experience. Stage one covers car control (0-10hrs of experience), stage two Basic Drives (11-40hrs of experience), stage three Complex Drives (41-80hrs of experience) and stage four covers Rehearsing Solo (81+hrs of experience). There is also a fifth stage defined as 'pre-learner' for those who have not yet commenced their on-road driving. Despite all stages promoting sharing the road, stage 3 (Complex Drives) is when learners are most likely to begin driving in more complex environments that include a variety of different road users including heavy vehicles. This section does have information related to sharing the road with other road users however only has limited information about sharing the road with heavy vehicles.

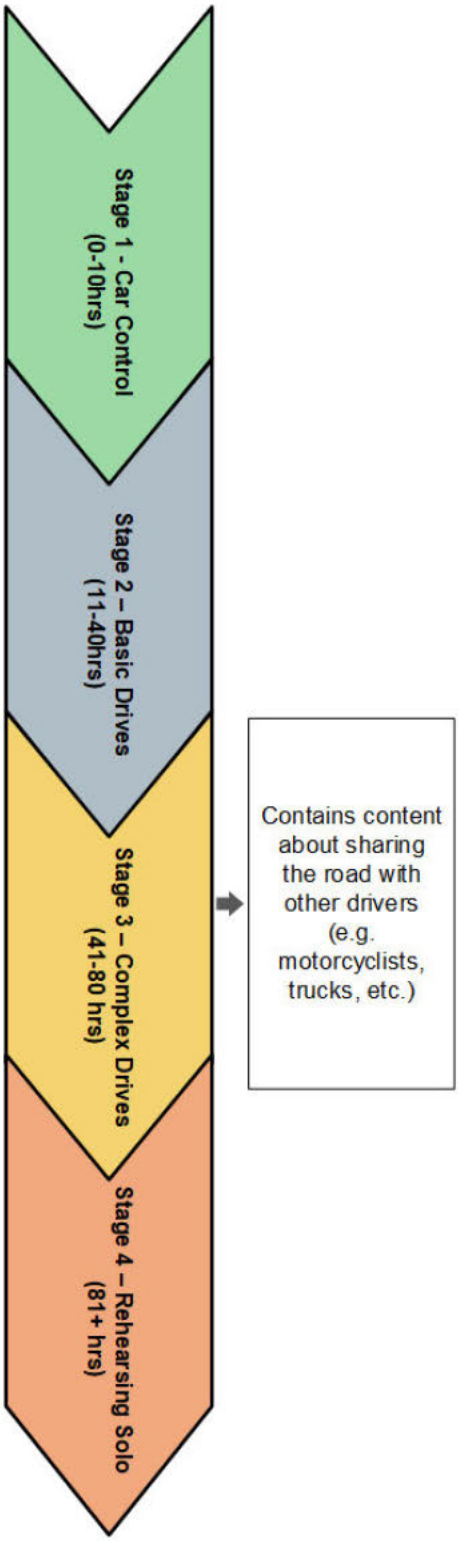


Figure 4. The myLearner driving stages.

YOUNG DRIVER AWARENESS CAMPAIGNS

Towards Zero

Towards Zero is a road safety strategy launched in 2016 by the TAC aiming to reduce Victorian road deaths by 20% and serious injury by 15% by 2020. As part of the Victorian Government strategy there have been several Towards Zero campaigns focusing on several aspects of road safety including mobile phone use, fatigue, safety barriers, driving under the influence, and sharing the road with other drivers. As part of the Towards Zero vision, the TAC collaborated with Melbourne Museum to develop the Road to Zero exhibition focussing on secondary school students and the Victorian Government's Young Driver Safety Package. Road to Zero aims to reduce road trauma in pre-learner drivers by building knowledge and awareness that will empower young road users to make safe decisions. The exhibition uses several state-of-the art technologies to educate young people and the wider Victorian community about making safer driving choices such as the safety features on newer cars, how modern road designs impact road safety and driving at safe speeds. Part of the exhibition includes a 3-minute VR experience where users experience travelling in a car from 1970 to 2055 to provide a history of road safety in Victoria and a vision of the future with zero road deaths.

Linfox Truck Safety Series

The Linfox Truck Safety Series comprises a series of short videos narrated by four Linfox truck drivers. Each driver provides an overview of their daily employment activities and the challenges of driving heavy vehicles. They discuss their responsibility to contribute to road safety and provide information about how they share the road with other drivers, manage fatigue, and the importance of maintaining and monitoring their truck to ensure safe operation. The Linfox truck safety series is a great example of fostering empathy for those operating heavy vehicles on our roads.

Re-act

Re-act is a behaviour change initiative started in 2016 as a collaboration between Hard Edge, a Melbourne based creative agency, and Swinburne University of Technology. The initiative began as a way to provide Swinburne design students with real world design briefs to raise awareness of road safety issues aimed at changing behaviour among young drivers aged between 18 and 25 years. In 2018, Re-act's design brief focused on educating young drivers about the importance of sharing the road with heavy vehicles and how to interact safely. The winning campaign titled "Don't Truck Around" was developed by students Charlotte Hicks, Grace Kirby and Caitlyn Preyser that provided a detailed marketing campaign including posters, merchandise and digital advertising strategy.

The involvement of students in developing a campaign not only can provide a wide range of creative ideas and approaches, but if the students are of the correct demographic, it can provide valuable insight as to how the target demographic perceive the challenges faced. While the nature and timeline for the Truck Wise project wasn't well suited to campaign design by students, valuable opportunity to involve Bendigo Tech School (BTS) students in other aspects of the project was identified.

LICENCE ACQUISITION DEMOGRAPHICS

Licence demographic data was sourced to investigate whether the narrowing of the Truck Wise target demographic from 18-25-year-olds down to 16-18-year-olds suggested by stakeholders at the project planning workshop was justified. The Household, Income and Labour Dynamics in Australia (HILDA) report (Wilkins & Lass, 2018) is an ongoing survey conducted by Melbourne Institute of Applied Economic and Social Research. HILDA covers a wide range of social aspects in Australia such as household and family relationships, childcare, employment, education, household income and expenditure, health and well-being and attitudes toward several different subjects. As shown in Figure 5, the HILDA report includes the collection of survey data on the proportion of people for each age group who hold a current driver's licence. Results show that from 2012 to 2016, the number of females in the 18-19 age bracket that held their driver's licence increased by 3.4%, and for males of the same age this decreased by 6.2%.

Licence Acquisition by Age Group

Table 11.1: Proportion holding a driver's licence, by age group, 2012 and 2016 (%)

	Women		*Men*	
	2012	*2016*	*2012*	*2016*
18–19	60.2	63.6	71.0	64.8
20–24	79.8	82.4	79.9	83.0
25–29	81.8	88.0	90.0	86.1
30–34	88.6	91.6	93.5	92.7
35–44	93.8	93.0	95.9	95.9
45–54	91.1	93.6	96.4	96.4
55–64	90.0	90.4	95.0	94.6
65–69	78.7	85.1	91.2	94.9
70–74	78.8	78.1	91.4	88.7
75–79	69.3	75.6	87.9	92.6
80–84	61.7	61.0	82.0	81.7
85 and over	31.8	42.7	79.4	73.8
All aged 18 and over	84.2	86.4	91.4	91.1

Figure 5. The Household, Income and Labour Dynamics in Australia Survey (HILDA) survey results for driver licence held by age group (2012-2016) (Wilkins & Lass, 2018)

Vehicle Licence by Age

The Victorian Integrated Survey of Travel and Activity (VISTA) is an ongoing survey of household travel activity. As part of the survey, road users were asked about the level of licence they currently hold (e.g. probationary or full licence). Figure 5 shows survey results conducted over the four-year period of 2012-2016. Despite the shifts shown in the HILDA report for the same 4-year period (Figure 6), the Victorian Integrated Survey of Travel and Activity (VISTA) report on household travel activity shows that for the age bracket of 19-20 those who hold a learner's permit compared to a licence decreases significantly. As can be seen from the results, most learner permits are held by those aged 16-18, and most probationary licences held by those

aged 18-21. This aligns with the age of eligibility for both learner and probationary licences and suggests that after reaching the age of eligibility for the respective licence, they will apply for it.

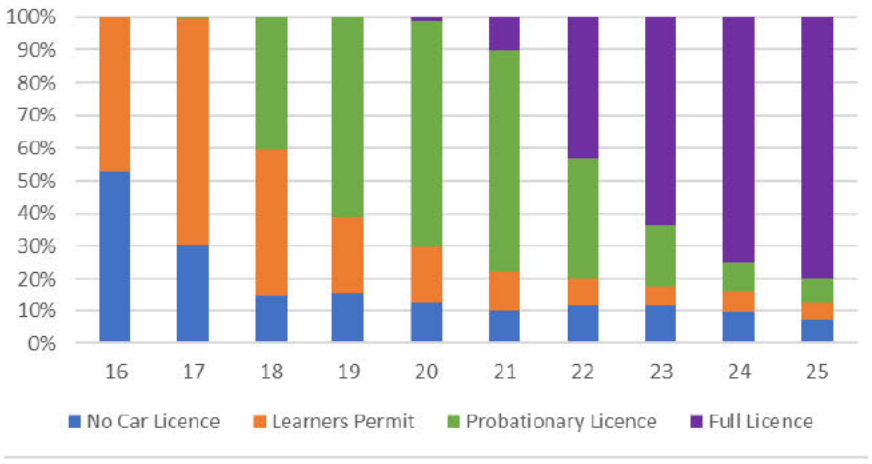


Figure 6. Victorian Integrated Survey of Travel and Activity (VISTA) survey results for licence type held per age group (2012-2016) (Transport, 2016).

VIRTUAL REALITY EMPATHY AND CHANGING BEHAVIOUR

Virtual reality is a medium allowing users to immersively interact with virtual environments. Unlike traditional forms of media such as print, imagery and video, users can experience scenarios and it is not uncommon for users to feel, to a certain extent, like they are actually there (Felnhofer et al., 2015).

VR enables access to environments and scenarios that would not otherwise be possible for reasons including cost, safety, distance or that the environment does not exist or cannot be easily reproduced. VR experiences can be interactive, such as where a user's interaction modifies the outcome of the experience. VR experiences, such as 360-degree video, enable less interactivity where the user can only control the vantage of the virtual environment, however, can still be highly immersive and an effective way to expose someone to a certain environment.

This section considers VR solutions aimed at fostering empathy in users of the experience. Virtual Reality Perspective-Taking experiences (VRPT) are VR experiences designed to allow a user to be embodied within a virtual character or person. Through embodiment VRPT can increase empathy towards others and Stanford University has shown that cognitive empathy increases when a user embodies someone than they have an existing relationship with (van Loon, Bailenson, Zaki, Bostick, & Willer, 2018). In this work, users undertook a VRPT experience that simulated a "day-in-the-life" of a virtual person and were then asked to perform a virtual classroom presentation embodied as that person. While the results focused on increased empathy and not consequential behaviour, other research has demonstrated VRPT to change behaviours. For example, research below shows that VRPT can change behaviour such as aggression and racial bias through virtual embodiment and empathetic experiences.

Figure 7. Subject Matter Expert development feedback session.

Domestic violence is a complex and global social issue. One of the factors believed to contribute to domestic violence is that perpetrators have significantly less ability to recognise the fear experienced by their victims when compared to non-perpetrators. The research described in (Seinfeld et al., 2018) demonstrated this; and that by using VRPT and embodiment where perpetrators took full body ownership of victims who experience domestic abuse; their level of empathy for victims increased leading to an increased ability to recognise fear in others.

Undertaking VRPT experiences and virtual embodiment are also believed to reduce racial bias. The research described in (Peck, Seinfeld, Aglioti, & Slater, 2013) showed that light-skinned participants who were embodied to a darker-skinned virtual person, reduced their racial bias. Embodiment was achieved using a virtual mirror in the virtual environment.

Research described in (Patil, Cogoni, Zangrando, Chittaro, & Silani, 2014) shows that VR can be used to help improve decision-making when faced with moral dilemmas. Through a series of virtual experiences, the research demonstrated that compared to text-based experiences, VR experiences were perceived more emotionally and had a positive impact on decision making related to moral dilemmas.

Research suggests that virtual embodiment is a powerful tool to help change behaviour towards others, as well as to help subjects behave in a more socially responsible manner. Research described in (Ahn, Bailenson, & Park, 2014) consisted of two studies that compare the short and long-term impact of traditional print and video media with virtual reality embodiment on social behaviour. The first study explored the short-term effects of virtual embodiment and results showed that participants who undertook the virtual role responsible for cutting down a tree in a virtual environment consumed 20% less paper than those presented with the tree cutting process in print material. Paper consumption was measured subtly by presenting participants with an unexpected event of spilt water where they were asked to clean it up using napkins, and those who undertook virtual tree cutting experience used less napkins.

The second study considered the long-term effects of the virtual embodiment experience when

compared to print and video media. It was found that one week after their respective experiences, those who undertook the virtual embodiment experience reported to have a greater level of control over the health of the environment and improved behaviour towards the environment than those who were presented with print or video information.

Historical empathy relates to empathy of those of the past and research described in (Sweeney, Newbill, Ogle, & Terry, 2018) demonstrates that VR can help improve historical empathy in students. The authors describe how, through the reconstruction of three historical sites in VR - Ruins of Montfaucon, Blacksburg 16 Squares and New Town, historical empathy can be improved.

In the Montfaucon virtual experience students were able to empathise with American soldiers fighting in World War 1 and French residents who saw their homes and communities devastated by the war. The 16 Squares virtual experience presented students with an early representation of Blacksburg allowing them to empathise with founders and their future vision of the town without knowing how it would grow. In the third experience students were presented with a reconstruction of New Town allowing them to empathise with the African American communities of the first half of the twentieth century.

There is little work using VRPT and virtual embodiment to support improved road safety behaviour. A study conducted in 2002 focused on using VR to help teach young children how to safely cross the road. The results demonstrated a significant increase in safe street crossing behaviour (McComas, MacKay, & Pivik, 2002). A report released by the Southeastern Transportation Research, Innovation, Development and Education Centre (STRIDE) in 2015 found similar results when using VR to educate about pedestrian safety (Schwebel, Combs, Rodriguez, Severson, & Sisiopiku, 2016). The report found that following six 15-minute virtual pedestrian training experiences, children's pedestrian safety improved. The research described in (Ali, Elnaggarz, Reichardtz, & Abdennadher, 2016) looked at young participants (aged between 20 to 23) and the use of a VR driving simulator to change behaviour around speed limits, using blinkers and giving priority to pedestrians. Results show that, on average participants changed their driving behaviour to correct actions that led to undesirable driving behaviour.

The above examples highlight the potential benefits of VRPT and virtual embodiment to foster empathy and drive change in behaviour. There is the possibility for the Truck Wise project to explore the use of VRPT and virtual embodiment to —

- *Enhance* awareness of the physical constraints and challenges of driving heavy vehicles.
- *Improve* understanding of safe behaviour when interacting with heavy vehicles.
- *Foster* empathy for heavy vehicle drivers and the challenges they face.

Refined Demographic

The literature review, outlined above, of the current Victoria licence requirements, associated online material, licence acquisition demographics and academic research was undertaken to respond to stakeholders' suggestion that that the initial targeted age group of 16-25 was too broad and that the age range should be narrowed.

Based on this review it was recommended to narrow the target demographic to include those aged between 16-18. Novice drivers are at the highest risk of being involved in casualty crashes within the first few months of probational licensing. By targeting 16-18-year-olds, Truck Wise has the potential to raise awareness and promote safe driving behaviours among the subject group before independent driving begins, at a stage when novice drivers may be more receptive to safety messaging.

This refined target demographic also aims to ensure that the Truck Wise pilot project aligns with and complements successful evidence-based online resources, such as DriveSmart and myLearners, thus helping to strengthen key learning outcomes that these resources aim to achieve, while generating cross-promotional opportunities.

Virtual reality is an important component of the Truck Wise pilot project and it was believed that this feature was likely to be popular with secondary school students, based on the experience the Deakin VR lab has with approximately 3000 secondary school students visiting each year.

Finally, the Bendigo Tech School's (BTS) well established networks with 13 Greater Bendigo secondary school staff and their students provided unprecedented access to the refined target demographic (16-18yo).

Project Outline

Project Stages and Methodologies

The Truck Wise project deliverables are —

- Educational material deployed to *the Hub* including videos, imagery, FAQs and links to other information.
- A series of educational social media posts that use imagery and short animated GIFs, live feeds, question and answer sessions and quizzes to educate the audience.
- VR scenarios on safety around heavy vehicles from both light and heavy vehicle driver perspectives.
- Lightweight 360 video VR experiences similar to those above but able to be accessed by anyone anywhere using only a web browser.
- Public launch and *Roadshow* to bring the VR experiences and associated key safety messages to local high school students, stakeholders and the broader public.
- Mobile road safety messages featured on the side of a heavy vehicle.

This section provides an overview of the different project stages (Figure 8) and milestones that constitute the Truck Wise project. The pilot was designed to include five main stages: pre-production, production, seeding, launch and report.

Pre-production included baseline evaluations to help inform key messages and design decisions throughout the project. Pre-production tasks such as storyboarding, scenario planning, legal and copyright checks and enlisting of any required actors were also undertaken in this stage. Production included different stages of development for the VR content with design evaluation undertaken, including involvement by BTS students at the completion of the development phases. The TAC was also presented with an opportunity to provide feedback at each of the development stages and right through to the pilot's conclusion.

Promotional content was captured during design evaluation and was included on *the Hub*. Seed included activities through social media platforms and *the Hub* as well as spreading the message through schools, community groups and project partners. Seed was to also include final testing and refinement of developed VR content which was disrupted by COVID-19 (see COVID-19 Impact and Challenges section). Launch was to involve a large public event and the roll-out of the *Roadshow* to selected local high schools. The launch stage was to also include the deployment of online lightweight VR experiences via *the Hub* and supported online platforms along with evaluations to measure the project's effectiveness. Finally, the reporting stage provided this final report that summarises the outcome of the pilot project and outlines future recommendations.

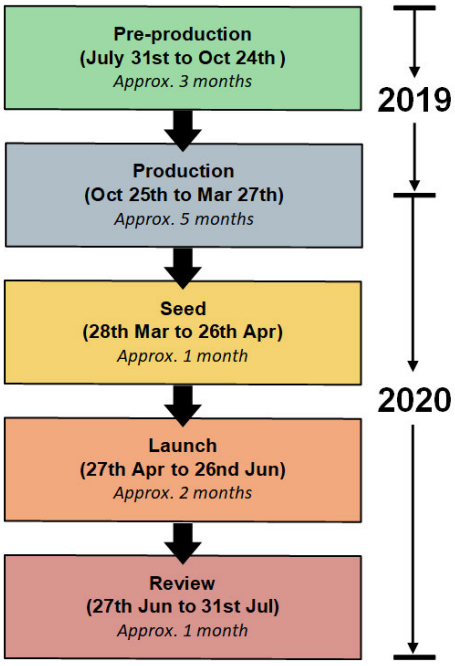


Figure 8. Truck Wise project stages.

COVID-19 impact and challenges

The year of 2020 saw the international outbreak of the COVID-19 pandemic across the globe. The COVID-19 pandemic caused several countries to put in place a range of different restrictions upon their citizens in response to the outbreak. In Australia restrictions ranged from bans on international flights and crossing of state boarders to closure of non-critical business and community facilities, shift to online education and the need for face masks. During COVID-19 each of the states within Australia developed their own set of restrictions that responded to their individual needs.

Victoria responded well to the initial COVID-19 outbreak in the first half of 2020 that saw few case numbers being reported throughout May and June which initially led to restrictions being eased. Unfortunately, throughout July 2020, Victoria saw significant increases in COVID-19 case numbers that were much larger than those reported in the first half of the year. This second wave of COVID-19 cases saw a severe lockdown of the state which significantly restricted movement throughout the community including the introduction of a 5km travel limit, night curfew and the mandatory wearing of masks. Figure 9 shows Victoria's daily COVID-19 cases numbers and how it unfolded throughout 2020.

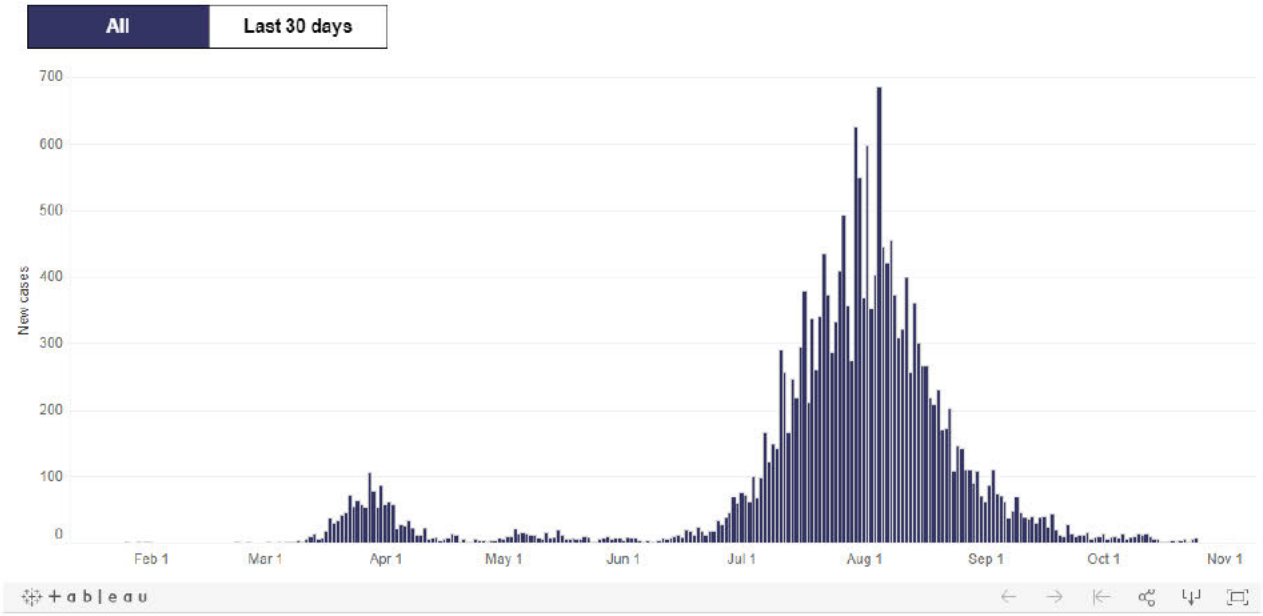


Figure 9. Victorian daily COVID-19 case numbers (DHHS, 2020)

COVID RESTRICTIONS AND PROJECT TIMELINE

Greater Bendigo schools were consulted throughout the pilot project to seek their interest in taking part in design and development evaluation. These activities aimed to provide end user feedback to the project team during development as part of the bottom up design approach. Schools were also invited to take part in the *Roadshow* activities.

Pre-COVID-19 Evaluation and Roadshow Commitments

A total of six local Greater Bendigo schools met the Truck Wise pilot project criteria (classes with students aged 16 -18-year-olds). Schools were first contacted in December 2019 seeking expressions of interest in the Bendigo Tech School (BTS) Truck Wise program (see BTS program in Supporting Documentation section) and the *Roadshow* (see Roadshow Brochure in Supporting Documentation section), this resulted in —

- Sign-up from two Greater Bendigo secondary schools for the BTS Truck Wise activities.
- Two Greater Bendigo secondary schools also registered their interest in hosting the *Roadshow*.

BTS played an important role in assisting the project team with school engagement. BTS collaborated with the project team to refine and schedule the BTS parallel education program which included —

- Development of Truck Wise BTS parallel program.
- How the program would be hosted using BTS facilities.

- The booking of schools to participate in Truck Wise evaluation and testing activities.

Early Project Activities and the Unfolding of COVID-19

In March 2020 Truck Wise evaluation and testing activities began with BTS hosting a preliminary test session of the BTS parallel program. In this session students learned how to apply augmented reality in designing a road safety campaign based on Truck Wise. The Truck Wise project team participated in the session which provided valuable insight into how well it was received by the students. The team also offered BTS feedback for future sessions.

The first VR evaluation activity was undertaken on 16th March 2020, it was also the day that Victoria announced a 'State of Emergency' in response to the unfolding of the COVID-19 outbreak (Foley, 2020). This activity was initially scheduled to take place at BTS. However, on the morning of the scheduled evaluation activities, the participating secondary college required the project team to undertake the evaluation activities onsite. This requirement was due to the introduction of an internal 'no excursions policy' in response to the COVID-19 pandemic. A total of 11 students took part in this first evaluation activity which was well received. They also offered very positive feedback that helped guide future revisions of the VR experiences (see Virtual Reality Development Evaluation section .

Project's Response to COVID-19 Restrictions

Throughout April and June 2020 quarter COVID-19 government restrictions prohibited school-based activities. During this period communication continued between the project team and schools who showed early interest and registered in Truck Wise evaluation and *Roadshow* activities. The schools confirmed their ongoing support and commitment to taking part in the Road Show post COVID-19 restrictions.

In July 2020, government social distancing restrictions were loosened, providing the project team an opportunity to shift the evaluation and *Roadshow* activities to the second half of 2020. Discussions were held with schools about delivering the Truck Wise *Roadshow* in late Term 3 – early Term 4 (see School Engagement section). It was planned that the *Roadshow* activities were to be held at the Bendigo Tech School as part of a full day of educational activities.

On August 2nd, 2020, the Victorian government introduced a new set of COVID-19 restrictions in response to the second COVID-19 outbreak. These new restrictions resulted in schools returning to on-line learning in Term 3 and that ended with a staggered return to onsite learning in Term 4.

In response to the second set of COVID-19 restrictions, a stakeholder meeting was held to discuss options for delivering the Truck Wise *Roadshow* with several options being discussed. It was decided to offer the *Roadshow* to schools as a live online session presented in a virtual format. It was planned that prior to the online session participating students would each be sent a Google Cardboard, a low-cost mobile VR headset that uses a modern smart phone to view 360-degree videos including those developed as part of the Truck Wise project.

Following the stakeholder meeting held in August 2020, an online virtual *Roadshow* session was developed and shared with registered schools who were invited to take part. Unfortunately, due to the significant impact that COVID-19 had on schools, no school took up the invitation to participate.

In September 2020, it was decided that with the uncertainty surrounding COVID-19 and the impacts it had on local schools throughout 2020, the *Roadshow* would not be able to go ahead. In replacement of the physical *Roadshow*, the team developed a school resource pack (see Education Resource Pack section) that contains an educational Truck Wise program and corresponding resources, that schools are now able to access upon request.

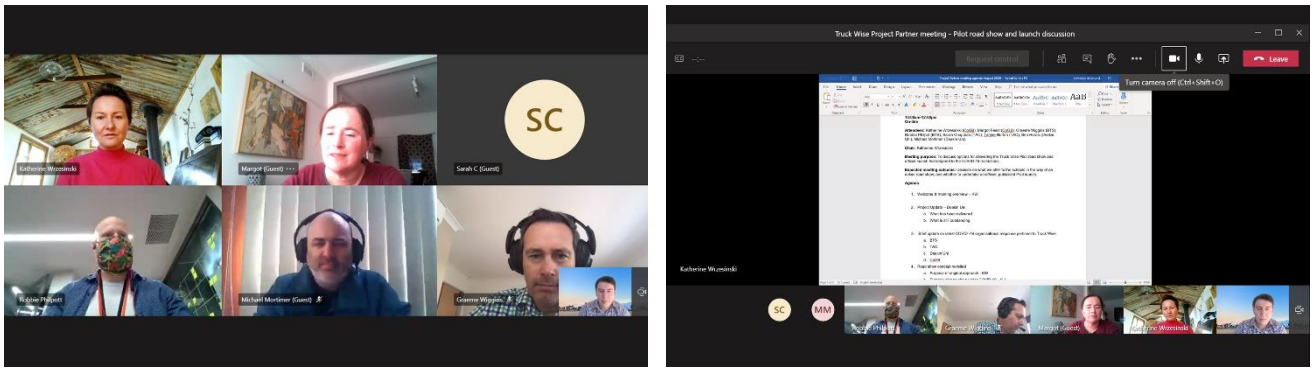


Figure 10. Project stakeholder conduct online meetings.

Deliverables and Outcomes

Virtual Reality Development

DESIGN OF THE VIRTUAL REALITY EXPERIENCES

Virtual Reality development activities were undertaken between October 2019 and March 2020. These development activities were based on the planning and research activities undertaken prior (between July 2019 and October 2019) to ensure that the virtual reality experiences achieved —

- A focus on empathy as opposed to a shock.
- A focus on awareness as opposed to driver training.
- A 360-degree video version able to be deployed to anybody, anywhere, through a standard internet web browser.
- An interactive Virtual Reality experience accessed via a dedicated VR headset and tailored for school groups.

An innovative method was developed to fully leverage the capabilities of virtual reality and provide users with experiences that would not be possible in the real world. The method involves experiencing the same on-road interaction from both heavy and light vehicle perspectives. Doing this the user can experience the interaction first from within a light vehicle (sedan) and then from within a heavy vehicle (truck).

The virtual reality experiences were also strategically designed to cover both a highway and urban driving environment and were based off common crash types using feedback provided by participants in the Truck Wise SME focus group (see Subject Matter Expert Focus Group section).

Figure 11. Virtual Reality Development Evaluation at local Greater Bendigo secondary college.

TRUCK WISE VIRTUAL REALITY AMBASSADORS

In order to support the promotion of the Truck Wise project and awareness of the challenges heavy vehicle drivers face, and to provide an engaging way to foster empathy towards heavy vehicle drivers, the design of the virtual reality experiences included the two project ambassadors as virtual reality avatars.

- Marla Stone and Damien Power are two "real life" Truck Wise ambassadors from the trucking industry.
- Ambassadors contributed to the promotion of the project in several different ways (refer to Safety Videos, Mobile Safety Messages and Subject Matter Expert Focus Group sections).
- Damien and Marla were 3D scanned by Mark Ruff, a well-known 3D scanning expert in the film and TV industry, and then turned into virtual reality avatars by the Deakin team.
- The avatar ambassadors accompany the user throughout the virtual reality experiences and aid in fostering empathy towards heavy vehicle drivers.
- The avatars employ advanced artificial intelligence technology to talk to the users with realistic facial motions and Damien and Marla's real voices.

Figure 12. Digital Scanning of Truck Wise ambassadors Marla Stone and Damien Power by Mark Ruff.

TRUCK WISE LEARNING OUTCOMES

The VR experiences take place over two 'seasons' (scenarios or chapters) each with four episodes. Season 1 focuses on safe braking distances and Season 2 on needing two lanes to make a tight turn.

The first episode of each Truck Wise season introduces the user to the scenario and the truck drivers. The two seasons have a different truck driver, i.e. Damien and Marla. After the introduction there are two episodes which take the user through the particular scenario (safe braking distance or tight turns) from two distinct perspectives. In the fourth and final episode of each Truck Wise season the truck driver (virtual reality ambassador) de-briefs the user on the learnings from the experience, each season runs for approximately 5 minutes.

S1

SEASON 1 – WE NEED OUR SPACE

Tackles the common challenge of leaving a safe braking distance for heavy vehicles.

S2

SEASON 2 – WHY TWO LANES?

Tackles the common challenge of tight turns in a truck and the need to sometimes use two lanes.

Truck Wise Season 1 — *We Need Our Space*

Season 1 comprises four episodes that tackle the challenges heavy vehicle drivers face in maintaining a safe braking distance. Season 1 occurs on the highway.

- Episode 1 — Introduction at the truck depot with truck driver Marla Stone to conduct vehicle safety check.
- Episode 2 — Safe stopping distance on the highway (light vehicle perspective).
- Episode 3 — Safe stopping distance on the highway (heavy vehicle perspective).
- Episode 4 — De-briefing on keeping a safe braking distance at the truck depot with truck driver Marla Stone.

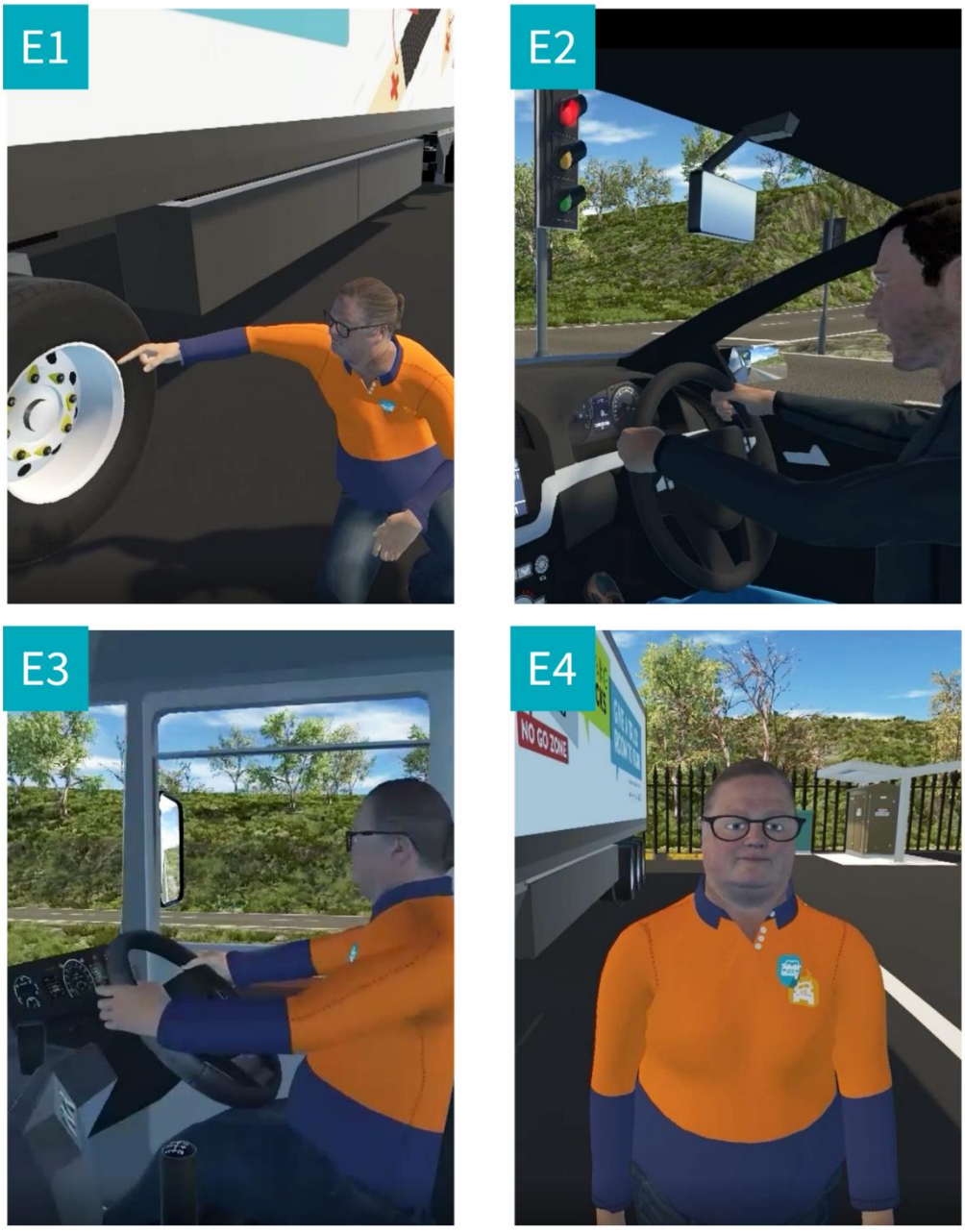


Figure 13. Truck Wise Season 1 "We need our space" VR experience with a screenshot from each episode.

Truck Wise Season 2 — *Why Two Lanes?*

Season 2 comprises four episodes that tackle the challenges heavy vehicles have when needing to sometimes make tight turns using multiple lanes. Season 2 occurs in a regional urban setting.

- Episode 1 — Introduction at truck depot with truck driver Damien Power to conduct vehicle safety check.
- Episode 2 — Tight turning in the CBD (light vehicle perspective).
- Episode 3 — Tight turning in the CBD (heavy vehicle perspective).
- Episode 4 — De-briefing at the truck depot with truck driver Damien Power.

Figure 14. Truck Wise Season 2 "Why two lanes?" VR experience with a screenshot from each episode.

DESKTOP VIRTUAL REALITY EXPERIENCES

The desktop virtual reality experiences are developed for the Oculus Rift S VR headset that requires either a high-end desktop or laptop to run. Having a dedicated desktop VR headset was important to provide users with a high quality fully immersive VR experience that allows users to interact with the virtual environment using tracked hand controllers rather than just being a passive viewer. The Truck Wise interactive virtual reality experiences include the following interactions.

Desktop Virtual Reality User Interactions

- Point and click interaction with trailer coupling pin to ensure connected correctly to truck.
- Point and click interaction with rear door of trailer to ensure securely closed.
- Point and click interaction with wheel nut indicators to ensure wheel nuts are securely tightened.
- Left and right trigger controller button interaction to check indicators and brakes to ensure lights working correctly.
- Trigger button interaction for light vehicle radio for song selection.
- Trigger button interaction to make phone call with friend while passenger in light vehicle.

Figure 15. Truck Wise desktop VR equipment.

360-DEGREE VIDEO VIRTUAL REALITY EXPERIENCES

The 360-degree VR experiences are specifically designed videos that allow users to control the camera view of the virtual environment as if they were residing within it. Truck Wise 360-degree videos are hosted on YouTube and accessible via *the Hub*, direct access to videos can be gained upon request for local viewing. Truck Wise 360-dgree videos can be viewed with using several different methods depending on a user's hardware configuration.

Truck Wise 360-degree Video Viewing Methods

- Standard desktop with mouse where the mouse controls camera viewpoint within virtual environment.
- Modern smartphone with built-in sensors where rotation of smart phone controls camera viewpoint within virtual environment.
- Modern smartphone and Google cardboard (or similar) as a low-cost mobile VR experience, user's natural head rotations controls camera viewpoint within virtual environment.
- Dedicated mobile or desktop VR headset, user's natural head rotations controls camera viewpoint within virtual environment.

Figure 16. Google Cardboard (left) and Truck Wise 360-degree video (right).

The Hub Website

The Hub website is a key component of the Truck Wise project aimed to engage with the target audience, project stakeholders and the wider community. *The Hub* website includes educational content in the form of 360-degree videos, educational fact sheets, a quiz, safety videos and the education resource package (available on request). The website also includes Truck Wise ambassador profiles (Marla Stone and Damien Power), project FAQs and reciprocal links to existing road safety programs already on the market which avoids duplication of existing information and resources.

The Truck Wise Hub can be accessed at — www.truck-wise.com.au

EDUCATION FACT SHEETS

Truck Wise educational fact sheets are downloadable from the HUB website and provide great educational information ideal for classroom environments. Education fact sheets include information on heavy vehicle blind spots, safe braking distances, merge safely with heavy vehicles, space required for heavy vehicle turning, trucks carrying livestock and even the different types of trucks you might encounter on the roads. A summary of each of the educational fact sheets is given below —

- Blind spots — explains heavy vehicle blind-spots and their position relative to the vehicle.
- Distances — explains the safe braking distance needed by trucks.
- Turning — explains the challenges of turning a heavy vehicle including the "do not overtake a turning vehicle" rule.
- Merging — explains the challenges of merging with heavy vehicles.
- Livestock — explains the challenges of transporting livestock.
- Risk — highlights the statistical risks of being a probationary driver.
- Truck Types — provides an overview of the different types of common heavy vehicles.

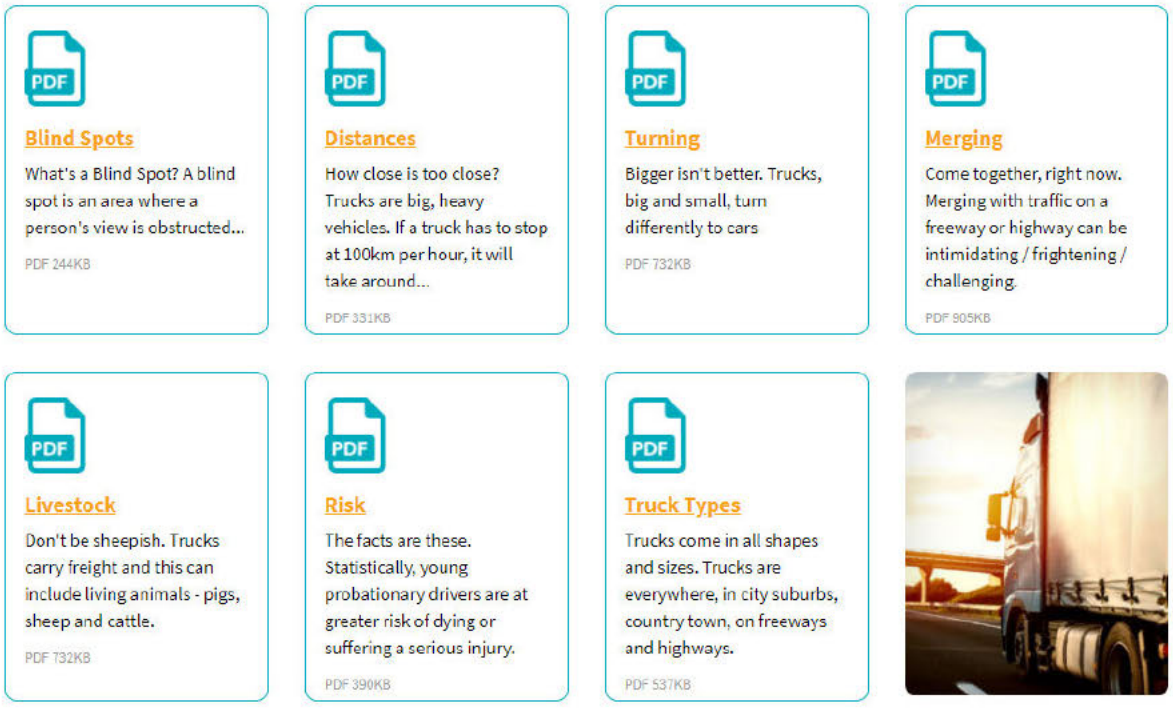


Figure 17. Truck Wise educational fact sheets.

TRUCK WISE EDUCATION QUIZ

Truck Wise education quiz in an interactive quiz available on the HUB website ideal for classroom environments. The quiz includes 15 true or false questions that are listed below —

- When turning at a roundabout, a truck is allowed to driver over the shoulder of the roundabout to turn.
- When a truck indicates to turn right, it is safe to pass on its left-hand side.
- It's safe for a driver to check their phone when they get a message as long as they don't answer it.
- The "B" in B-Double stands for 'Big'.
- Trucks of different sizes behave differently when on the road.
- Red P Plate drivers are the highest risk group for road trauma.
- The safest blind spot to be in is at the front of the truck.
- When a truck turns it can legally use two lanes to do so.
- Livestock trucks only travel to farms and never in towns or cities.
- Trucks have 'super brakes' and can easily stop suddenly.
- You should allow at least two seconds between your vehicle and the back of a truck.
- Trucks have four main blind spots.
- When merging into traffic on a freeway, it's always safer to merge in front of a truck rather than behind.
- Trucks can be more vulnerable to glare from high beam headlights than other vehicles.
- Livestock presents no additional complications or challenges for a truck driver.

SAFETY VIDEOS

Truck Wise safety videos are presented by Truck Wise ambassadors Marla Stone and Damien Power. The safety videos are hosted on YouTube and available on the HUB website. Marla and Damien provide key safety messages from personal experiences about the challenges that heavy vehicle driver's face daily.

Marla Stone

Damien Power

Figure 18. Truck Wise safety videos.

ROAD SAFETY RECIPROCAL LINKS

The Truck Wise project has been designed to complement existing road safety programs and truck awareness initiatives. The HUB provides several links to external road safety resources about other road safety programs, truck interactions and driver awareness.

Road to Zero

Victorian road safety strategy which Transport Accident Commission and its road safety partners aim to achieve the vision of no road deaths and serious injuries – a future where every journey is a safe one.

http://www.roadtozero.vic.gov.au

myLeaners

Outlines the various stages a young driver will encounter as they progress through the Victorian Graduated Licensing system.

https://www.mylearners.vic.gov.au

Travel Happy

The roads and freeways are a truck driver's main workplace, so to make their workplace safer and more enjoyable this site outlines a few things we can all do to share the road.

https://sharetheroad.vic.gov.au/truck-drivers.html

NHVR — *We need space campaign*

Promotes truck safety awareness through videos, posters and factsheets aimed at giving Australia's truck drivers the space they need to keep drivers safe.

https://www.nhvr.gov.au/we-need-space

Drive Smart

DriveSmart was developed to support novice drivers to improve their hazard perception and concentration skills. The interactive program takes you through a range of driving scenarios and quizzes, where the driver needs to make safe driving judgments. DriveSmart aims to help users become better, safer drivers as they gain experience on the road and prepare for safe solo driving.

https://drivesmart.vic.gov.au

Road Smart

Delivered by VicRoads, Road Smart is a new road safety education and training program for Year 10 or equivalent students. The program is part of the Victorian Government's Young Driver Safety Package and aims to build the knowledge, skills and behaviours for safe driving among young people.

https://www.vicroads.vic.gov.au/safety-and-road-rules/road-safety-education/secondary-schools/road-smart

F2D (Fit to Drive)

The Fit to Drive program website has information on road safety programs and resources. The program's objective is to engage with young people to deliver road safety messages that will empower and support young road users (aged 16-25) to achieve zero deaths on Victorian roads.

https://www.f2d.com.au

Linfox Truck Safety Series

In a four-part truck safety series launched by the TAC, Linfox truck drivers provide insight into their working life on our roads. They talk candidly about road safety and share their thoughts on everything from fatigue and speed through to interacting with other road users and coping with stress.

https://www.linfox.com/about/safety-centre/

Education Resource Pack

The Education Resource Pack (see Education Resource Pack in Supporting Documentation section) was developed as a substitute for the *Roadshow* in school program, which could not be delivered as part of the Truck Wise pilot due to COVID-19 social distancing restrictions. This section provides an overview of the work conducted with schools throughout the project that helped guide development of both the planned physical *Roadshow* activities and the replacement education resource pack.

SCHOOL ENGAGEMENT

The Truck Wise pilot project was to culminate in a travelling *Roadshow* bringing the VR experience to registered Greater Bendigo schools. *Roadshow* participants were to wear VR headsets which would provide them with an opportunity to participate in virtual interactions between light and heavy vehicles. The *Roadshow* was to give the participants a sense of what it's like from a truck driver's point of view and as a car driver interacting with trucks. The purpose of the *Roadshow* was to —

- Bring the Truck Wise road safety messages to students.
- Undertake research activities that would inform the VR experience refinement.
- Test the effectiveness of VR in raising empathy for heavy vehicle drivers and the challenges they face (see Research data section of this report for further detail).
- Test the effectiveness of the *Roadshow* program as delivered to participating schools.

A highly experienced education program designer and facilitator was engaged to assist the Truck Wise project team with school liaison and facilitation of the collaborative bottom-up *Roadshow* design process. The TAC also provided support through road safety education and behaviour change advice to help guide the development of the *Roadshow* program design.

Each School is a Unique Learning Environment

Timetables, subjects, class sizes, teacher expertise vary from school to school. To address this diversity in school environments it was important that we developed the pilot program in close consultation with individual schools and teachers. Through this consultation it became apparent that the pilot program needed to be designed with a degree of flexibility in mind, especially in regard to how the program was delivered. No one model would fit every school.

Target Audience

In high schools, the majority of the target age group of 16 -18 years are involved in studying for their VCE (Victorian Curriculum of Education Certificate). Studying for your VCE involves selecting numerous subjects that each comprise 4 Units. Units 1&2 are generally completed in Year 11 and Units 3&4 are completed in Year 12. Other students in this age group may study Vocational Education and Training (VET) or Victorian Certificate of Applied Learning (VCAL).

The challenge in working with this audience in schools is that not only are the VCE students under enormous pressure (due to their study load) teachers also often struggle to get all the necessary learning material covered each year. Finding room to incorporate extra learning programs at the VCE level is difficult for schools.

Curriculum Alignment

To engage this target audience, it became apparent early that the pilot program must align with subjects and learning material within the VCE curriculum (rather than be an extra program).

The topic of Vehicle Safety is specifically addressed in the curriculum material for the VCE subject of Health and Human Development. In Unit 1 Understanding Health and Wellbeing and Unit 2 Health Care in Australia.

The other links to VCE curriculum exist around the programs use of VR technology. In many subjects, students learn about new technology and examine the related issues that stem from this use, such as those related to security, ethics and safety.

Another way in which the pilot program links to the VCE curriculum is to focus on investigating human behaviour, most notably empathy in young people. In VCE there are numerous subjects that look at human behaviour, including one of the most popular, Psychology.

DELIVERY MODELS

With our understanding of the busy nature of schools and their diverse environments it was important to investigate a range of delivery models for the pilot program. These included —

Lunchtime sessions

In this model schools would advertise the sessions broadly to the students and or hand pick students to attend. Possible incentives could be provided to students to encourage participation.

BENEFITS

- No time taken away from teaching the curriculum.
- Less teacher involvement required.
- Interested students would attend so engagement would be high.

CHALLENGES

- May not attract enough students.
- Students may fail to recognise value of program (as not attached to class learning).
- No guarantee of attendance.

In-class sessions

Class would be divided into small groups and students would move between a range of safety focused activities, one of these being the VR experience, another would be investigating *the Hub* and quiz. Teacher would be present in the classroom but only to monitor behaviour. The session would be facilitated by an experienced facilitator or educator.

BENEFITS

- Students guaranteed to attend.
- Works well with ensuring that all participating students have parental consent.
- Scope to work with a specific class/subject area and value add to their learning program.
- Establishing links with a range of curriculum areas would readily engage teachers/schools.
- Design format so whole class is engaged in Truck Wise program at the same time.
- A double period (90 minutes) would allow at least half a class to participate in VR.
- *Roadshow* could visit school twice so the entire class is able to participate.

CHALLENGES

- Staff demands are high. Up to four members from Truck Wise team would need to be present to deliver program.
- Space and noise issues could arise from having so many activities running concurrently.
- Ensuring program meets curriculum outcomes.
- Setting up and packing up the classroom would take considerable time.

Out-of-class sessions

Four students at a time would leave the normal classroom to participate in VR testing and surveys. This model is delivered by Deakin with no requirement for an additional facilitator. Each session would run for approximately 20 minutes.

BENEFITS

- Management of students and delivery of VR straightforward for Truck Wise team.
- Easy and quick to set up in the school.
- Minimal disruption to school learning program.
- Teachers have no additional work.
- Works well with ensuring that all participating students have parental consent. Interested students would attend so engagement high.

CHALLENGES

- Working with so few students in a session would require a major time/staff investment by Truck Wise (or at least Deakin team).
- Other important safety learning activities may not take place.
- Could be disruptive to classroom with students coming and going.
- Difficult for teacher to complete lesson with missing students.
- Movement of students from one classroom to another could raise issues around duty of care/safety.

With the onset of COVID-19 and its effects on schools the Truck Wise team needed to think of new models of delivery. In our meeting with one of our pilot schools the teacher asked if the program could be delivered at Bendigo Tech School rather than have the Truck Wise team visit the school. The other obvious method for delivery during COVID-19 was online, both methods are shown below —

Tech School Delivery

The Bendigo Tech school were very supportive of working collaboratively with the Truck Wise team to develop a whole day excursion for students that included the pilot program.

BENEFITS

- Easy to set up and delivery as space purpose built for delivering tech-based programs.
- Students often more engaged when program is delivered outside the classroom and by guest presenters.
- More time to deliver the pilot program and involve student enquiry and discussion.
- Safer in COVID-19 times for students to attend excursions rather than have incursions.
- Provides teacher professional development around technology.

CHALLENGES

- More in-depth content needed to deliver a day or half day program.
- Greater time demands on Truck Wise staff.
- More extensive coordination and timetabling required (working across organisations).
- Safety messages could get lost amongst technology tools.

Virtual Delivery

The pilot program delivered live to schools (students) via a video conferencing platform such as Zoom. The program would be integrated into a class and students would be either at home or school participating via their personal laptops. For the VR component Google glasses would be used with student's mobile phones.

BENEFITS

- Easily tailored to link with a range of curriculum areas.
- Easy and quick to set up in the school.
- All students could do VR at the same time.
- Delivery and set up for Truck Wise team and teachers simple.
- COVID safe.

- Few demands on teacher.
- Able to easily incorporate a range of interactive elements.
- Few costs involved.

CHALLENGES

- Harnessing student involvement in the program (especially in terms of discussion). Older students are generally quite shy when asked to participate in online conversations with teachers and others. Will only provide feedback that requires very short responses.
- Delivering goggle glasses to individual students (if at home).
- Dealing with student apathy towards learning online.
- Making program unique/alive not just another Zoom session.

EDUCATION RESOURCE PACK CONTENT

The education resource pack is aimed at supporting students to drive safely on the road with trucks. The content also explores the design and use of emerging technologies in areas such as health and education.

The range of activities in the resource pack engage students and encourage participation and knowledge building. At the same time the pack is designed in line with best practice in terms of student learning and teaching. The resource pack is a key Truck Wise deliverable and will be made available to interested schools upon request.

Short Videos – Setting the Context

The education resource pack includes two short videos featuring truck drivers and their stories on the road. Short videos are one of the most highly used education tools today. Videos immediately engage students and hold their attention. Beginning the program from a truck drivers perspective establishes why the students are here and why the program is necessary. It also positions them early to empathise with the truck drivers and the difficulties they face in their workplace (i.e. on our roads).

Deakin Presentations: Connecting with Experts

This pre-recorded presentation from Virtual Reality researchers at Deakin University involves outlining their experiences designing and working with emerging technologies. By providing project examples from a range of areas, such as Health, Design and the Truck Wise program, key questions relating to the use and ethics of technology are addressed. In schools' technology is an area that all teachers need to support their students to use and understand. One of the most valuable ways teachers are encouraged to do this, especially at the VCE level is to provide opportunities for students to connect with experts and investigate real-life situations and projects.

VR — Learning through Experience

Following discussion about technology students have the opportunity to experience immersive technology for themselves. To deliver this virtually each student is provided with their own set of google glasses and use their mobile phone to access the 360degree video.

Learning in any area is best done through experience. Using the Truck Wise 360-degree video, students experience driving from a truck driver's point of view. It is hoped that this form of learning will better support young drivers in making safe choices when sharing the road with trucks.

Students today have grown up with technology. This activity engages students as most view technology as an essential and positive aspect of their lives. They are keen to explore and embrace new technology.

The google glasses are relatively cheap and will be provided to schools by Truck Wise. By providing students with their own personal glasses there are no risks of COVID-19 related health issues

Surveys and Safety Quiz — What do I Know?

Provide both students and the Truck Wise team with an understanding of the level of knowledge they have in regard to heavy vehicles. They also help to reinforce student knowledge and in the post-survey provide an indication to Truck Wise how much learning has taken place during the session.

Bendigo Tech School Truck Wise VR and AR Program

In their role as the Truck Wise project partner, BTS developed a special VR and AR Program for high school students, which included opportunities for them to test the Truck Wise VR experience with the development team. As part of the BTS program, students were to explore the issues of truck safety in our community, as well as develop their own VR or AR safety scenarios. The program offered an opportunity for students to receive valuable pre-driver education, whilst participating in testing activities to guide refinement of the Truck Wise VR experience

The first session successfully took place in late March 2020 and was well received by attending students, unfortunately the onset of COVID-19 restrictions placed future sessions on hold. An online version of the Truck Wise AR program has been developed and is available for students in Years 7-10. The VR online program was developed but was not run due to restrictions on program delivery at BTS for most of 2019.

VCAL students from BTEC attended the Truck Wise 1 Day AR Program, supported by Michael Mortimer and Katherine Wrzesinski who also provided feedback on student Truck Wise campaign pitch ideas. BTEC teachers reported that students were highly engaged and had a positive experience —

IN-CLASS TRUCK WISE TECH SCHOOL PROGRAM

- Students were given a brief overview of the Truck Wise Pilot Project and how AR and VR technology is used to help communicate important road safety messages around safe interactions between light and heavy vehicles.
- Students were challenged to come up with an Augmented Reality campaign that will help inform passengers of light vehicles about the Truck Wise initiative.
- Using design software, designed their own Truck Wise AR logo and stop motion animation.

The alpha testing session was scheduled to run at Bendigo Tech School as part of a VR Workshop on March 16 but was moved to Victory Christian College at short notice due to changes in school operations guidance prior to the first lockdown. Students undertook alpha testing activities gaining valuable insight to the development process and providing feedback through surveys to help guide further development.

Figure 18. BTS Truck Wise parallel program.

Stakeholder Engagement

The Truck Wise pilot project includes development of educational content made accessible to the target audience and the broader public via *the Hub* website (refer to *the Hub* section above for details). The online content encourages sharing of information and experiences with friends and family.

Truck Wise safety messages and project updates were shared via project stakeholder networks, traditional media releases and social media. The project's inception as well as project activities including VR experience testing with students and mobile (truck side) road safety messages were widely reported by online and traditional print media as well as television news channels.

SOCIAL MEDIA

Social media was essential in reaching the project target market demographic. In the pre-production / production stages social media channels were created and used throughout the project including a Facebook page, Instagram profile and a YouTube channel —

- Facebook used to share Truck Wise event details and project updates.
- Instagram used to promote in a simple way images from Truck Wise events using the project hashtag #TruckWise.

- YouTube used for sharing videos such as the 360-degree Truck Wise video experiences.

Figure 19. Truck Wise social media assets.

TRADITIONAL MEDIA

The Truck Wise project attracted several different traditional media outlets throughout the project including the following —

- Online – Australian Transport News on 1st April 2019.
- Online – ITNews.com on 14th August 2019.
- Online – RACV Royal Auto on 22nd August 2019.
- Radio – Interview on ABC Central radio morning show on 16th March 2020 with Ben Horan.
- Television – WIN News story on 6pm news on 16th March 2020.
- Television – NINE News Central Victoria story on 6pm news on March 17th 2020.
- Television – WIN News story on 3rd December 2020.
- Press – Bendigo Advertiser half page article on March 17th 2020.

Figure 20. Student evaluation of Truck Wise VR experience (held on 16ht March 2020)

UPDATE BULLETINS

Stakeholder bulletins were used throughout the Truck Wise project to share important project updates with stakeholders including —

JANUARY 2020 BULLETIN

Updated stakeholders about development of the VR experiences including 3D scanning of Truck Wise ambassadors (Marla Stone and Damien Power) and engagement with local schools around the Truck Wise *Roadshow* with delivered planned for May to June 2020.

JUNE 2020 BULLETIN

Updated stakeholders about COVID-19 and its impact on the delivery of physical activities (school *Roadshow* and public launch) which were placed on hold. It also provided a general update on the development of VR experiences, *the Hub* website, alpha testing activities with local Bendigo high school students delivered prior to COVID-19 restrictions and the launch of mobile road safety messages deliver through the installation of a custom designed truck curtain on a Power's Country Express truck.

DECEMBER 2020 VIDEO BULLETIN (WRAP-UP)

Updated (via email) a wide range of community, government and industry stakeholders about Truck Wise pilot project media launch and the release of Truck Wise educational material via the HUB. The update also provided a brief wrap-up video including how schools can request access to the Truck Wise education resource pack.

Raising the Industry's Profile

One of the key recommendations of the Bendigo Freight Study (2017) is the need to work with the freight and logistics industry to shift public perception of the freight sector. There is a disconnect between the public's need to access the goods they want, and their understanding of the difficulties faced by drivers responsible for delivering these goods. Truck drivers are often vilified as the general public does not appreciate how difficult it is to manoeuvre large vehicles or the risks heavy vehicle drivers are exposed to in their workplace. i.e. on public roads. The Truck Wise project aimed to lift the industry profile through public messaging and project ambassadors.

MOBILE SAFETY MESSAGES

The Truck Wise mobile road safety initiative involves a Power's Country Express truck featuring truck safety messages: one highlights heavy vehicle blind spots; and the other warns the public about the dangers of overtaking a turning truck (see Truck Curtain Design in Supporting Documentation section). The purpose of the initiative is to bring these important safety messages to as many road users as possible thus making the truck driver's workplace safer for everyone. Initially planned for the pilot project launch, the June 2020 unveiling of the mobile messages was brought forward during COVID-19 restrictions in support of the good work the freight industry is doing during the pandemic.

Figure 21. Powers Express Transport heavy vehicle installed with Truck Wise mobile safety messages.

INDUSTRY AMBASSADORS

The Truck Wise pilot project aimed to shift negative perceptions about trucks and truck drivers and thus make public roads safer for all. The project was supported by renowned freight operators: Marla Stone, co-owner of Agri-Trans and a representative of the Livestock and Rural Transporters Association of Victoria (LRTAV); and Damien Power, founder and owner of Powers Country Express. Ms Stone has extensive experience as an educator and a freight business operator and brings her unique expertise to the Truck Wise project. Mr Powers is an experienced truck driver who brought first-hand knowledge to Truck Wise as well as providing access to his vehicle for road safety promotion.

Their real-life expertise guided the development of the VR experience, ensuring the scenarios replicate what really happens on the roads. Ms Stone and Mr. Powers have been digitally scanned and their avatars including their voices feature in the VR experience – where they play the role of virtual truck drivers. In their roles as Truck Wise ambassadors they have committed significant time and resources to this project.

Figure 22. Truck Wise ambassador profiles of Marla Stone and Damien Powers.

BENDIGO INVENTION AND INNOVATION FESTIVAL (BIIF)

The Bendigo Invention and Innovation Festival (BIIF) aimed to share valuable information with small business and industry about the benefit and challenges of cutting-edge technology and how it can apply to their businesses, it includes presentations from both national and international key speakers. Deakin University lead, Associate Professor Ben Horan, was invited to be a panellist and discuss about how innovative VR technology can be used including the Truck Wise project and its objective to share key road safety messages through fully immersive experiences.

- The Truck Wise project was presented as a case study.
- Audience of 200 people including attendees from overseas.

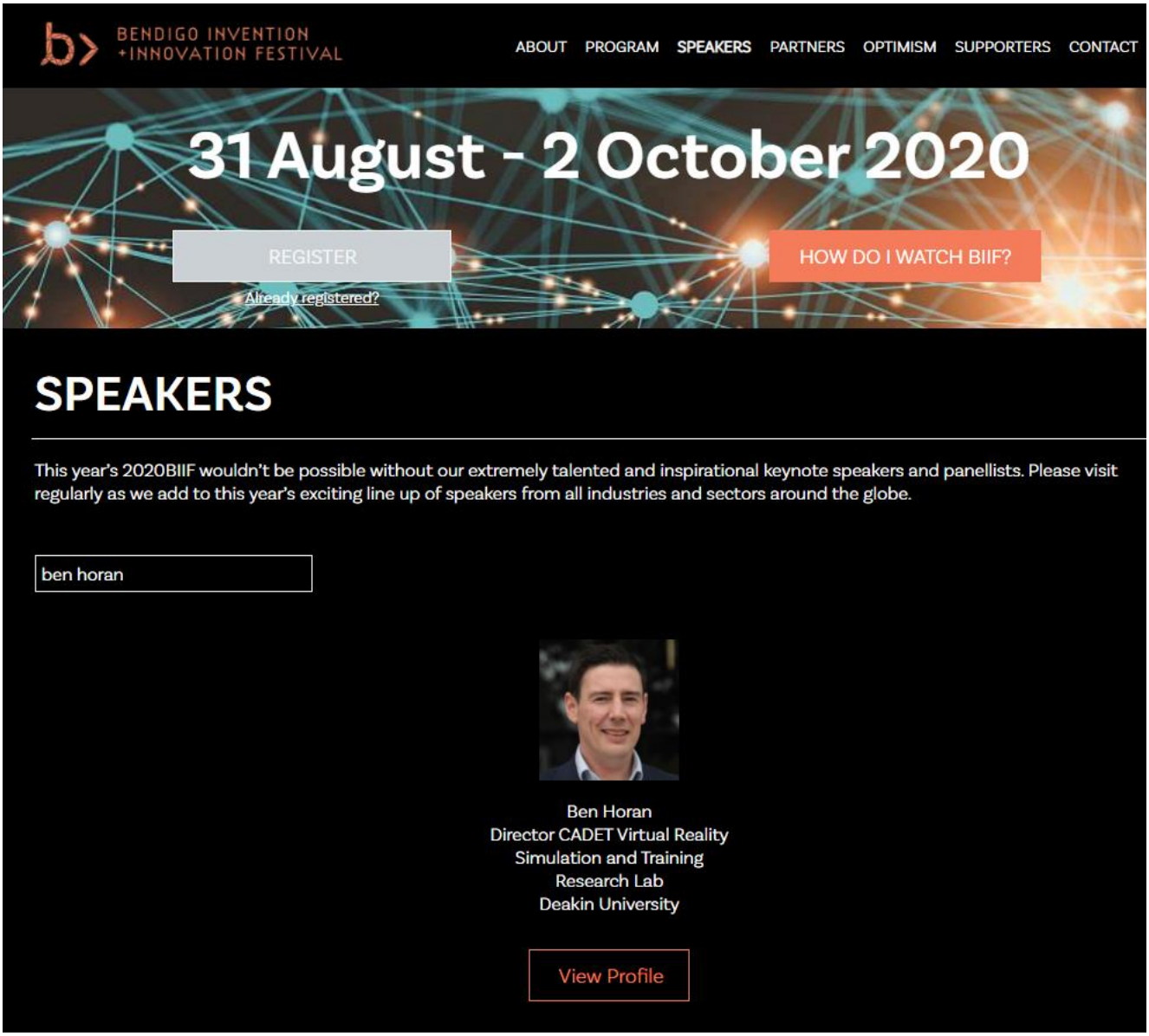


Figure 23. Truck Wise BIFF presentation.

Ancillary Benefits and Activities

DISSEMENATION AND COLLABORATION

Truck Wise is attracting the attention of experts in the field and is generating benefits that extend beyond the road safety improvements it is designed to bring about —

The project team has submitted an abstract for the ARSC2020 Australasian Road Safety Conference. Due to COVID-19 the conference was delayed, and the team will aim to present the paper at the 2021 conference.

Transafe WA, a Western Australian not for profit organisation has expressed interest in using the Truck Wise VR experience as part of their mobile road safety initiative (a 'safety truck'). Discussions are currently underway to collaborate with Transafe WA with a level of access to the Truck Wise VR experience and for Transafe WA to bring the mobile education program to regional Victoria.

Project Evaluation

Evaluation Design

The Truck Wise project undertook evaluation activities aimed at guiding the development of the Truck Wise VR experiences and the educational resources. These evaluation activities included —

1 Subject Matter Expert (SME) Focus Group

The Truck Wise SME group session was held in early September 2019 with results helping to inform key messaging and design decisions for the Truck Wise VR experiences and educational resources. The focus group consisted of heavy vehicle SME who shared first-hand experience and industry knowledge that provided the project team with several insights into the daily challenges that heavy vehicle driver's face.

2 VR Design Evaluations

VR design evaluations were conducted to gain feedback from both the target audience and SMEs after undertaking the Truck Wise VR experiences at different development stages. In March 2020 students from a local Bendigo secondary college undertook testing of the *Season 1 – We need space* VR experience and conducted pre- and post-surveys that evaluated the designed experience. The VR experience was well received by attending participants (students) who also provided valuable feedback that was used to guide final development of the Truck Wise VR experiences.

In late June 2020 both *Season 1 – We need space* and *Season 2 – Why two lanes?* VR experiences and scripts were evaluated by SME to assess both the technical language used by virtual avatars and accuracy of light and heavy vehicle interactions presented within the virtual experiences. The VR experiences were well received by SME who provided valuable feedback used to refine the accuracy of the experience.

Design evaluations played an important role throughout development to ensure the final release is both accurate and well suited to the target audience.

3 Truck Wise Education Resource Pack Evaluation

The Education Resource Pack (see Education Resource Pack in Supporting Documentation section) includes a discussion guide for teachers who may request to run the Truck Wise program at their school. The discussion guide's aim is to provide valuable feedback about the program back to the project team. The discussion guide aims to capture the following feedback from the teachers who have undertaken the Truck Wise program—

- Identify how teachers become aware of Truck Wise program and their reason for booking.
- Feedback about the booking process and any issues they may have experienced.
- Suggested improvements to the booking process and any associated preferences.
- Appropriateness of program content and duration.
- Student engagement and most valuable parts of the Truck Wise program.
- Suggested improvements or recommendations for program content.
- Awareness of the Hub website and associated educational resources.
- Any engagement in pre and post activities.
- Feedback and suggestions on curriculum alignment.
- Comparison of Truck Wise program with other road safety programs.
- Likelihood of partaking in the Truck Wise program again and whether it would be recommended to others.

ETHICS

Ethics approval is required by all Australian Universities in order to undertake data collection and was required for both the SME focus group session and VR development evaluation. Ethics ensures that the rights of participants are maintained throughout research and evaluation activities as well as the integrity of data collected. Due to the sensitive nature of school environments the Truck Wise project was required to submit and obtained successful ethics applications for the following —

- Deakin University low-risk ethics application.
- Victorian Departments of Education and Training research in Victorian government schools and childhood setting (RISEC) application.
- Conduct research in Catholic schools' application.

Evaluation Results

This section provides an overview of results obtained from project evaluation activities including the SME focus group session, VR design student and SME evaluation activities used to help guide the development of VR experiences and education resources.

SUBJECT MATTER EXPERT FOCUS GROUP

Main Challenges Associated with Driving Heavy Vehicles

- Mobile phones (e.g. texting while driving).
- Driver fatigue.
- Pedestrians.
- Knowing heavy vehicle length (challenge when heavy vehicle drivers change vehicles).
- Reversing of trucks (e.g. pedestrians in blind spots).
- Spatial recognition (e.g. trailer length when overtaking), heavy vehicle drivers need to be like football players and are always aware of space around them.
- Light vehicle drivers pulling back and pushing truck out of the road.
- Being constantly aware of everything going on outside of heavy vehicle, challenges due to large blind spots, limited visibility.
- Two lanes required when turning left (e.g. light vehicle drivers jumping in left lane while truck in right lane).
- Intersections (e.g. turning lane not wide enough).
- Poor road designs, truck drivers need to adapt to fixed road condition.
- Long stopping distance for heavy vehicles due to vehicle weight, largest cause of accidents.
- False perception of seeing everything due to high seating position in heavy vehicle, this is not true due to the introduction of several blind spots in heavy vehicles as opposed to light vehicles.
- Difficult to see motorcycles due to large blind spots.
- Light vehicle drivers having difficulty understanding heavy vehicle driver perspective (e.g. heavy vehicle sometimes required to sit in middle lane, light vehicle perceives this as blocking the road and sometimes try to overtake on inside lane).
- Regular driver understanding of stopping distances (e.g. 5m, 20m and time required.

Significant Differences between Heavy Vehicle Loads

- Loads can be static (e.g. physical items) or dynamic (e.g. livestock or liquids).
- Narrow roads determine suitability by weight, but heavy vehicle dimensions are more important to determine capability to navigate narrow roads.
- Heavy vehicle drivers are subject to different considerations\inspects based on carrying loads (e.g. check\inspection points, navigating bridges, meeting deadlines, load\unloading times for different loads).
- Maximum drive time for all loads is 12hrs, this is internally checked by manager audits, recorded in logbooks, regulator bodies can stop delivery due to driving time breach, requirement to plan stopping points to meet 12hr limits.

Light Vehicle Drivers and their Understanding about Safe Interactions with Heavy Vehicles

Heavy vehicle SME participants were asked to rate the knowledge of light vehicle drivers based on observed driving interactions in both metro and regional areas.

METRO

- Participants rated metro heavy vehicle driver understanding as 4/10, they believe the level understanding is also going down with time.
- Ranked light vehicle drivers as 2.5/10.

REGIONAL

- Rural\Regional areas ranked at 4.5/10, challenges with English competency as many regional workers have moved from overseas.

Additional Challenges with Younger Light Vehicle Drivers

- Young drivers tend to source information from their peers.
- Difficulty accessing reliable information (e.g. information source from parents, teachers and driver instructions who maybe behind in current practices and lack full understanding of challenges).
- Determining role models (who do young driver's trust when sourcing information).
- Use trusted celebrities to help communicate correct information via YouTube or other social media platforms.
- Students always using smart phones to source information (e.g. on way to school, at home, with friends) possible avenue to share correct information.
- "Fit to Drive" program provides a good basis for teaching students about the challenges on the road. It is a not-for-profit program that runs between 2-4hours where participants undertake different roles and share experiences. Consists of short experiences relevant to younger drivers (e.g. driving to school, attending parties and drink driving).

Challenges Faced when Changing Vehicle or Load

- Managing the differences between live-stock and general freight.
- Heavy vehicle drivers are required to content with filming of livestock by public due to curiosity and criticism.
- Difficulty navigating built-up residential area's when carrying different loads.
- Live-stock transport consists of two decks on trailers, on top deck animal heads are exposed, animals hit head against roof of Burney tunnel due to 4.65m height limit.

- Bridges are often too low for current standard truck heights, therefore knowing each vehicle is important.
- Interstate truck drivers have difficulty knowing local bridge\tunnel heights especially when not on common run.
- Public understanding of heavy vehicles using middle lane when transporting large loads.
- Better signage for truck drivers to be aware of road conditions ahead of time to make appropriate decision for current heavy vehicle they are driving.
- Public understanding of importance for heavy vehicle drivers to deliver the country's goods, heavy vehicle drivers are often vilified (e.g. important of transporting foods, petrol, goods, etc).
- Learners books need more information about sharing the road with heavy vehicles, improve understanding about the importance and difference between different carrying loads (e.g. static and dynamic loads).
- Educating driving instructors not just learners about the important to share information about sharing the road with heavy vehicles.
- Lack of public exposure and courtesy for heavy vehicle drivers and the different loads they are required to transport.
- Public to see heavy vehicle drivers as people and not a vehicle type, truck drivers drive heavy vehicles for a job but drive other vehicles in personal life (e.g. cars and bikes).
- Different type of truck drivers for different loads including full-time.

Using VR Technology to Help Educate Younger Drivers

- Make scenarios relatable to target demographic include emotional elements to invoke empathy.
- Use a real truck driver for VR scenarios to provide a sense of relatability.
- Develop scenarios with the aim to improve the participants appreciation of the challenges heavy vehicle drivers are faced with.
- Overcome the perception of “angry truck drivers”, share the emotional feeling of fear and anxiety that truck drivers have when faced with tight deadlines and losing their job.
- Incorporate ability to sit next to real truck drivers (use 3D scanning to create avatars).
- Develop clear emotional states of avatars (real truck drivers) to invoke empathy from participants.
- Measure empathy and emotional response of participants during VR scenarios, investigate possible behavioural changes and improved decision making due to VR experiences.
- Understand the development of 16-25-year old’s and the physical\neurological aspect of driving behaviour and provide appropriate VR content.
- Provide information\scenarios that inform participants about heavy vehicle technical challenges (e.g. stopping distances, loads, blind spots).
- Provide career information about driving heavy vehicles, aim to overcome bad name truck drivers get.

- Highlight challenges of stopping distance, example scenario could be Monday freeway or Hume Highway (Melbourne - Sydney) include frustrated drivers cutting in and increasing the level of danger.
- Include scenarios where heavy vehicle gap between vehicles is taken by overtaking light vehicles. At take-off heavy vehicle drivers need larger gaps and longer time than light vehicles.
- Scenario showing how heavy vehicles don't always have control of infrastructure and need to adapt, e.g. scenario using double B trailer at intersection required to use middle lane, show lack of understanding from light vehicle drivers.

Figure 24. Truck Wise Subject Matter Expert (SME) focus group session (held on 6th September 2019).

VIRTUAL REALITY DEVELOPMENT EVALUATION

On March 16th, 2020, *Season 1 – We need space* Truck Wise VR experience was tested by students at a local Bendigo secondary college. This first season of Truck Wise VR was well received by participants who gave the experience a rating of 8.8 out of 10. Feedback suggested that students enjoyed being within a truck, listening to the truck driver and seeing their perspective whilst a passenger of the truck. They also suggested valuable improvements including increasing realism and quality of graphics and adding more user interactions and ability to drive the vehicles.

Demographics

- 11 participants undertook alpha testing evaluation activities.
- 7 female, 4 male participants.
- Participants aged between 15-17yo.
- 8 participants in Year 10, 3 participants in Year 11.

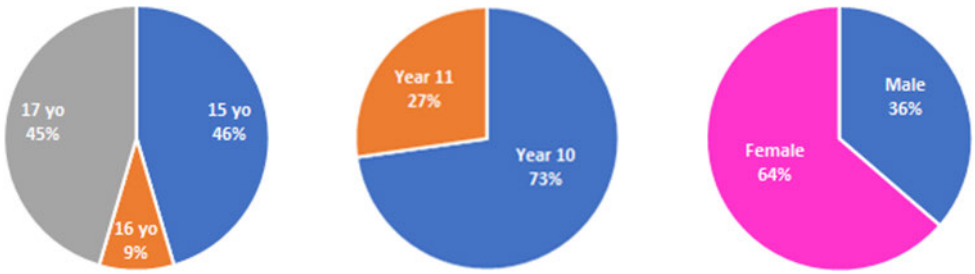


Figure 25. Participant (student) demographics.

- Approx. 27% (N=3) of participants had experience of being within a truck.
- None of the participants who had been in a truck could provide a clear explanation of the type of truck.
- Approx. 33% (N=4) of participants had family members who drive trucks.
- Approx. 82% (N=9) of participants reported the acquisition of new knowledge.

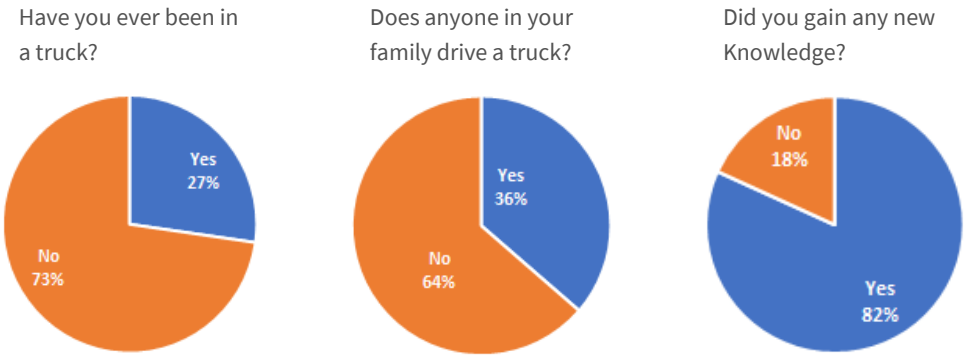


Figure 26. Participant (student) experience and knowledge.

Technology Acceptance Model

Technology Acceptance Model (TAM) evaluates how users perceive the usefulness of new technology, their intention to use and attitude towards new technology and its ease of use. The following TAM questions were answered by students during alpha testing in pre- and post-surveys —

PRE-SURVEY

- I expect the VR experiences will be easy.
- I expect the VR experiences will be useful to improve my understanding about safe interactions between cars and trucks.
- I expect the VR experiences will be enjoyable.
- Assuming I had access to the VR experiences, I would use them to refresh my knowledge about safe interactions between cars and trucks.
- If I had the opportunity to use the VR experiences again, I would use them for enjoyment\entertainment.

POST-SURVEY

- I found the VR experiences easy to use.
- I found the VR experiences useful in improving my understanding about safe interactions between cars and trucks.
- I enjoyed the VR experiences.
- Assuming I had access to the VR experiences, I would use them again to refresh my knowledge about safe interactions between cars and trucks.
- If I had the opportunity to use the VR experiences, I would use them for enjoyment\entertainment.

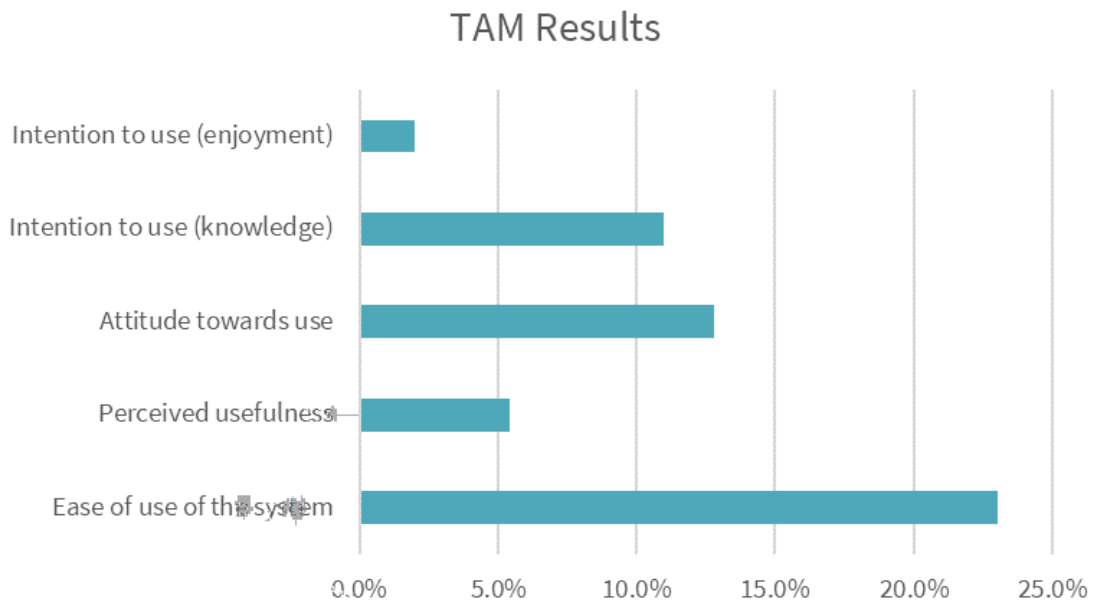


Figure 27. Technology Acceptance Model results showing acceptance exceed expectations.

Participant Feedback

ENJOYABLE ASPECTS

- Seeing trucks perspective.
- Listening to truck driver.
- Being in a truck.

CHALLENGING ASPECTS

- Took a bit to get use to VR.
- Lacking instructions for user.

SUGGESTED IMPROVEMENTS

- Increase realism in graphics.
- Inclusion of more interactions.
- Ability to drive vehicles.

Figure 28. Local Bendigo secondary college undertaking VR experience evaluation (held on March 16th, 2020).

SME Feedback and Scripting Session

On June 29th, 2020, *Season 1 – We need space* and *Season 2 – Why two lanes?* Truck Wise VR experiences were evaluated by SME at Powers Express Transport in Bendigo. Both VR experiences were well received participants. Participant feedback suggested subtle changes to technical aspects (e.g. braking times and distance) and language used by virtual avatars particularly with the heavy vehicle virtual ambassador voice-overs.

Figure 29. SME Feedback and scripting day (held on June 20th, 2020).

Conclusion and Future Work

Conclusion

The Truck Wise pilot project was awarded funding in late 2018 through the National Heavy Vehicle Regulator Round 3 Heavy Vehicle Safety Initiative. The pilot project aimed to increase awareness amongst younger drivers about safe interactions between light and heavy vehicles.

The project was commissioned with the lead contractor, Deakin University, in May 2019 and saw pre-production and production activities take place between June 2019 and March 2020. In early 2020, the COVID outbreak had begun to cause concern around the world, this saw the introduction of COVID restrictions around Australia including Victoria. These social distancing restrictions impeded the project team's ability to deliver the planned face-to-face activities including the *Roadshow* that were to take place in the second half of the project. After extensive consultation with project stakeholders and local Bendigo schools between April 2020 and September 2020, the project team decided to develop an education resource pack that is now available for schools upon request as an interim for the *Roadshow*. The following were delivered as part of the Truck Wise pilot project —

- An online website, named the Hub, that includes safety videos by Truck Wise ambassadors, 360-degree videos, educational fact sheets, FAQs, external road safety links and the education resource pack.
- Fully interactive VR experiences presenting common and challenging interactions between light and heavy vehicle drivers, the experiences show both light and heavy vehicle driver perspectives.
- 360-video experiences, similar to those above but, able to be accessed by anyone anywhere using either the YouTube app or web browser.
- The Truck Wise mobile road safety messages featured on a Power's Country Express truck, one highlights heavy vehicle blind spots and the other warns the public about the dangers of overtaking a turning truck. These messages have been circulating the Melbourne and regional Victoria road network since June 2020 and will continue to do so over the coming years.

Future Work

While the Truck Wise pilot project has made significant strides in improving awareness amongst young drivers about that challenges that heavy vehicles drivers face on our roads and how to have safe interactions between light and heavy vehicles the team would like to make the following recommendations for any future work —

- Increase the number of heavy vehicles scenarios available within the VR experiences, these can be represented as new seasons. For example, a VR experience representing Truck Wise Season 3 that deals with heavy vehicle blind spots tentatively titled “If you can’t see us, we can’t see you”.
- Present heavy vehicle scenarios within different environments (e.g. metro, mining or long highway environments that are frequently used by road trains).
- Further evaluation of both the effectiveness of the VR experiences and Truck Wise education program.
- Physical *Roadshow* roll-out with either Bendigo, state or interstate schools.

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Appendices

Supporting Documentation

The Truck Wise Final Report references several items that are external to the report, these items are assessible using links listed below —

- Truck Wise Project Plan.
- Bendigo Tech School Truck Wise Program.
- Truck Wise Roadshow Flyer.
- Stake Holder Meeting Reports.
- Mobile Safety Message Truck Curtain Design.
- Executive Summary Video.
- Public Wrap-up Video.
- Truck Wise Stakeholder Bulletins.
- Education Resource Package.
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