Crash Scene Investigation – The Science of Motion

Applying the Year 10 Science Curriculum to Reduce Crash Outcomes

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Abstract

The South Australia Police Road Safety Centre has developed a 90 minute Year 10 road safety product "Crash Scene Investigation - The science of motion", which is based upon the middle school science curriculum 'science of motion' unit of work.

Traditionally, road safety education (RSE) lesson plans are written to address the required learning outcomes and then links to the school curriculum are identified. For some schools, there is no other nexus with the student's education and RSE is delivered as a 'stand-alone' product. The 'science of motion' is a standard Year 10 unit of work under the National Schools Curriculum. Crash Scene Investigation is delivered as a lesson within this larger unit of work and provides natural world examples of how the formulae learned in the classroom are applied to practical, vehicle crash, scenarios. The presentation uses Newton's three Laws of motion to explain vehicle and occupant behaviour in a collision. The formula for kinetic energy and its crash implications is explained, as are other formulae such as the speed of light and the co-efficient of friction. Starting with the curriculum and then identifying road safety links, represents a fresh approach to designing RSE programs for secondary school students.

Being the age group most likely to crash and the group most likely to drive older vehicles, the package uses current ANCAP crashworthiness research and (authorised) video footage to demonstrate how vehicles respond to collision forces, including how the structure of a vehicle can have the capacity to prevent energy being transferred to the occupants. Crash scene reconstruction software is used to create an animation of a crash, by using data obtained from the scene and applying basic laws of physics.

A driving simulator is used to allow students the opportunity to safely participate in a number of driving tasks, whilst being distracted. The session is interactive and, through discussion, encourages students to develop social competence and resilience rather than the session being purely information based.

Introduction

People aged 16 to 19 make up 5% of the population, but account for 12% of all fatalities and serious injuries in South Australia, with a rate of 12 deaths or serious injuries for every 10,000 licensed drivers. Risk taking and extreme behaviour are often identified by

the media as a key factor in crash statistics, but "research shows that in South Australia over half of all fatal crashes, and 90% of injury crashes, are the result of mistakes, inattention or common lapses in judgement." (Government of South Australia, 2011)

Vehicle safety technology has a significant role to play in the incidence and severity of road crash outcomes; however, a study of South Australian vehicles with an ANCAP star rating, revealed that the state fleet has an average star rating of only 3.78. (Anderson, 2012, p37).

Young drivers have high crash rates, particularly in their first 12 months of unsupervised driving, yet typically the safety level of their chosen vehicle does not appear to be the first priority. (Anderson, et al., 2013) As a demographic that would benefit from safer vehicle technologies and vehicles with a high crashworthiness rating, it is interesting that "little information is available on the factors that go into family decisions about which vehicles teenagers drive." (Rivara et al., 1998)

An examination of the implications of vehicle choice and the potential safety benefits for young driver crashes across Australia and New Zealand identified that, by providing young novice drivers with vehicles with the best crashworthiness rating, "the estimated reduction in serious injuries and fatalities was approximately 86% for young Australian drivers." (Whelan, et al., 2009, p77)

Crash scene investigation – the science of motion, was developed to fit within the middle school science curriculum, as a means of communicating the road safety benefits of safer vehicles to both parents and Year 10 students at a point in time prior to the acquisition of a vehicle.

Methods

Prior to delivery of the program, teachers are provided with links to a series of printed and video PDplus teacher resources prepared by the Science Institute RiAus.

Newton's Laws

Newton's three Laws of motion are used to explain the behaviour of energy, the effects of mass and acceleration and to identify that energy is not lost in a collision. The formula for kinetic energy is used to discuss the fact that substantial increases in impact forces are achieved through relatively small increases in velocity. The speed of light, used in speed detection, the effects of rigidity in relation to energy transfer and the co-efficient of friction are also explored. Whilst the primary focus of this session is to demonstrate the

application of the formulae, the session also creates a perception of the relevance of, and need for compliance with, contemporary road laws.

Safer cars

The presentation uses current crashworthiness research from the Australasian New Car Assessment Program (ANCAP) to demonstrate how vehicles respond to collision forces and the relatively low speeds at which some collision types are tested. Data obtained from crash scenes is used to reconstruct the collision, using the same formulae that students have learnt in their science of motion topic. Data such as mass, friction, impact damage, photographs and measurements are used to create a computer generated simulation of a particular crash in which students are able to observe the crash from several different camera angles.

Distraction

Each year, over six hundred young people aged 16 – 19 years are injured on South Australian roads, with distraction being a well-recognised contributing factor. A driving simulator is used to replicate real world outcomes which can result from driving whilst distracted. The on-screen view available to the driver is projected onto a wall/large screen for the student audience to observe.

Parent night

Parents attend an information night in which their preparedness for the driver education task ahead is explored. The session includes a discussion on Road Rule knowledge, attitude and example setting, choosing a driving instructor and buying a safer vehicle.

Results

Table 1. Initial student feedback on vehicle choice, behaviour and risk perception.

	Strongly disagree	Disagree	Agree	Strongly agree
I understand the importance of choosing the safest car	0.33% n = 1	0.99% n = 3	27.06% n = 85	71.62% n = 217
I understand the importance of limiting risky behaviour to keep myself and passengers safe in a vehicle	0.33% n = 1	0.33% n = 1	14.85% n = 45	84.49% n = 256
I understand the concepts of hazard perception and risk	0.33% n = 1	0.33% n = 1	44.88% n = 136	54.46% n = 165

identification				

Discussion

Not every teenager will want to engage in driving at the earliest opportunity and perhaps, from a road safety perspective; this may be the best option. For those who will take up early licensure, there are a number of considerations which will impact on overall crash risk, such as frequency of use and distance travelled. That notwithstanding, providing a young driver with access to the safest car in the household has the capacity to significantly reducing the incidence and severity of road crashes.

Future directions include reviewing the delivery strategy so as deliver the program a little later in the term, when students have undertaken more of the unit of work. It was noted that some students struggled with content when they had not already been exposed to the basic concepts. Expanding the number of sessions to schools across the State and promoting deeper engagement with parents are also areas for development.

References

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