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The Use of Social Media Augmented Reality for Engaging Parents and Educating Children About Road Safety

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Abstract

Children are vulnerable road users. While many Australian parents are social media users and augmented reality effects are a huge trend in social media, there has been little research attention on the use of social media augmented reality for educating children in road safety. In this research, seven gamified social media augmented reality learning experiences were created about six road safety subjects to engage parents and educate children aged 5-9 years in the Australian Capital Territory region, Australia. The current research aimed to investigate the results of Facebook's augmented reality educational interventions (advertisement campaigns) and analyse the perspectives of the parents who tried the learning experiences with their children. The results of Meta's ads manager and Spark AR Hub analytics were used to evaluate the success of Facebook augmented reality advertisements. A questionnaire was developed to gather the perspectives of parents. Ten parents completed the questionnaire and were then interviewed to discuss their responses in more depth. Augmented reality Facebook advertisements reached 200,351 people and received 719,296 impressions and 3,218 clicks. All interviewees recommended the use of augmented reality gamified learning experiences to educate children about road safety. This study provides insights into how to use social media augmented reality to engage parents and educate children.

Key findings

- Augmented reality technology helped run awareness campaigns that were far-reaching
- Interviewees recommended augmented reality for educating children about road safety
- Simple and low-tech augmented reality experiences outperformed complex ones in engaging parents

Introduction

Parents are the primary teachers of road safety to their children and have three key roles in relation to children's road safety knowledge and skills: to educate; to monitor and supervise; and to be effective role models (Moyne, 2018). Ben-Bassat and Avnieli (2016) argue that two critical success factors for children's road safety educational programs are parents' participation and the playful format of the program. Therefore, children's road safety education by parents can lead to significant improvements in children's road safety behaviour (Green et al., 2008) and help create a cul-

ture of road safety at the community level. Engaging parents in children's road safety education help develop children's road safety knowledge and skills through practices in the traffic environment (Muir et al., 2017), and conversation within the family. Conversations about road safety between parents and children play a crucial role because many parents may not be aware of their children's lack of knowledge and skills. Consequently, they might not provide the expected level of education (Rivara et al., 1989).

Whilst parents and family members are the key providers of road safety education for young children, most of the children's road safety education programs, mainly provided

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by schools, early childhood services, health services, and community organisations, are child-oriented (Makin & Owen, 1996). Direct targeting of families for children's road safety education is less common. Moreover, recruiting parents for children's road safety education is a challenge due to factors such as time constraints, diverse priorities, and an awareness gap, among others.

Social media are powerful channels for reaching people. Many parents use social media to stay in touch with friends and family, find and share information, seek and provide advice or support, and reduce social isolation, and this has led to a high rate of social media usage among parents (Hammersley et al., 2020). With around 18 million active Facebook users (Centre for Media Transition, 2022), Facebook is the most used social media service in Australia. This opens potential opportunities for awareness raising and parent engagement. Social media can be a convenient, easy to access, and time-efficient way to promote short and simple messages.

On social media, Augmented Reality (AR) is a relatively new tool, contributing to the creation of immersive, interactive, and playful experiences for diverse purposes, including education and awareness raising. Virtual reality (VR), AR, and mixed reality (MR) represent distinct categories of emerging technologies that blend or manipulate the boundaries between the virtual and physical worlds. While VR immerses users entirely into a computer-generated environment, AR overlays digital information onto the real world. MR, on the other hand, encompasses a spectrum where virtual and real-world elements coexist and interact in real-time, offering a more integrated and interactive experience that merges aspects of both virtual and physical realities. A basic form of social media AR experiences are the virtual face filters that are already a part of many social media users' online experiences. The popularity of social media AR experiences is growing rapidly and the main social media companies like Meta (owns and operates Facebook, Instagram and WhatsApp), Snapchat, and TikTok have created their own AR development platforms to enable developers to create immersive, interactive, and shareable experiences for social media users. Developers can also create AR mini-games and add game elements to non-game experiences and activities that can be used for educational purposes. AR experiences created through social media AR platforms are referred to as "social media AR" experiences. These experiences can be employed for social media advertising or distributed through links or QR codes for regular access. AR games trigger positive emotions such as enjoyment and curiosity among children (López-Faican & Jaen, 2020). Previous research recommends the use of AR for educating children (Aydoğdu, 2022; Yilmaz et al., 2017).

Various forms of extended reality (XR) technologies (the umbrella term that covers AR, VR and MR) have been employed for educating children about road safety. The results of Purcell and Romijn's (2020) study revealed that children's road crossing performance improved progressively as they played and advanced through the levels of a virtual reality road crossing iPad-based game. In their research, Khan et al. (2021) found that a game-based virtual reality

learning experience positively influenced children's learning, leading to an improvement in their road-crossing behaviour.

We conducted an exploratory literature review using keywords and phrases, such as road safety education, social media augmented reality, augmented reality ads, and augmented reality learning experiences. We searched journal articles and conference presentations accessible on platforms including ScienceDirect, Scopus, SpringerLink, Taylor & Francis Online, Wiley Online Library, and Google Scholar. We did not identify any other programs that had used social media AR effects to engage parents and educate children about road safety through gamified learning experiences.

Previous research shows gamified learning experiences improve traffic safety among children (Riaz et al., 2019). Several studies reported the advantages of game-based approaches in improving children's knowledge and behaviour in various subject areas including eating behaviour (Chow et al., 2020), nutritional knowledge (Johnson-Glenberg & Hekler, 2013), problem-solving performance (Sun et al., 2022), basic psychological needs and academic performance (Quintas et al., 2020) and road crossing behaviour (Purcell & Romijn, 2020). Different authors have suggested diverse game elements for designing gamified learning experiences, and the associated terminology remains unsettled (Dichev & Dicheva, 2017). [Table 1](#) provides definitions of selected game elements as introduced by Reeves and Read (2009), and employed in this research, along with their respective roles.

This study investigated the application of gamified AR learning experiences created with Meta's AR platform, referred to as social media AR learning experiences. These experiences were made available through Facebook advertisements (ads) and QR codes. The aim of this study was to engage parents and educate children about road safety. The rationale was that AR ads enable widespread outreach to parents, motivating them to participate in brief and enjoyable road safety learning activities with their children. Additionally, the utilisation of QR codes served as an additional outreach strategy. It was assumed that gamified AR learning experiences contribute to enhancing children's road safety knowledge and reinforcing their existing understanding. The reach of Facebook's AR ads and additional data provided by Meta were used to understand how AR ads could enhance engagement with the target audience.

Method

This study was conducted in three stages: 1) the development of a series of AR learning experiences. The other two stages focused on feedback from parents of children who participated in the AR learning experiences through a 2) questionnaire or 3) in-depth interview. Ethics approval for the questionnaire was obtained from Shiraz University. Informed consent was obtained from all participating parents, emphasising the voluntary nature of their involvement and their right to withdraw from the study at any time. Confidentiality and anonymity were ensured by as-

Table 1. Definitions and roles of selected game elements utilised in this project

Game element	Definition	Role
Feedback	Information provided for users regarding their progress in relation to the goal or the status of their actions or responses, such as right-wrong feedback, points, or rewards	Boosts engagement in the activity and, when used appropriately, positively influences motivation, interest, and cognitive learning outcomes
Time pressure	The existence of in-game events that must be completed within a predefined timeframe (countdowns, clock, or timer)	Creates a dynamic and engaging environment that mirrors real-world challenges
Narrative context	A story that guides a user by providing textual or spoken information	Adds meaning to other game design elements and encourages users to become more involved
Self-representation with avatars	Digital representation of users in a virtual context	Allows users to personalise their experience, fostering a sense of ownership and individual connection, promoting engagement
Three dimensional environment	A digital or simulated space that offers depth and perspective, allowing users to interact with objects or elements in a way that mimics real-world experiences	Facilitates re-creation of real-world scenarios or the creation of completely new ones. Gives a "sense of presence" and the ability to view and control changes

signing pseudonyms and securely storing all collected data. The interview process adhered to ethical guidelines, including maintaining privacy, respect, and confidentiality throughout the study.

Development of AR learning experiences

Seven AR learning experiences were developed to educate children aged 5-9 years about six main road safety subjects below. Certain subjects were addressed in multiple learning experiences.

1. Traffic lights
2. The safe place to cross the road
3. The safest place to sit in the car
4. Use “stop, look, listen and think” when near or crossing roads
5. Treat the driveway like a road, not a play area
6. Always hold hands when crossing the road

One AR colouring page was also developed to promote the social media augmented reality experiences and engage more people. A related 3D animation came alive from the colouring page to repeat the road safety messages differently.

Kidsafe Australian Capital Territory (ACT) was consulted to design immersive AR learning experiences and AR developers from around the world were employed to co-create them. In the production process, the AR experiences were tested with some children and parents to get their feedback and make sure the learning experiences are both fun and educational. Different types of social media AR experiences and game elements were used to develop the learning experiences. The ACT Road Safety team reviewed and provided feedback on the AR experiences with some amendments made based on their recommendations. For example, in the “Treat the driveway like a road, not a play area” learning experience, the second part of the experience, showcasing the necessity of a fence separating the driveway from the home and yard, was removed. Or in the original AR colouring animation, a child crossed the road at the zebra crossing

alone after a puppy. The animation was amended to show the child should cross the road at the zebra crossing with an adult (puppy in the animation). [Table 2](#) shows details of the AR learning experiences.

[Figure 1](#) shows the seven AR learning experiences that were developed and published on Kidsafe ACT’s Facebook and Instagram pages. The experience “the safest place to sit in the car” was not approved by Spark AR for publication on Facebook, and it was exclusively accessible on Instagram due to a specific technique employed during its creation.

Provision and promotion of AR learning experiences

In the current project, AR learning experiences developed with Meta’s AR platform were employed for creating Facebook AR ads, actively promoted for a broader engagement with parents and to educate more children in the ACT region. Meta’s Ads Manager, a tool for creating and managing ads on Facebook, Instagram, Messenger, or Audience Network, facilitated the creation of AR ads incorporating AR learning experiences. When parents tapped AR ads on Facebook, the AR learning experiences opened, allowing them to interact with the learning experience. Furthermore, these AR experiences were made accessible through QR codes, providing an additional avenue for engagement and educational outreach.

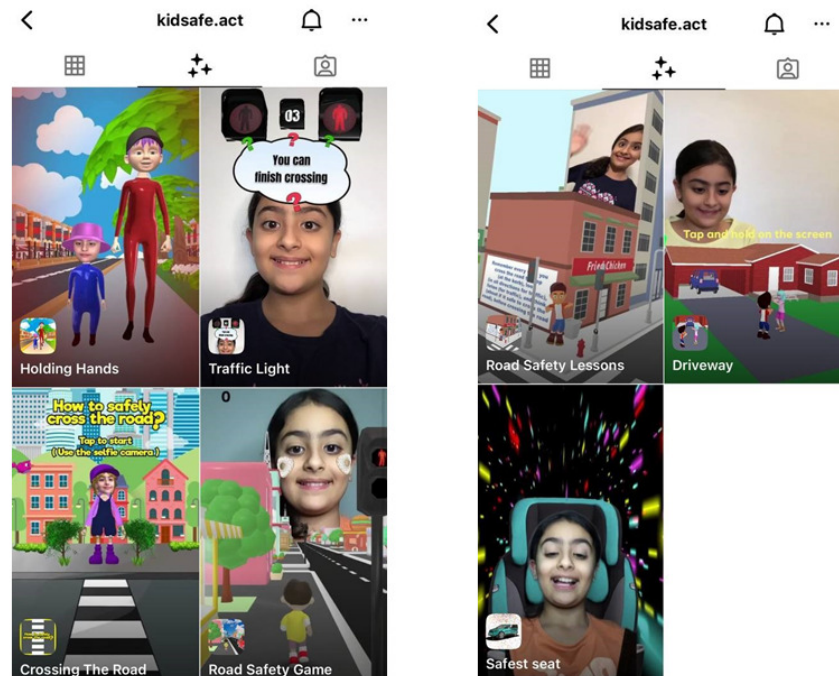
A total of AUD4,550.65 (GST excluded) was spent promoting AR Facebook ads from 6 July to 31 August 2022. The results of each campaign informed subsequent actions, for example, the promotional videos were replaced a couple of times to find the best AR ad and video, aiming to achieve improved results and enhance engagement. To attract the attention of people from different cultural backgrounds, we worked with three different children who played roles in the videos. The promotional videos and wording of the Facebook posts were designed to convey the intended message, reaching even those parents who did not click to try the AR learning experiences. The ads were promoted both weekdays and weekends to reach different categories of parents.

Table 2. Details of social media augmented reality learning experiences

	AR type	Main road safety subject	Other road safety subjects	Game elements
1	World AR ⁺	Treat the driveway like a road, not a play area	-	3D environment Feedback
2	AR game	Use “stop, look, listen and think” when near or crossing roads	Traffic lights; Always hold hands when crossing the road	3D environment Feedback Narrative context Time pressure
3	AR face effect	Always hold hands when crossing the road	-	Feedback Narrative context Self-representation with avatar
4	AR portal ^{**}	All subjects	All subjects	3D environment Feedback Narrative context
5	AR quiz & face effect	Traffic lights	-	Feedback Self-representation with avatar
6	AR face effect	Use “stop, look, listen and think” when near or crossing roads	-	3D environment Narrative context Self-representation with avatar
7	AR world & face effect	The safest place to sit in the car	-	3D environment Feedback

⁺Effects that put AR objects into people's surroundings

^{**} AR portals are like doorways or windows to the virtual world that lets users step into and explore a virtual environment

**Figure 1. Augmented reality experiences on Kidsafe ACT's Instagram page**

(Images: Parental permission provided)

Seven QR codes were generated using Bitly platform. This platform offers the results from the most recent one-month period at no cost. The QR codes were employed in various ways to broaden the project's outreach. For in-

stance, they were placed on the reverse side of the AR colouring page, allowing users of the colouring page to scan them and engage with AR learning experiences. The colouring page was used for a colouring competition to pro-

mote the activity across the ACT region. 3Doodler sponsored the competition and provided us with child-friendly 3D printing pens to be given to winners as prizes. The colouring page was accessible on the website for printing, distributed to shoppers participating in a pop-up activation at the South.Point Tuggeranong shopping centre and provided to visitors at Kidsafe ACT's office. Seven banners were also designed with QR codes on them which were used by the South.Point Tuggeranong shopping centre to encourage and enable shoppers to try gamified learning experiences by scanning the QR codes. A dedicated webpage was created on Kidsafe ACT's website to introduce the project and provide end users with the necessary materials, including the AR colouring page and QR codes. The Facebook ads were designed to encourage the target audience to visit this page, learn more about the project, and try all other learning experiences.

Data collection and analysis

Analytics

Meta's Ads Manager supplied the figures pertaining to the boosted Facebook AR ads. The number of reaches, impressions, and clicks were used to analyse how the AR ads performed. Reaches represent the number of people who saw the ads at least once. Clicks indicate the number of interactions with links within the ad that led to destinations or experiences, whether on or off Facebook. Impressions measure the frequency with which the ads were displayed on the screen for the target audience. The Spark AR (Meta's AR development platform) hub analytics provided figures about the number of times each learning experience was tried on Facebook or Instagram. Google's Firebase supplied the results related to the AR app and the frequency of user scans for the AR colouring page.

Questionnaire

A questionnaire was developed to get feedback from the target audience. The questionnaire included a blend of 13 open-ended and closed questions, accessible on the project's webpage. These questions included how participants learned about the project (Facebook AR ads, Kidsafe ACT, colouring competition, CreativiTek, Shopping centres, or other channels), the AR learning experiences they undertook with their children, whether they or their children gained insights into road safety, and if so, the specific knowledge acquired. Additionally, participants were asked if these experiences influenced their children's attitudes, knowledge, or behaviour regarding road safety. The questionnaire also explored which learning experience their children found most enjoyable and whether the activities sparked conversations within their families.

Interviews

Telephone interviews were conducted with parents who had experienced AR learning experiences with their children to assess the impact of these experiences on children's

road safety knowledge. Ten parents who completed the questionnaire and experienced all AR activities with their children by scanning QR codes were interviewed by telephone to further discuss their responses. The interviews, ranging from 20 to 25 minutes in duration and were transcribed for analysis.

Results

Platforms results

Meta's ads manager showed that AR Facebook ads reached 200,351 people, with 719,296 impressions and 3,218 clicks. As expected, AR ads reached a large number of parents in a short time frame (about two months), and the number of engagements (clicks) was considered an acceptable return on the investment (AUD4,550.65) and the time period.

The Spark AR Hub analytics showed that AR learning experiences were opened 1,210 times by social media users in Australia and about 9,700 times by people from around the world. The average time each experience was tried was 12 seconds. People took about 920 photos and videos of the gamified learning experiences. The "treat the driveway like a road, not a play area" AR experience was opened and used most, followed by the AR game. Google's Firebase showed that AR colouring page was scanned 756 times in the ACT region. From that we infer that the educational AR animation was seen by up to 756 parents and children in the ACT region.

Parents' feedback

In total, 10 parents completed the questionnaire and participated in the telephone interviews. These parents were from various cities across Australia, not just the ACT. They learned about the project through the website or other channels.

All interviewees supported using gamified AR experiences to educate children about road safety and said that the experiences were both attractive and educational for kids. With some of the experiences, children learned new things about road safety, and in some cases (particularly among older children), the AR experiences reinforced what children already knew. Below are some of the comments made by parents during their telephone interviews:

"My son learnt that you can finish crossing the road when the red man is flashing red."

"Road safety repetition and reminders are always useful. And it was fun for her to do it in game form."

"My daughter learned about traffic lights and crosswalks near school."

"I think they're good reinforcements and they're a good bit of fun for children. My son loved the augmented reality aspect of it."

"I found it to be a simplistic approach to teaching children road safety. Having them interact with the activities is a great idea."

"My son has requested we do these activities again so it definitely sparks a child's interest."

"Perhaps the driveway (learning experience) was a new one for him and teaching it as a small road."

“They (my daughters) especially enjoyed the donuts game, and played it a couple of times.”

One parent explained how AR learning experiences kept his son with Attention Deficit Hyperactivity Disorder (ADHD) engaged and interested in the topic and the experiences. He added that his son gets bored of things quickly, but because there were colours, words, music, and fun activities in these AR experiences, he did not get bored of them and was keen to try them all.

Three out of ten parents who were interviewed were immigrants. Two parents said that they learned something new from the AR experiences. For example:

“I didn’t know a driveway should be treated as a small road.”

“The holding hands (experience) was something new for me.”

The research participants said that some of the experiences were more fun and easier to use (e.g., the “road safety game”) but some were a bit hard to understand or use. For example, the “AR portal” enabled kids to walk inside a virtual city, read the signs on the walls to learn about road safety, and have fun in a couple of ways. Four parents said that it took longer time for them to figure out how this learning experience works and they needed more instructions for this experience. One of these parents added: “I had issues with the ones (AR experiences) where we needed to use the rear camera, but once I figured out what to do it was ok. But some people may need more clear instructions for this type of experience.”

Half of the parents said that their children enjoyed the road safety game the most. Children liked the AR experiences where they saw themselves on the screen or their faces being put on the body of a virtual character and the possibility to play with their faces:

“He especially loved the “stop, listen, look and think” experience, because he was able to put his face on the body and it was reacting to his movements..”

“It was interesting for him to see his face on the character’s body.”

Eight interviewees expressed their interest in using these types of fun learning experiences to educate their children about other subjects in road safety or even other important subjects. Some parents gave suggestions on how to improve and continue this project, for example, including more activities or a reward program or certificate or an app that could be downloaded so the child could continue to play” safety games.

Nine research participants said that the learning experiences stimulated conversation between children and parents about safe road behaviours, and opened the opportunity for their children to ask questions:

“It sparked conversation. I read things for him and he asked things and talked about some places and situations. The experiences allowed us to discuss things we see in everyday life.”

Social media AR experiences are shareable in nature, and it is easy for social media users to share the experiences

with their network, and this helps further extend the reach of the project into the community. One of the interviewees said that she shared the learning experiences with her family and friends when she saw her child enjoyed them a lot. Another interviewee stated: “I would talk about this with other friends with young children and I’m sure they’d enjoy it too.”

Discussion

To our knowledge, this study is the first of its kind in Australia and around the world in which social media AR effects were used to engage parents and educate children about road safety through gamified learning experiences.

The campaign’s figures and the results of the interviews showed that social media AR provided many opportunities for educating children both directly and indirectly, through their parents. Gamification and personalisation of learning experiences are two important factors in children’s education (Foshee & Nelson, 2014; Li & Chu, 2021). The utilisation of social media AR enabled the gamification and personalisation of the road safety learning experiences in the current project. Based on parents’ feedback, the immersive learning experiences helped children acquire new road safety knowledge or reinforce previous learning. This finding is consistent with results from previous research. Khan et al. (2021) reported that a game-based virtual reality learning experience had a positive impact on children’s learning and improved their road-crossing behaviour. Further, Johnson-Glenberg and Hekler (2013) reported that a mixed reality game improved the (nutritional) knowledge of children aged 11 years. As argued by Ben-Bassat and Avnieli (2016), parents’ participation and the playful format of the program are two success factors of children’s road safety educational programs.

AR technology enabled the implementation of extensive campaigns, reaching 200,351 individuals and generating 719,296 impressions. Regarding user engagement, the primary expectation for social media AR campaigns is users actively tapping on the ads to explore the interactive experiences. The experiences received a total of 3,218 clicks but obtained only a limited number of likes or comments. A likely reason for the reduced number of comments and likes is the user’s journey within AR ads. When users tap on an AR ad to try it, they are directed to another page, and they often do not return to the original ad page to like or leave comments. This is especially noticeable when the content on the destination page offers a playful learning experience, requiring time for users to try. Therefore, it seems that the number of likes and comments (as indicators of engagement) is decreased in AR campaigns compared to other traditional types of social media campaigns.

The findings of this research revealed that the playful learning experiences sparked discussions within families, covering not only safe road behaviours but also other related observations in their daily lives. Encouraging parents to engage in immersive and gamified experiences for children on Facebook can bridge the gap between children’s playful world and parents’ concerns, particularly in educat-

ing them about road safety. This approach connects children's experiences with games to parents' interests in social media and their focus on their kids' safety. Road safety conversations between parents and children are important, as parents may be unaware of their children's lack of knowledge and skills, leading to a gap in expected education (Rivara et al., 1989).

Some interviewed parents mentioned that their child attempted each experience multiple times. They said that the learning experiences were easy to access and they were keen to use these types of playful experiences to educate their children even about other subjects. This is consistent with the findings of Zare et al. (2019) who reported that the majority of parents were willing to continue using at-home activities to educate their children about appropriate street-crossing behaviours.

Our finding regarding the appropriateness of immersive and playful AR experiences for educating children with ADHD aligns with the findings from Lin et al. (2016) that the multi-sensory learning environment captures the interest and attention of children with ADHD, thereby enhancing their effective absorption of knowledge. While this finding shows promise, it should be approached with caution as it is based on an interview with only one parent discussing the matter concerning her child. According to O'Toole and Christie (2018), children with ADHD, autism or other neurodevelopmental disorders are at a greater risk on the roads. Road safety education often fails to provide the extra assistance needed by these children (Graham et al., 2005), and simpler and different resources would benefit some children with learning disabilities.

Among four AR effects that were used for advertising purposes, the "treat the driveway like a road, not a play area" experience had the greatest reach. This effect was a "world AR" with a very popular social media audio effect that got a lot of attention. The next one that had a significant reach was the AR game where children used their heads (with a face effect on their faces) to control a character and collect donuts to get higher scores. In this game, the road safety subjects were taught to children using narration and some pre-planned movements by the virtual character. The results of the interviews also confirmed this finding. Five out of ten interviewees said that their children enjoyed the road safety game the most.

Certain AR experiences, such as "world AR" and "AR portals", are still novel for general mobile users on social media. In the context of this study, some interviewees highlighted the need for clearer instructions to navigate certain learning experiences. Further exploration during the interview indicated that their concerns primarily centred around world AR and AR portals. There were mixed results about the AR portal. Some of the users found it hard to use and gave up quickly. However, some of the users who were able to try it said their child enjoyed the experience as there were different types of things happening in the virtual city and the phone was responding to their movements.

For social media AR learning experiences, we suggest using simple and low-tech experiences. If more complex AR experiences are used clear instructions for users are

needed. Although "world AR" experiences and AR portals are perfect for creating immersive experiences, if users are not supported, they may lose interest quickly or the complexity of the experiences may discourage users from trying other learning experiences. These types of experiences seem to be better suited for older children who are more familiar with AR experiences and finding out how new digital things work, often more easily than their parents. This finding aligns with findings from Chow et al. (2020) that the effectiveness and suitability of game-based interventions depend on the age of the targeted children. Children aged six years and younger need simple game designs and short playtime, but children aged 6-12 years old respond to more complex games.

Our findings showed that two out of three immigrant parents interviewed learnt something new from the learning experiences. As concluded by O'Toole and Christie (2018) in their literature review, parent engagement in road safety education has positive impacts on both parent and child behaviour and knowledge. Some parents, for example, those from socioeconomically disadvantaged backgrounds, may lack knowledge about the most up-to-date traffic rules. Some new immigrant parents might not be sufficiently informed about certain traffic rules in their new country, and many of them may face challenges in fully participating in related community or school programs. Social media AR learning experiences offer new opportunities for these parents to engage in play and learning with their children, reinforcing knowledge whenever and wherever they choose.

The collaboration with local organisations and retailers, including Kidsafe ACT and South.Point Tuggeranong Shopping Centre, to develop learning experiences and deliver the project contributed to creating suitable learning experiences and reaching a broader audience. Partnering with organisations and people who already have a social media presence is useful for building an online community and influencing others to both join and share the campaign. For example, if engaging parents is a project objective, partnering with Facebook groups with a high volume of parents, would be very useful. Building social media communities needs a continuous focus, even when the campaign is not active, as it is possible to capitalise on that strong community support for future campaigns (Freeman et al., 2015). For future similar projects, we recommend having an active and ongoing communications strategy to ensure a strong launch, maintain the promotion of the campaign, and drive traffic to the website if needed. This can be time and human resource-intensive as it may require ongoing content generation and interaction with users but helps get better results. We also used QR codes in different ways to expand the reach of the project and ran an AR colouring competition. These activities helped us get better results out of this project, and therefore, we recommend using social media AR learning experiences or awareness campaigns with other methods or activities for higher engagement and better results.

Strengths and limitations

This is the first study that has explored how the AR learning experiences can be used to engage parents and children in road safety education. This study provides insights into the elements of the scenarios that were successful in attracting and engaging the participant including the 3D environment, feedback and narrative context. In particular, the avatar that allows children to insert themselves in the scenario was a popular feature and we encourage future programs to consider how children can further personalise their experience. A secondary strength of this program was the engagement with parents who reported new road safety knowledge. It can be difficult to engage with people from culturally and linguistically diverse background and the AR learning experiences, developed here for children, could be extended to engage with adult groups, particularly drivers from non-English speaking backgrounds.

As with all research, this study had limitations. First, this study was conducted among parents in the ACT region, Australia, and may not be generalisable to other geographic locations or adolescent populations. Second, we used Bitly to generate QR codes and this platform provides the results of the latest one-month period free of charge. We had to pay to access other data including how many times the QR codes were scanned during the project period which was required for our discussions about the success of our partnerships and the colouring competition. Future campaigns can use other platforms or consider this cost in their budget planning to use the QR code results for the project evaluation. Third, the project's website was built on Kidsafe ACT's website, and Kidsafe ACT was not able to provide data on visits to the project page. We were not able to compare the number of visits to Kidsafe ACT's website during the campaign in comparison to the rest of the year.

Conclusion

Overall, this study contributes to the growing body of literature on the use of AR for providing immersive educational experiences for children. This study has provided valuable insights into leveraging gamified social media AR learning experiences for enhancing parental engagement and educating children on road safety. The findings suggest the use of social media AR to engage parents and educate children. In exploring various AR learning experiences, including AR portals, games, world AR, quizzes, and face effects, the study revealed that simpler, low-tech AR experiences would be more successful than their complex counterparts in capturing parental engagement. For future research, employing a diverse set of measurement tools to assess children's road safety knowledge and investigate actual behaviours resulting from social media AR ads is recommended. While this study provides evidence of the usefulness of social media AR ads for engaging parents and educating chil-

dren, we did not investigate if this project led to behaviour change or crash and casualty outcomes. Future studies are encouraged to work on longer projects and use multiple measurement tools to assess children's road safety knowledge and identify actual behaviours taken in response to social media AR ads.

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Author contributions

The author of this article was awarded a grant from the government to work on this project. He worked with the government, Sponsors and supporters, and AR developers to conduct the project. Then he collected data, did interviews, and analysed data to prepare the article.

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Human Research Ethics Review

All subjects gave their informed consent for inclusion before they participated in the study. The protocol was approved by the Research review team at the Ministry of Science, Research and Technology, Shiraz University on 19 May 2022.

Data Availability Statement

Data used for this project is available with researcher ethics approval from the corresponding author.

Conflicts of interest

The author declares that there is no conflict of interest.

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