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Research Article

IMPLEMENTING AUGMENTED REALITY SCENARIO-BASED LEARNING: IMPACT STUDY IN THE SECURITY INDUSTRY

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ABSTRACT

Augmented Reality (AR) is a technology that allows virtual information to be overlaid onto a live direct or indirect real-world environment in real time. Augmented Reality Application for Security Training (ARAST) is an AR platform that is designed for security officer training. It can be used to supplement WSQ training for security operations and as refresher training for security officers at the workplace. ARAST sets itself apart from most other AR/VR training available, with its flexibility to create a learning environment using the deployment of markers (QR Code) and mobile app on trainee's mobile devices. ARAST does not rely on bulky hardware (VR/AR glasses) thus making it conducive to adopt for workplace learning. To study the effectiveness of this program, from scenario design, AR App development, to training implementation and delivery to results measurements using the training evaluation framework by Donald Kirkpatrick through an experimental design impact study to demonstrate.

- Realistic and mediated AR content to engage users in an immersive learning environment.
- A supporting platform that allows collection of learning data for analysis.
- Allows trainers to easily create training/assessment scenario as well as to remotely view progress.
- Trainees can learn at their own time and reports can be made available to trainees regarding their learning progress and training gaps.

Introduction

Augmented Reality (AR) is a technology that allows virtual information to be overlaid onto a live direct or indirect real-world environment in real time (Azuma 1997). The innovative approach has been used in training in different domains, such as improving tracing activities (Yu, Ong & Nee 2015), in medical surgery (Fallavollita et al. 2016), in military contexts (Oskiper et al. 2015) and in logistics (Cirulis & Ginters 2013). More specifically, previous researches demonstrated how the use of AR as a training system might enhance practical skills, learning processes and improve training outcomes (Tang. S, Hernandez, E.J. & Adams, B., 2004).

Currently within the Security Industry, besides e-learning, there are no other tech enabled training tools that can facilitate workplace learning to enhance the productivity of security officers. There is also no standardized refresher training for security officers upon completing their basic licensing modules. Security agencies are not mandated to adhere to a set of standards or methods to engage their officers in refresher training and many may not be equipped to conduct refresher courses. Augmented Reality Application for Security Training (ARAST) is an

AR platform that is designed for security officer training. It can be used to supplement Workplace Skills Qualification training for security operations and as refresher training for security officers at the workplace.

Method and Materials

To study the effectiveness of this program, from scenario design, AR App development, to training implementation and delivery to results measurements among the participants of the security sessions, it was necessary to use a training evaluation framework. Donald Kirkpatrick first published his four-level training evaluation model in 1959. This model was then updated in 1975 and again in 1994 for the purpose of evaluating training programs. Kirkpatrick's (1994) model of training evaluation has four levels:

1. Level 1, which measure reactions - how participants react to their training
2. Level 2, which measures learning - what participants have learnt from their training
3. Level 3, which measures behavior - whether what was learnt is being applied
4. Level 4, which measures results - whether applying training is achieving results.

The four levels of evaluation fit neatly with the four hypotheses of this research, which could then be modelled after Kirkpatrick's evaluation of training framework. This framework enabled an evaluation frame that had multi-levels and measured the outcomes of training evaluation using different research methods at different levels. Based on these requirements, the Kirkpatrick model of training evaluation was proposed and eventually adopted as the measuring frame for this research.

The study hypotheses were linked to the following objectives:

1. To determine the reaction of the trainees to the AR scenario-based learning approach
2. To measure the effectiveness and impact on learning
3. To measure the application and performance results of learning

These objectives lead to the following research questions:

1. How effective is this AR scenario-based learning approach in terms of trainees' reaction after the lessons?
2. How effective is the learning in terms of the trainees' assessment results?
3. To what extend was their learning applied at work and the results achieved?

Table 1: Summary of Hypotheses and Instruments.

Hypothesis	Instrument
H1	Workshop feedback survey, pre and post
H2	Assessment measures of whether trainees in the treatment group achieved equal or better results than did those in the control group, and at T2 compared with T1.
H3	Performance measures of application of scenario-based skills of trainees after one month back to work
H4	Performance results from supervisors of trainees after three months at work

Scenario-based Learning modules are based on 2 scenarios;

1. Handling Improvised Explosive Device.
2. Responding to Small Fire.

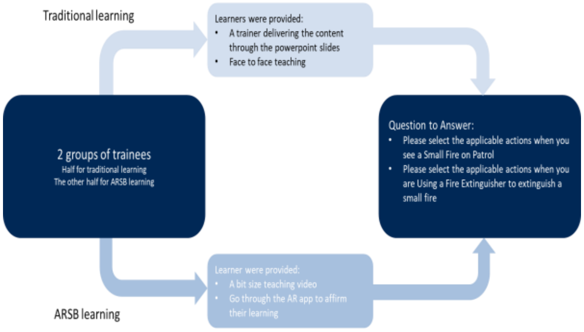

Figure 1: Comparison between Traditional and ARSB Learning.

Results and Discussion

The demographics of the study groups are listed in the infographics below.

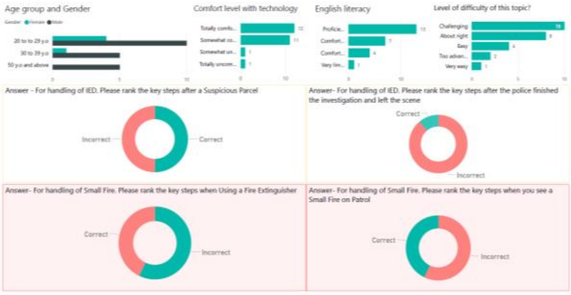

Figure 2: Demographics and Results Overview.

The results are computed and analyzed, and the charts show the positive results of engagement and usefulness using the AR scenario-based learning.

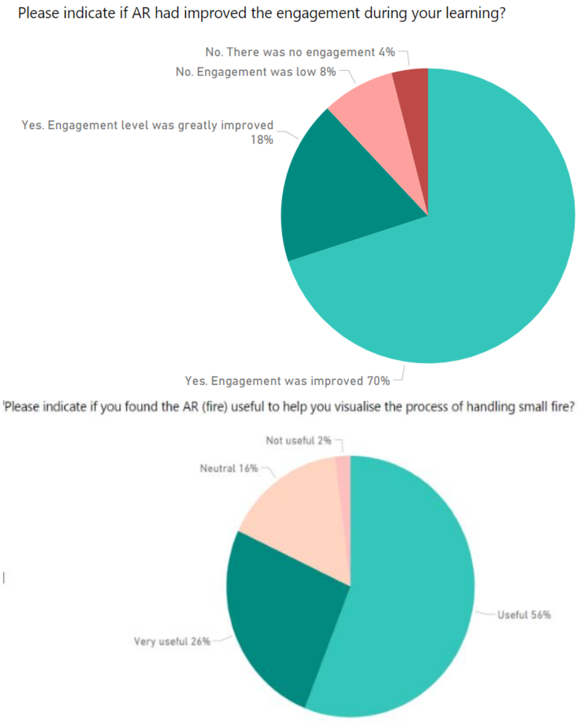

Figure 3: Comparison on Engagement and Usefulness.

From the analysis, we can observe that there are positive outcomes with increased trainee-centricity, this was achieved through the individualized approach, pace and duration of learning afforded by the use of the digital app. Each trainee had their personalized access to the scenarios and learning content and this resulted in an increased in self-directed learning across the entire cohort. There was also a function in the AR app that provided a 'help' button, to alert the instructor, and allow for a more individualized instructor-to-trainee interaction and clarification especially when help was required by the trainee. Over and above that, an instructor dashboard was created to allow for instructors to remotely observe the pace and learning completion of every trainee without the need to have them centrally located in the classroom.

From the results, we also observe that the trainee's learning retention and comprehension also improved. The table shows the results of AR vs Traditional Learning, where AR has a higher correct score of 27.91%.

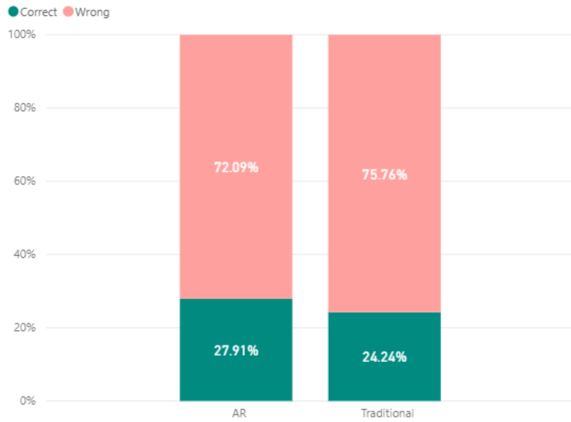

Figure 4: Comparison of Results for AR vs Traditional Learning.

Conclusions

It was found that using the Augmented Reality approach to learning in these scenarios produced positive outcomes, with more trainee centricity observed as a result of a self-paced approach to learning, which also increased self-directed learning. This is also because the AR app included a 'help' button when help was required, and learners could activate that function as and when help was needed.

Results show that learning retention and comprehension also improved as students had a continuous access to information sources at any time of the day, this access to information provided the 'just-in-time' effect to learning. Each learner was able to individually interact with the data with a certain degree of flexibility (Gil & Pettersson, 2010) and from any place and at any time (Holzinger, Nischelwitzer & Meisenberger, 2005; Kurti, Spikol & Milrad, 2008), resulting in better learning results and outcomes.

This study also introduced new tools for learning in the security sector, where mobile devices are useful single-user tools for managing information (Marin & Mohan, 2009) and can be effectively applied to adult learning and educational settings especially for Security Training.

Finally, as a result of this study, there are now new roles for instructors and faculty through the use of technology in learning. These new roles are essential in the management process of adapting learning content and information to these new technology-learning platforms. We anticipate that this study will eventually evolve into the new way of security learning through virtual scenarios and learning environments beyond the physical limit of classroom walls.

In conclusion, the Augmented Reality scenario-based learning app has proven effective and sets itself apart from most other training available, with its flexibility to create an efficient learning environment anytime, anywhere using mobile apps on trainee's mobile devices.

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