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Article:

Evaluating the use of virtual crime scenes to support student understanding of crime scene investigation

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Abstract

This project aimed to explore the implementation of a virtual crime scene using the interactive visual platform ThingLink, to support student learning of crime scene investigation. This was necessary to facilitate learning during the national lockdown and subsequent restrictions imposed due to Covid-19. A Level 6 undergraduate Forensic Science module was evaluated, covering two academic years to enable comparison between in-situ based teaching methods and a virtual crime scene replacement. Evaluation of the overall grades found no difference in student performance when year on year assessment grades were analysed. Furthermore, an end of year survey found that whilst the majority of comments regarding ThingLink were positive; finding it easy to navigate and enjoyable, students indicated a strong preference towards solely face-to-face learning for the future and identifying as hands-on learners, preferring to use both observation and personal experience. However, it should be noted that the response rate to the survey was only 19% and this could be reflective of the general trends in student engagement during the pandemic. Further analysis of student engagement remains an area to be more fully explored. Future applications of technology such as ThingLink could still prove beneficial to support a blended style, a deeper learning experience and a more inclusive curriculum though further research exploring the effects on inclusivity and this blended approach should be evaluated now that the pandemic restrictions have been lifted.

Context and Objectives

Background

A fundamental part of any Forensic Science programme is an appreciation for Crime Scene Investigation (CSI) and traditional methods for CSI skills are often supported by hands-on practical based learning strategies. CSI skills inherently affiliate with the higher order of Blooms Taxonomy (libguides.com, 2020), guiding students to develop an "expert" opinion and providing justification for their decision-making process, whilst using personal involvement (Moon, 2004) to create a concrete learning experience (Hopkinson, 2004), grounded by constructivist theory (Hein, 1991). The current in-situ methods are further based around learning supported by group collaboration and teamwork (Lyon & Lagowski, 2008), for example using a team of scientists with their own specialist skills to work together on one criminal case. The applied nature of Forensic Science requires not just learnt skills and knowledge but the application of this to casework and therefore supports future employability. The global pandemic has highlighted the lack of novel online teaching resources for students in Higher Education enrolled on some courses which have historically relied heavily on face-to-face teaching methods.

Virtual Reality (VR) and similar digital methods have been part of CSI for some time now, both in realworld applications and education settings with much discussion focused on immersive technology (Kader et al, 2020; Lv et al, 2017; Mayne & Green, 2020; Wang et al, 2019). Lv and colleagues (2017) describe virtual scenes as being semantic scenes where the user interacts with the relationship between objects within the scene, suggesting that the advanced technology surrounding video games can be used for e-learning and promote motivation of users. Wang et al (2019) highlight the potential and significance of using VR to assist in crime scene documentation and reconstruction and therefore to support evaluation of evidence by the scientist including bloodstain patterns and footprint analysis. Whilst their focus was a real case, (the investigation of a murder in China), rather than education, the principles for creating an immersive and interactive platform apply here. From an education point of view, providing an immersive environment that can be accessed remotely would allow students to interact with the scene more flexibly. Moreover, this freedom in access allows for repeatability, the student can access the scene as many times as they desire, not something that traditional in-situ learning can offer. The parallel here between a one-time only access is a real concern for a crime scene investigator and therefore awareness of this for learners is fundamental to scene investigation, linking with the concept of authentic assessment (Wiewiora & Kowalkiewicz, 2019). However, revisiting the scene as part of education allows for further observations to be made and in turn, for reflective learning to take place, thereby solidifying the learning experience (Bourner, 2003; Norton, 2007; Zulfah & Aznam, 2018). Furthermore, students could access the scene following feedback and therefore further support reflective practice (Fung, 2017). This supports the concept of a hybrid approach, allowing students to experience each method and compounding the learning experience.

Impact of Covid-19 on Forensic Science teaching at Keele University

For the academic year 2019/20, all scene based practical sessions (three in semester one and one in semester two) were held in the crime scene house on campus with the analysis and evaluation of the evidence recovered conducted in the laboratories. A final assessment for the module, at the end of semester two, is a mock court assessment that is usually completed in the Moot Court on campus. However, towards the end of this academic year saw the first national lockdown and the court assessments were moved online. The subsequent restrictions and further lockdown measures forced a change for the 2020/21 academic year and a more blended learning (Garrison & Vaughan, 2008) approach was considered. The first semester consisted of in-situ socially distanced sessions held in a laboratory for the crime scene practical work, whilst the second semester required exclusively remote learning. The semester two crime scene was conveyed to students using the interactive platform ThingLink (www.thinglink.com) to assist student learning alongside synchronous support sessions.

Aim and Objectives

The aim of this research was to assess the validity of using an online virtual mock crime scene to support an authentic learning model for understanding crime scene investigation and scene interpretation. It was not to use virtual examination to fully replace in-situ examinations but rather to compliment the learning style to create a blended approach and to evaluate the strengths and weaknesses of the different learning strategies. The grades from one academic year where the crime scene practical sessions were all held in-situ were compared to those from the following year where a virtual scene was implemented in a blended approach to evaluate performance. A survey questionnaire was used to collect student perspectives on the virtual scene to gain insight into student perception.

Method

The Forensic Science Level 6 module; CHE-30028 Interpretation, Presentation and Evaluation of Evidence was evaluated, covering two academic years to allow for comparison between in-situ based teaching methods and a virtual crime scene replacement.

Typically, in semester one, the learning outcomes are centred around Crime Scene Investigation skills with student practical sessions completed in small groups of 3-5 students. These practical sessions simulate crime scenes with assessments covering contemporaneous notes, a witness statement and practical skills such as evidence recovery and scene management. Semester two begins with a crime scene examination practical however, the focus shifts towards interpretation of evidence and the role of the forensic scientist. The assessments here are linked to expert witness status, requiring an expert statement and a mock court exercise focused predominately on cross-examination. This final assessment of the module is a culmination of the skills learnt throughout the programme and strives for authenticity in replicating the court experience, a particularly useful skill for future employability within the Forensic Science field.

In-situ teaching using simulated crime scenes

All crime scene work completed by the students for academic year 2019/20 took place in-situ using the crime scene house with simulated crime scenes. These scenes were designed to replicate serious offences such as sexual assault and murder. Individual grades were recorded for each assessment and were broken down into semester one coursework, semester two coursework and mock court assessment. The data for each assessment was analysed to produce a mean value to show the overall student average for each, the standard deviation and range were calculated to evaluate the spread of the data.

Remote teaching using a virtual crime scene

For the academic year 2020/21, a reduced number of in-situ crime scene practical sessions took place in semester one due to the Covid-19 pandemic. These sessions were completed in the laboratory rather than the crime scene house to comply with social distancing measures; however, they were further supported with additional remote activities to support the condensed number of contact hours. For consistency with the previous year, these assessments were based on similar scenarios as those used previously.

For semester two, all teaching was conducted remotely due to the national lockdown imposed at that time. The initial crime scene examination was replaced with a virtual alternative using the ThingLink software based on the same scenario as the previous year to ensure consistency. The mock scene was set up in the crime scene house on campus, with images taken of the scene to generate the ThingLink. This was supported with additional images and data for the interpretation elements. Examples of each can be seen below in figures 1, 2 and 3 respectively. The remaining remote practical requirement of evidence analysis was bolstered with synchronous sessions to further support student learning. The learning outcomes for each semester remained the same as the previous year and the grades recorded for each assessment were analysed as described above.



Figure 1. Screenshot section of ThingLink used as part of the 2020/21 academic year virtual crime scene. The scene was set to simulate a suspicious death and embedded within the ThingLink are supporting images and data to assist the student investigation of the scene.



Figure 2. An example of additional crime detail embedded within the Thinglink. Here, fingerprint evidence is shown in-situ on the wine bottle, accessed by clicking on the wine bottle in the scene. Additional images of these fingerprints were provided to form part of the evidence evaluation.



Figure 3. An example of an image of footwear evidence recovered from the crime scene to facilitate evidence interpretation.

Student Perspectives

Following completion of the final assessment, students were asked to reflect on the learning for this module and a survey questionnaire was sent out to all 70 students registered on the CHE-30028 module for academic year 2020/21.

Evaluation of the responses was completed to;

- gain insight into how the students felt about the virtual aspect from semester 2
- allow comparison between the virtual scene and the previous experience of in-situ teaching during semester 1
- to establish any preferences between methods
- to gain further understanding of the preferred learning style.

Results

Analysis of data based on in-situ simulated crime scenes

For academic year 2019/20, there were a total of 41 students partaking in the module and each student experienced a wholly face-to-face crime scene experience based on simulated scenes using the campus crime scene house. The final Court assessment was completed remotely using Google Meet. This would usually be conducted on campus in Keele's Moot Court, however, the start of the first national lockdown in March 2020 forced a move to an online alternative.

The data, illustrated in figure 4 below, shows very little deviation between each of the assessments, with students performing marginally better with the semester one coursework, however, given the standard deviation for the data, this difference cannot be considered significant. The spread of the data for each is also similar as indicated with the range values, though marginally more consistent with semester one grades. In further support of this agreement, the highest values observed across the assessments is comparable, however, the highest mark for the mock court was identified as an outlier as indicated in figure 4 below. Many of the lower values were also identified as outliers, which is likely due to some non-submissions for some of the coursework elements, however, the general trend of the data supports the similarities in student performance overall.



Figure 4. Box and Whisker of the assessment grades shown as a percentage value for academic year 2019/20

Analysis of data based on in-situ simulated and virtual crime scenes

The grade data from academic year 2020/21 is presented in figure 5 and similar trends to that noted in the previous year can be observed. It is apparent that overall students performed less well on the semester two coursework than either of the other two assessments. However, the mean here is recorded as 63% which is identical to the mean from the previous year (see figure 4) and when the standard deviation is considered this supports a consistent trend in performance across both academic years.

The spread of the data is also much the same as the previous year, however, fewer outliers were identified suggesting more consistency of marks overall as shown in figure 5. There were fewer non-submissions for some the coursework components to the previous year (15 in 2019/20 compared to 8 in 2020/21), a likely contributing factor in reducing the quantity of outliers.



Figure 5. Box and Whisker of the assessment grades for academic year 2020/21

Comparison of year-on-year grades

Analysis of the data shown above, shows that there is no discernible difference between the performance from each academic year. Overall, the grades presented were very similar when examining the mean, the range of the data and the standard deviations. The virtual crime scene used in academic year 2020/21 had little, to no bearing on the final grades and therefore the quality of the

work submitted for assessment has been neither positively nor negatively affected when evaluating grades alone. A large majority of students in each year achieved a module grade at 2:1 level or higher as shown in figure 6 below.



Figure 6. Comparison of grade classifications for each year evaluated, with a very similar spread of data across the grade boundary and the majority of students performing at 60% or higher.

Student Perception

The summarised results from 13 student responses to the Likert questions are presented in figure 7.



Figure 7. Student responses to the survey questionnaire.

Figure 7 shows that overall, 77% of students enjoyed the virtual crime scene experience. This is based on combined "strongly agree" and "agree" responses. Furthermore, 92% either "agreed" or "strongly agreed" that the virtual scene was easy to navigate and that the ThingLink provided a good representation of the scene. Minocha and Hardy (2011) caution against using virtual learning suggesting it is difficult to navigate, however, this was found not to be the case for this project. Surprisingly, despite the students generally engaging well with the ThingLink and expressing views of enjoyment, and ease of use, overall, the students who participated in the survey indicated a preference to traditional face-to-face teaching with 85% selecting either agree or strongly agree to the premise of all sessions held face-to-face. This is further supported by 53% choosing "disagree" or "strongly disagree" to a combined approach in future.



Figure 8. Pie chart indicating preferences relating to a blended learning approach in response to the survey question " In future, I would like a combination approach using both virtual crime scenes and face-to-face practical exercises"

Further evaluation of the survey was to gain insight into student preference towards learning type and the results are shown below in figures 9, 10 and 11.



Figure 9. Pie chart indicating preferences relating to learner style when asked "I consider myself to be ...?"



Figure 10. Pie chart indicating preferences relating to learning style.



Figure 11. Pie chart indicating preferences relating to group work for crime scene practical sessions.

From the above figures (figures 9-11) it can be seen that 69% of students identified themselves as being "hands-on learners, relying on physical engagement" which is also supported by 85% indicating a preference to a blend of both observation and personal experience with no students selecting "through observation" alone. Interestingly, students indicated a preference for smaller groups than their experience on the module, with 84% showing preference for groups of 2-3 students.

Discussion

Despite the positive views regarding the virtual scene, most students indicated a preference for faceto-face teaching and hands-on experience. It should be noted, however, that only 13 of the 70 students (19%), responded to the questionnaire and this may be somewhat reflective of the overall level of student engagement. An evaluation of the online participation indicated much reduced levels of engagement as the semester progressed, possibly due to the increased stress created by prolonged period of lockdown and therefore diminishing enthusiasm in some students. The overall grades showed no significant difference between the grades for each year and yet, student perception of the experience could have a significant impact on the survey responses. There could be a direct link between the preference for face-to-face teaching and the isolation created by working remotely due the Covid-19 restrictions. Evans et al. (2021) found an increase in loneliness and reduction in wellbeing as well as increases in other psychological effects such as anxiety and depression in undergraduates. Therefore, any observation in trends here should be treated with caution as this cannot be considered representative of the year group or a typical academic year. Further work needs to encompass greater student response over a greater time frame where lockdown is not a factor to be truly representative and therefore valid.

Many of the students surveyed indicated a preference to small group work and Mayordomo & Onrubia, (2015) suggest that collaboration supports knowledge construction. The initial intention was for the virtual scene to be examined as a group and this is something to consider re-instating moving forwards. Future research could explore the effects of using a group-based activity coupled with the virtual scene and this would align more closely with authentic learning (Parwati et al, 2019) by replicating the team effort required in a criminal investigation. This would be more centred around problem-based learning (Pepper, 2009), (Inel & Balim, 2010) which is very akin to Forensic Science as a discipline.

The survey indicates caution in using a virtual platform for a practical based course, particularly given that 85% choose observation in combination with personal experience as a preferred learning method. The issue may not simply be with implementing a virtual crime scene to support the current learning methods, as was the intention, but rather that students perceived a forced change due to the national lockdown and with that came some resistance to change. Furthermore, the approach could have been hindered by poor internet connections, which is supported by Pringle et al. (2022) who found that poor internet connectivity was a factor in accessing the virtual software combined with using unfamiliar software. Furthermore the remote access can lead to an inability and inaccessibility to open discussion, collaboration and therefore a shared learning experience (Boettcher & Conrad,

2016). In previous academic years, the evidence analysis has been completed in a laboratory setting and this promotes the opportunity for both student to student and student to tutor discussion, a much more conscious act with remote working. This is further compounded by the survey being implemented at the end of the semester, and there should be some thought given to whether a more immediate response to the ThingLink could yield different results and perhaps a greater response rate. Gopalan (2021) suggests that flipped teaching can be used with virtual teaching and the idea of incorporating a flipped teaching approach could enhance the learning experience here by providing the virtual scene in advance of an in-situ practical. Reviewing the crime scene virtually prior to conducting an examination would fit well with this theory and a follow up synchronous review session could be added to pave the way for a more computer supported collaborative learning environment (So & Bonk, 2010).

A similar survey to the one used here was conducted by Kader and colleagues (2020) with 100% response rate from 37 students. They suggested that the use of a virtual scene hosted on Uptale (a similar platform to ThingLink), during the pandemic was necessary and could be used to support laboratory practical in future. Overall, they also found that most of the students enjoyed the experience (79%) and would recommend it (84%). What is not clear from this paper though, is whether there was discussion or questioning around the student's preference for the technique compared to more traditional methods. Whilst the sample size was rather small at 37, this was a response rate of 100% and therefore much more representative than this study. However, an alternative could also be considered; by adapting the methodology to evaluate student performance by other means than grade averages for example, evidence recovery rates as used by Kadar et al. (2020).

A fundamental difference between this study and much of the current literature is the use of VR headsets to create a more truly immersive environment and some comparison between VR headsets and platforms such as ThingLink for education could be reviewed in future to better understand these different styles. Dziekan (2019) suggests that these approaches are more "submersive" rather than being truly immersive. However, it's important to note that the use of VR headsets would likely mean a learning experience created on campus to access the equipment. A distinct advantage of ThingLink is that in can be accessed anywhere with an internet connection using a mobile phone, laptop or computer.

Another potential avenue to explore is student experiences throughout the year with repeat surveys of the same students before and after each a hands-on and a remote practical. All students would be required to complete both elements to ensure no student is disadvantaged by the research. Furthermore, future similar research conducted without the social restrictions imposed by the pandemic would be advantageous to ensure that the results obtained were not unduly influenced by the pandemic.

Conclusions

Year on year comparison of grades were remarkably similar with no observable difference in student performance related to assessment grades. Therefore, there was no significant improvement or detriment to utilising a virtual crime scene for the semester 2 learning experience compared with the previous year where an in-situ crime scene was used. This does therefore support that the use of a virtual crime scene has been successful in achieving the intended learning outcomes for the module. However, it should be considered that whilst grades were not affected, student learning goes beyond grades alone and a blended approach could facilitate learning on a deeper level. The flexibility and repeatability of access to a remote scene promotes reflective learning and practice, a key skill for a practicing investigator.

The survey data suggested the virtual crime scene was a positive experience, however, the majority of those students surveyed also indicated a strong preference to face-to-face teaching rather than either fully remote learning or a hybrid approach. The limited response rate to the questionnaire suggests the validity of the data here should be treated with caution as this cannot be considered representative of the cohort. Furthermore, limited engagement with the survey could be linked with an overall reduced level of student engagement with online learning due to the Covid-19 restrictions, however, further research in this area would be required to support this claim. Specifically overall student engagement should be further analysed, not just with this module but throughout the Forensic Science programme and even more widely across the university to encompass different courses to gain a better understanding of the wider student engagement. This could be one aspect of the

research that created skewed results; influenced by the pandemic rather than truly representative of the learning experience.

The implementation of a blended learning approach using both face-to-face and therefore hands-on practical experience coupled with virtual remote learning could yet prove to be advantageous, offering a more inclusive curriculum as well as deepening the learning experience and future research could explore this. Some immediate amendments could include explaining to the students ahead of the sessions the importance of different skills to promote a more positive reaction and remove the forced element perception possibly created with lockdown and using repeat surveys of the same students throughout the year to gain greater insight into immediate attitudes. Evaluation of student grades would need to be explored over a greater time span and include years where the university experience was not impacted by Covid -19.

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Competing interests

'The author(s) declare that they have no competing interests'.