

## **Educational e-gaming to provide an innovative, effective and flexible 24/7 learning environment**

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## **Abstract**

*Current HE undergraduates have mostly grown up with computer technologies and gaming. As such, computer game learning resources might provide an effective complementary learning environment. This project developed a forensic geoscience e-game using computer game software development tools and design skills. Using a real forensic search case to locate a clandestine burial of a murder victim, e-game users progressively work through search phases, including both desk-based and actual search phases within specific budget and time frames. Once actively searching, users are immersed in virtual gaming environments, collecting datasets and pinpointing potential burial sites. Project evaluation by Keele UG/PGR students and staff evidence it as an effective complementary learning environment, allowing increased understanding of difficult concepts, rapid learning of new knowledge, appreciation of real-world problems and statistically improved knowledge of forensic search post-gaming. The e-game works through an internet front-end and is planned to be downloadable as a PDA 'app'.*

## **Keywords**

*egaming, virtual, employability, serious games*

## 1. Introduction

Common concern for HEA STEM lecturers is students effective engagement with a topic(s) and ability to learn, understand and apply knowledge in a different situation. This may, in part, be due to traditional lecture and associated laboratory practicals teaching environments that may not be effective, particularly when compared to accepted learning models.

Current students comprise so-called Generation “Y” generally defined as 1982-2001 birth years (Knight, 2009). Generation Y students have been suggested to be “*fundamentally different in outlook and ambition from any group of kids in the past 50 or 60 years... it is clear that they already know they don’t want to live or work the way we do*” (Hill, 2002). They are “*digital natives connected 24/7, bored by routine and goal-orientated*” (Knight, 2009). However this is a generalisation as there will be different technological abilities, interests and cultural backgrounds and thus the cohort will be more diverse (Sternberg, 2012). Educational e-gaming is starting to be studied (see Squire, 2008; Pringle 2012). This action research project to ask if “*immersive e-gaming can provide an effective complementary learning environment for HE physical science students*”.

## 2. Methodology

An **Action Research approach** used Keele UG/PGR students studying Forensic Science, Geology, Geoscience and staff. The e-game was Degree-relevant to UGs & useful to PGR students. A *sequential mixed methods approach* was used:

**(1) Pre-game questionnaire** to gain data on student gaming experience and current usage, preferred learning environment(s), thoughts on University learning experience, self-rating forensic search knowledge and anything relevant;

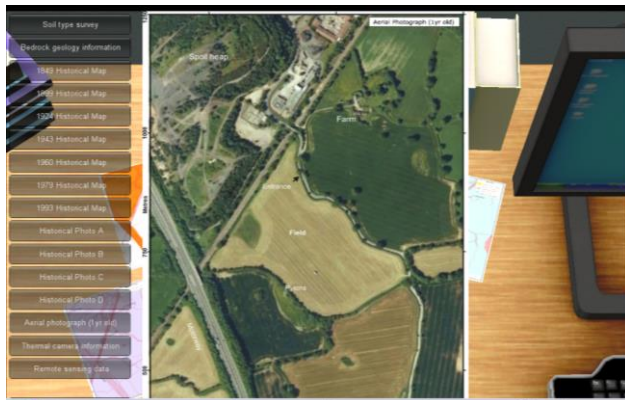
**(2) Participants undertake e-game.** Simultaneous semi-structured, chronological observations made, to gain ‘live data’ that gave insights. The exercises were also taped for later transcribing and coding to provide triangulation data.

**(3) Two post-intervention UG focus group interviews** to discuss learning experience, the egame beneficial elements (or otherwise) and any other project thoughts.

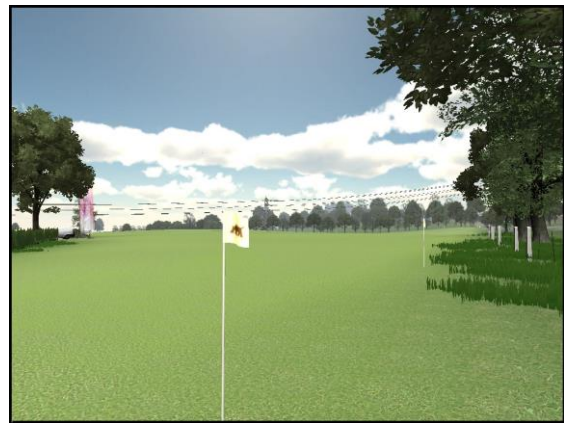
**(4) Finally end-project questionnaire** for participant to self-rate search knowledge, determine e-game learning experience and any un-intended project outcomes.

## 3. The e-game

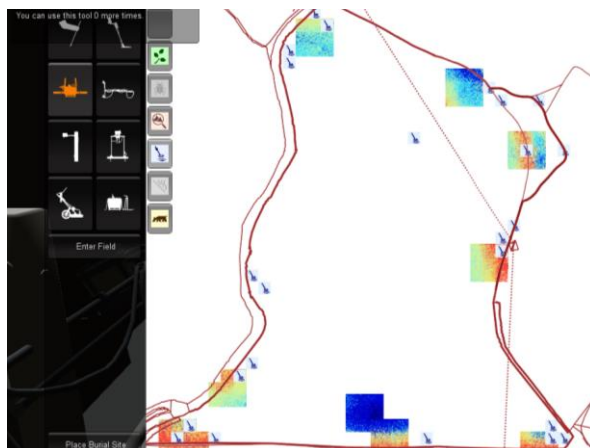
The **egame** comprises a 3D virtual environment based on a real sites’ geoscientific data. User(s) explore the virtual environment as a standalone application. Designed to lead users acting as CSIs through investigating a crime scene; once desk-study and initial reconnaissance stages have been completed, users then have freedom to roam, decide upon and operate search equipment, plant flags at likely burial positions and decide areas for intrusive investigations. The egame randomly moves burial location and associated data when loaded, so repeat users are still challenged; a linked game time leader board also encourages refinement of search skills. Once completed, a success/failure newspaper article appears, game transcript/link to the published case study (Pringle & Jervis, 2010) – see Figures 1-4.



**Figure 1.** E-game screen-shot showing (stage 1) initial desk study data (icons on left) and site image with suspect field marked.



**Figure 2.** E-game screen-shot showing initial reconnaissance (stage 2) suspected flag positions and van with 'teleport' position (background).



**Figure 3.** E-game screen-shot (stage 3) with user in van viewing conductivity data (squares) and metal detector results (icons) in main screen. Left bar shows equipment.



**Figure 4.** E-game screen-shot completion with text and brief user feedback. Alternative finish is 'Killer goes free' newspaper headline.

## 4. RESULTS

(1) All UGs and 95% of PGRs had played e-games before and  $\frac{3}{4}$  of UGs and 40% of PGRs currently played daily or once a week (Figure 5). Almost  $\frac{1}{2}$  of UGs (49%) and over  $\frac{1}{3}$  of PGRs (35%) had previously used e-gaming as an educational tool.

(2) E-game participants sequentially worked through the search scenario, were task-focused (Table 1) and a non-systematic noting of participants e-game completion time varied between 12-60 minutes (~30 minutes average). There were also a surprising variety of gaming styles used by participants; some were methodological, exploring the entire game environment, whilst others were 'lazy gamers', one of whom commented "lots of short-cut buttons to save my time".

(3) UGs focus groups discussed educational e-gaming, other learning environments, and other relevant comments. From coding the themes together (in italics): (A) *E-gaming* in general and this e-game was positively received with 7 comments wishing it to be an assessed component of a course module; (B) There was also discussions on *other learning environments* with formal taught lectures being given a mixed reception, laboratory practicals judged to be useful, and some ambivalence on usefulness of group problem classes; (C) Participants judged the e-game positively for *job skills* and; (D) *subject engagement* comments evidenced e-gaming was a positive way to learn.

(4) 95% of UGs and 90% of PGR students enjoyed the e-game, giving it an average (non-parametric) rating of 4.1 for UGs and 4.0 for PGR students with 5 the highest.

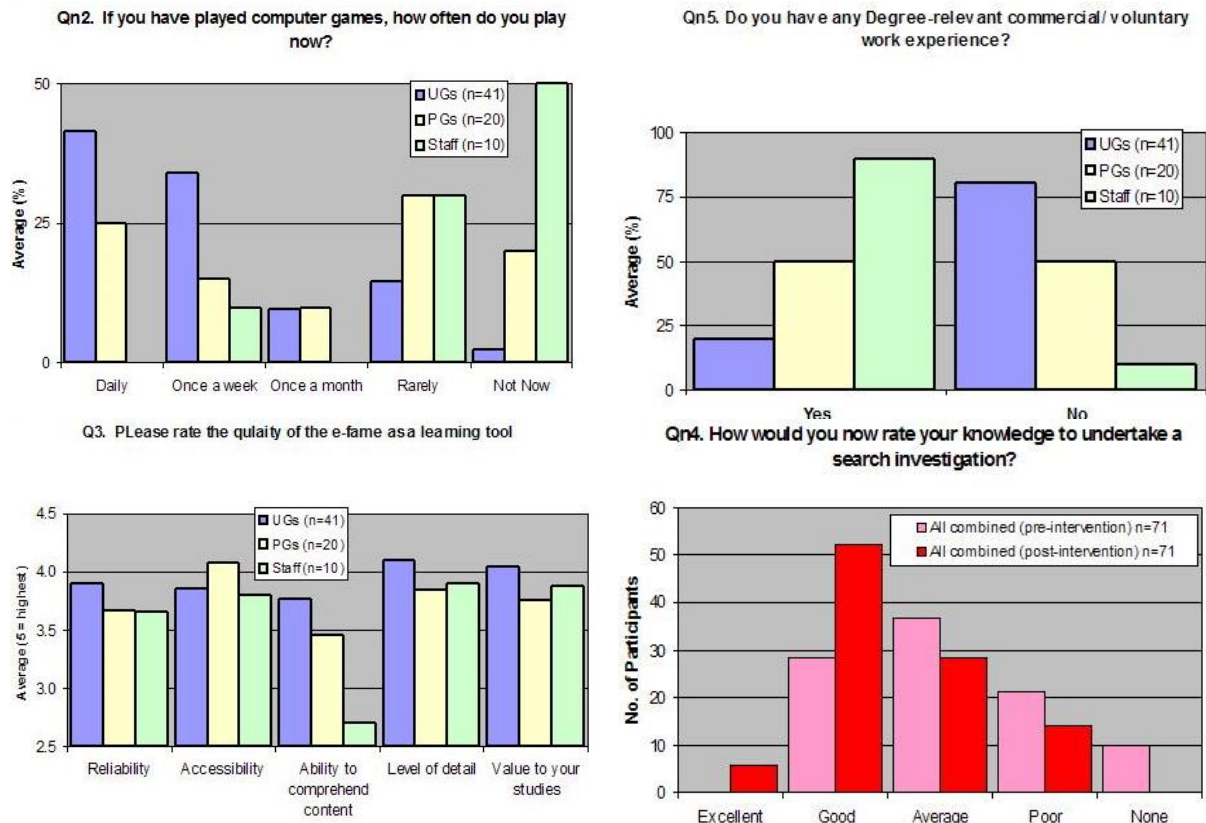


Figure 5. Key bar graphs from pre- (left) and post- (right) intervention questionnaires.

UGs rated 'level of detail' highest, followed by 'value to your studies', whilst PGR students rated 'accessibility' then 'level of detail' highest. 96% of UGs and 64% of PGR students self-rated their search knowledge as either good or average, a +32% and 0% change from before the e-game respectively (Figure 5). The majority of the UGs (80%) and, interestingly, 54% of the PGRs stated they had an improved search knowledge after playing the e-game. Participants' combined anonymous questionnaire comments showed participants enjoyed the e-game and found it fun (9), that it: aided their understanding (5), showed how searches are conducted (3), was realistic (2), practical (2), good for revision (2) and training (1). UGs anonymous comments included: "I think it's a good tool to use, [it] really helped develop my understanding to what sort of results I should expect in the field" and "useful as get chance to use all equipment in a real-life application, which can be revisited multiple times" although one commented "just a game, not really representative". PGR students' anonymous comments included: "great way to bring together different data sets and synthesize data to reach a conclusion" and "really good, makes you think about what techniques work best. Much easier when you play again. I used different techniques on the second go". One PGR student commented they found it novel that they could be wrong, perhaps indicating that current students are used to success or to the complexity of reality that is modelled in the game?

## 5. DISCUSSION

This study shows giving current HE students the opportunity to use **complementary learning environments** to traditional lectures and associated laboratory practicals is to be recommended. This is in line with other researchers' findings (e.g. Squire, 2008, Falloon, 2010). More experienced learners (i.e. PGRs) may use educational e-gaming to **hone their search skills** rather than significantly improving them. Most current HE UGs (at Keele at least) were Generation Y: ½ of participants were daily

or weekly game users and therefore e-gaming has great **untapped potential** as an educational environment. Over ½ of UGs had used educational games before. An un-intended learning outcome was that it was important to **pilot e-games** at an early stage. The e-game was almost **uniformly appreciated** as a useful, reliable and informative learning environment. It was reliable because, unlike some others, e-games give a consistently reliable experience and there is no variation in weather conditions, teaching staff, learner(s) interactions, etc. It would also be a credible alternative to outdoor fieldwork/practicals for less physically able students, as others have discussed (see, for example, Mountney, 2009). There were contrasting suggestions and little agreement of having e-games **formally assessed**. Clearly educational e-gaming is a **hybrid learning process**, from e-game-participant-participant knowledge transfer, participant decision making, peer group interaction and participant/observer interventions all contributing to learning experience.

## 6. CONCLUSIONS

E-games provide consistent, 24/7 reliable learning environments that assists with current large learning UG knowledge. It also provided PGR students to hone search skills. For others to replicate, they would need significant computer programming and design expertise, appropriate scientific input and time spent developing and refining e-game. There is scope to expand activities for effective, self-paced student learning.

## 7. Acknowledgements

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