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ABSTRACT

Taking effective notes is an important skill in academic and professional settings and one that is cultivated primarily in Higher Education (HE). However, students often find it difficult to effectively record important information in their notes [37], while it has been suggested that they often record less than 50% of the key information of a lecture [15].

Games can be a powerful way to help students learn [30]. Yet, to

facilitate and support this process in various contexts are explored in literature, with studies looking at natural note-taking [14], note-taking in the digital age, exploring areas such as mobile technology implications [55], the use of wireless technologies for collaborative note-taking [58], and the use of the iPad for innovative note-taking [4]. However, there is only but scarce empirical evidence in literature on the use of game-based learning to assist the development of note-taking skills. The study presented in this article explores practically the use of educational games for note-taking focussing on the game design approach.

2 Game-based Learning for Skills Development

Game-

objectives, thus allowing skills to be developed incidentally as learners find

responsibility for every area of production throughout the entire development cycle.

The participation process mimics that of the industry. Each year students apply with a cover letter explaining whether they would like to undertake the role of producer, designer, programmer or artist. The producer is responsible for managing the team and making sure everything is on track and liaising with any external parties. In this instance, the producer was the main liaison between the student team, the researchers and key stakeholders such as members of the University's Academic Skills Service (ASK) team and members of the Disability and Dyslexia Service (DDS) team. *Investigate: Tudors* was developed in three months in a studio-based environment. The team of researchers supervising the development, visited the students daily to ensure the smooth development of the game, and to provide guidance and technical support. Students were also involved in design workshops aimed at developing the learning and design objectives of the game and experienced seeing first-hand the planning and development of a game-

recipes as to how to mix different ingredients to create different types of potions (Fig.8).

Figure 6: Crime scene investigation.

The "Strand Strangler" level is about bringing down a terrifying serial killer in a time without fingerprints and DNA evidence. The aim is to investigate five murders conducted in a short period of time and interrogate witnesses in order to collect useful notes to help identify the killer. Gameplay features crime scene inspections to gather further evidence from the victims (Fig.6). In this level skills like surmising of information, information gathering and conflicting information as well as validity inspection can be practiced.

"Drake's Armada" is a naval officers level which utilises a strategy approach to gameplay. The player is tasked with developing the right strategy for battle against a foreign invasion to protect the country and the Queen. To successfully lead ships to battle, the player must learn about different battle tactics and ship formations. Information on possible generals, to best face opponents and lead to victory with minimal casualties, should also be gathered. Once all relevant information has been gathered in the form of player notes, players are asked to complete a battle report as seen in Fig.7. This level helps practice abbreviation, information gathering and attribution.

Figure 7: Battle planning report.

The "Potion Commotion" level features puzzle elements via alchemy and helps players practice heavy information gathering and surmising of information over extended time. Here the player is first tutored in the art of potion making via noting down

Figure 8: Potion making interface. Notes appear on the bottom right and recipe progress on the top left.

The most effective way to take notes to facilitate heavy information gathering in this level, is to avoid noting everything down, since overly wordy notes are unnecessary for potion recipes and will make it difficult for the player to go back and review specific content when needed. This mechanic draws on Friedman [28] who discusses how organised, coded and shorter notes reduce the burden on the note-taker's working memory and put the focus on comprehension.

Figure 9: Matchmaking interface.

Puzzle elements and decision making are utilised in the later part of this level, where the player is tasked by the Queen to find suitable matches between lords and ladies of the court, to strengthen bonds between countorhe most eTQq0.00000912 0 612 792 reW*nb

matchmaking report (Fig.9), based on information gathered regarding individual wants and personalities.

Cues are provided throughout the game to emphasise the importance of the information provided [37]. As dialogue progresses during a scenario, such cues can be presented via repetition, use of pauses, or punctuation marks and there is also the use of a quill icon that only appears on the screen when the player should be taking notes, as a visual indication of important information being communicated (Fig. 10). The game features an awards system where players are rewarded based on their performance. This system provides a further incentive to do well and progress. King, Delfabbro & Griffiths [38] found rewards and rare game items amongst the most enjoyable aspects of gameplay. Rewards are stored in an inventory in the form of trophies and can include prizes like a horse or a ship (Fig.11). As players progress, better rewards are unlocked.

Figure 10: Quill icon indication during tutorial (top right).

Figure 11: Awards inventory featuring rewards.

Mimicking distractions in real life lecture settings was another aim of the game design. To mimic distractions, animations were incorporated into some game screens in an attempt to distract the player when taking notes. An example can be seen in Fig.12, where a dog walks by the alley in the background while the suspect is talking. These allow players to

practise not getting distracted, a skill which can then be carried forward into real lecture settings.

Figure 12: Distractions to mimic real life lecture settings.

Informed by microlearning design [16], *Investigate: Tudors* includes hints and tips on the loading screens, a time during which players are briefly idle. Microlearning is based on the idea of developing small chunks of learning content and presenting them in a series of microlearning units [34]. The hints and tips provided were informed by consultations with ASK advisors, as well as literature on effective note-taking practices. The hint shown on Fig.13

information you have already written down or know, focus on

which in the context of note-taking should be balanced between comprehension of information and production of notes, via identification of important and non-repeating (rt)4()-3621c01 0-4(o(((g)13()-10

used in the survey (Appendix A.1) were informed by Whitton's questionnaire to measure post- experiential engagement with educational games [61] and crafted with respect to the identified learning heuristics. For example, questions 1,3,5,10 and 11 of the survey (A.1) addressed L1, question 4 and 9 addressed L2, and questions 2,6,7 and 8 addressed L3. The focus groups questions (Appendix A.2) were more open-

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A.2. Playtest Questions