

Teaching Children Hygiene Using Problem Based Learning: The Story Telling Approach to Games Based Learning

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Abstract. This paper discusses the design and implementation of a browser based game (“e-Bug Detectives”) that teaches 13-15 year olds about hygiene, microbes and appropriate antibiotic use. Despite the recent interest in technology enhanced learning, there has been little investigation of how to develop design a game that teaches specific Learning Outcomes (LOs) using an established pedagogy. We demonstrate that Problem Based Learning (PBL) is an appropriate framework for games that aim to teach a number of disparate LOs. The introduction explains why it was necessary to create a bespoke game to satisfy the project’s requirements. Section 2 presents the reasons behind choosing the adventure game genre and the PBL framework. Section 3 discusses the technical implementation of the game. The five stages of PBL are explained and mapped to the game in section 4. Finally, early evaluation results are presented and future work is discussed.

Keywords. games based learning, problem based learning, narrative, pedagogy, health, games design, educational games, technology enhanced learning, serious games, hygiene

1. Introduction

Recent studies have shown that there are many ways in which games can aid learning. Trials in Scotland used commercial games such as *Neverwinter Nights* [1], *Guitar Hero*, *Nintendogs* and *Endless Ocean* [2] as starting points for teachers to theme lessons over a term. These games did not teach directly. Lessons were created around them. Squire [3], Svarovsky and Shaffer [4] have shown that players can gain real world understanding from playing commercial games. However where the teachers used lessons outside of games to teach Learning Outcomes (LOs), Squire, Svarovsky and Shaffer document the kinds of learning taking place naturally within the games themselves. None of these studies used games to directly teach LOs as required by school curricula.

e-Bug is a European Commission funded project that aims to reduce inappropriate antibiotic use and improve hand and respiratory hygiene through the education of young people in 17 European Countries. e-Bug targets two age groups, 9-12 years olds and 13-15 year olds. For each of these age groups, there is an educational pack for classroom use and an online game which can be played during class time or in pupils’ own discretionary time. LOs agreed by teachers and domain experts from each partner country were used to define requirements for both packs and games.

The games are intended to teach the LOs without requiring that a teacher build a lesson around them. As such, bespoke games have been created that blend traditional games design with appropriate learning models. These games are being translated and localised and will be available to play, for free in 10 languages from the e-Bug website [5] from September 2009.

In order to ensure that the game be both fun and educational, it is necessary to choose a pedagogical model that can be supported and implemented by the game’s mechanics. There is little research that can be used to inform this process. Because e-Bug needs to support youths playing in their own time as well as in the classroom, it was necessary that the pedagogy support a learner driven process and not rely on activities such as classroom discussion.

2 Choosing Appropriate Game Mechanics and Pedagogy

A focus group with the 15 boys and girls identified game types that would appeal to 13-15 year olds. Most of the popular game types were unsuitable for teaching e-Bug (e.g. shooters and sports games). A few individuals enjoyed playing narrative driven adventure games such as Sam and Max [6], Phoenix Wright [7], or Hotel Dusk [8]. In a follow-up session, all pupils played games of this nature (Phoenix Wright or Beneath a Steel Sky [9]) and provided generally positive feedback ranging from “I love this kind of game” to “I wouldn’t mind playing it”.

Because adventure games feature interactive stories driven by puzzles and exploration [10], they offer the flexibility e-Bug requires to cover a wide range of disparate learning outcomes. This reason, coupled with a lack of other genres that satisfied the audience as well as being appropriate for education, led to the decision to create an adventure game.

In order to avoid what Habgood calls “Chocolate Covered Broccoli” [11] where the game offers no educational benefit beyond extrinsic motivation, it is necessary to integrate learning through game mechanics. However, there is no established pedagogy that has been proven to work in this context.

Problem Based Learning (PBL) is “any learning environment in which the problem drives the learning. That is, before students learn some knowledge they are given a problem.” [12].

By posing a problem before any learning takes place, students are able to contextualise new knowledge instead of simply learning stand-alone facts. PBL encourages independent learning with minimal intervention from a teacher. Used extensively in medical training, PBL can be adapted to teach a wide range of LOs, making it suitable for e-Bug.

There have been a number of studies on the effectiveness of PBL and whilst there isn't conclusive evidence that PBL is preferable to other successful methods of teaching, it has been shown to be effective [13]. Some research has suggested that PBL is a natural approach to games based learning [14] but there has been little empirical evaluation to date. Picard found that using PBL in a business game had a positive effect on university students in terms of satisfaction and attainment [15]. A recent study using a PBL based game in high school found that pupils were successfully engaged but the difference in knowledge gain between intervention and control groups was not significant [16].

Whilst the evidence supporting PBL’s use in games based learning is not conclusive, the concepts behind PBL map very well onto the core game mechanics of adventure games. Given the lack of a clearly established pedagogy to support this type of game and considering the wide remit of e-Bug and the flexibility that is required to cover all LOs, it was decided to use PBL to underpin the game’s teaching.

3 Technical Implementation

Each European partner completed a survey identifying the technology infrastructure in their country’s education system. The widely varied responses meant that the game would have to be playable on a basic system. Additionally, teachers do not typically have the rights to install software on machines so we were unable to require installation of a game via download or CDROM. Flash Player version 8 was chosen for implementation due to its wide penetration (95% of internet enabled machines [17]) and the ease of which it can be used to play games in a web browser.

There are game authoring tools available to create Flash based adventure games (most notably Lassie Adventure Studio [18]), but none of these were suitable for e-Bug. A bespoke game engine was created that implemented common adventure game mechanics and e-Bug specific requirements such as “Microbe Vision” (used to find microbial ‘hot spots’) and support for multiple languages. Game scenarios are written using comma separated value files that the designer creates using a spreadsheet. This allows for scenario revisions without the need to write or change code.

4 Applying the Five Stages of Problem Based Learning to Adventure Games

The stages of PBL vary between implementations. For e-Bug, the Queens University definition was used [19]. Under this definition, Stage 1 is the Topic Introduction and sees the facilitator introduce the topic, highlighting why the topic is relevant. In Stage 2, students write the Problem Statement in their own words and care is taken to ensure that they correctly understand the problem. In Stage 3, the students hypothesise potential solutions to the problem and identify one to pursue. The students carry

out research in Stage 4, seeking information that confirms or refutes their hypothesis. In Stage 5, students consider whether their hypothesis is confirmed through evidence. If it is, they present their findings, with an emphasis on methodology, rather than the final answer. If the hypothesis proved incorrect, students return to Stage 3 and identify a new hypothesis to investigate.

Each chapter of the game covers related LOs and presents the player with an overall problem. The player does not have the information required to solve the problem and must solve multiple sub-problems first. Similarly, each sub-problem covers other LOs and may be further sub-divided.

Below, we will look at how the game delivers two LOs using PBL. In the scenario, the player is tasked with investigating why an actor has fallen ill. The LOs covered in the scenario below include: “different types of microbes are found in different places”; “microbes can be found on our food and can transfer to humans”; “separate chopping boards should be used for meat and vegetables”.

Stage 1: Topic Introduction

NPCs use dialogue to describe the initial problem. Here, an actor has fallen ill and his bodyguard suspects foul play. The overall problem is to identify the cause of his illness.

Stage 2: Problem Statement

The bodyguard offers theories that may explain the illness. One such hypothesis is that the chef deliberately poisoned the actor. Another theory suggests that poor food hygiene is responsible.



Fig. 1. The player meets the bodyguard (left) and explores the kitchen using microbe vision (right)

Stage 3: Hypothesise

In order to solve the problem, the player has to investigate one of the hypotheses. If the player switches on “Microbe Vision” (MV), she can identify potential evidence that may suggest which of these is most suitable. Relevant to the food hygiene hypothesis are evidence of microbial concentrations on the actor’s leftover food as well as the chopping board in the kitchen.

Stage 4: Research

Having decided to pursue the food hygiene hypothesis, the player may speak to NPCs, visit locations, collect and test evidence. If the player tests the chopping board and food leftovers, an NPC passes information to the player, teaching the desired LOs. For example, when the player tests the chopping board, salmonella is present. The player is told that this is normal for chopping board used for meat. If the player tests the leftovers, she is informed that the chicken is clear of microbes (it was properly cooked) but that the salad is infested with E. coli. Together, these items refute the food hygiene theory.

Stage 5: Presenting Results

During dialogue with NPCs, the player has the option to present an item of evidence in response to a statement. By showing evidence that the microbes on the plate are of a different type than those on the chopping board, the player disproves the bodyguard’s hypothesis and completes the problem.

5 User Evaluation and Feedback

The game is complete and an evaluation has taken place with 346 pupils. Evidence for knowledge and attitude change has been collected through an online pre and post game questionnaire. Qualitative feedback has also been collected through focus groups and an open ended questionnaire.

Throughout development, the game was evaluated and revised to reflect feedback. Analysis of data is ongoing but early results highlight some interesting issues.

PBL has at its core an assumption of learner independence. It is expected that the learner will be proactive in seeking out information and research. Contrary to this, evaluations showed that youths are conditioned to expect significant help from games. Many players frequently asked “what do I do now?” and the game interface had to be revised multiple times to provide help to the player.

The game does not feature spoken audio. Players must read a significant amount of text. Those who have poor reading ability or who have no interest in reading may not enjoy or learn from the game. This is consistent with a recent industry article in which the Gameplay Director for World of Warcraft explained that players are not interested in reading quest text [20]. Many players who did engage with the game have reported that they enjoyed the story and puzzles but analysis has yet to be completed to determine the effectiveness of the game as a teaching tool.

Conclusion

This paper presents an implementation of a narrative driven adventure game called e-Bug Detectives that attempts to combine a modern approach to player centric videogame design with the established pedagogy of Problem Based Learning to teach children about microbes, hygiene and appropriate antibiotic use. Unlike previous studies which have discussed PBL in games without implementation, or which have not shown how they applied the stages of PBL to their design, this study shows in detail how PBL can be used to teach a wide range of Learning Outcomes using an adventure game. The game is still being evaluated but feedback has shown that whilst players are receptive to this kind of game, care is needed in developing a game interface that helps guide the struggling player whilst still allowing agency. More analysis will be carried out to determine the effectiveness of learning through the game. Further research could also look at the implications of the trade off between player independence and in-game help.

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