Game-Informed Learning:
Applying Computer Game Processes to Higher Education

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Computer games have made a significant cultural, social, economic, political, and technological impact on society (Newman 2004). Given the widespread popularity of video games, their ability to sustain long-term player engagement with challenging tasks (Gee 2003), and their tendency to elicit proactive player comm unities (Rheingold 1994), it should come as no great surprise that educators have become increasingly interested in the potential of such games as learning tools.

The term *game-based learning* has emerged as a general name for the use of games in education. Despite early work showing rich inferential learning taking place as a result of gameplay (Greenfield 1984), most game-based learning has been geared towards using a game as a host into which curricular content can be embedded. This approach can be problematic, however, because it too often builds upon the premise that learning is not fun and that games are, and that by introducing a game element, one can make learning fun. As we will argue, the processes involved in learning and play are often very similar, and the true potential of gaming in higher education may be realized in other ways. By allowing the learning process to become informed rather than supplemented by processes identified with successful gameplay, instructors can maintain consistency and coherence without relying on extrinsic motivational interventions. The importance of consistency and coherence shall be touched upon throughout this work, but for specific discussion on intrinsic and extrinsic motivation, see Malone (1982).

In contrast to game-based learning, *game-informed learning* suggests that educational processes themselves should be informed by the experience of gameplay—a tenet similar to the principles of contemporary active learning approaches such as constructivism and problem-based learning (PBL). Recent discussion of such approaches has been offered by Boud and Miller (1996), but these methods clearly have their roots in Kolb (1984), Lewin (1948), and Dewey (1933). Indeed, the principles of successful gameplay build on these established learning practices, suggesting that game-informed learning may offer a particularly valuable—and already influential—alternative to game-based learning in higher education.

Game Process – Learning Process

Consider the following description of gameplay:

- When entering a gaming environment, a player adopts a character role or assumes an identity appropriate to the environment.
- Once within the gaming environment, the player perceives tasks to be completed and, consequently, progress to be made.
- In order to progress through the game's more complex levels, the player picks up the necessary game vocabulary.
- The player explores intriguing hidden corners and alluring vistas.
- The player adapts to the gaming environment by interacting with it.
- The player realigns expectations and judgments through each exploration and interaction, reappraising the cause and consequence of each experience accordingly.

Now, reread this sequence while replacing "player" with "student." The result is a model paradigm of the active, *constructive* learner. Conceptualized by Piaget (1970) but also applied within the work of other influential figures such as Vygotsky (1978), Biggs (1999), and Wenger (1998), constructivist theory suggests that learning is intrinsically linked to learners' sense of identity. Through personal experience and critical reflection on their beliefs about the world in which they live and the domains in which they hold affective agency, learners come to *know* themselves and what they are *becoming*.

The descriptive sequence of gameplay above might also be read as a model paradigm of problem-based learning (PBL). In medical schools, PBL has long served as a method through which educators invite students to perform as medical investigators. In this role, students work, often in teams, to unravel learning objectives from carefully structured narrative scenarios that simulate plausible clinical cases involving case history, clinical investigation, diagnosis, and treatment. Through these scenarios, educators compel students to intervene in a simulated environment where each intervention creates consequences that prompt further action.

Consider the following two scenarios derived from course content in the undergraduate medical curriculum at the University of Edinburgh's College of Medicine and Veterinary Medicine. In the tradition of constructivist pedagogy and problem-based learning, these scenarios require students to respond to particular events, but instructors present these activities to students in a style not normally associated with curricular descriptors.

Scenario One: Outbreak

A mysterious virus is sweeping through a city; infrastructure is collapsing. Death, chaos, spiraling costs, and political intrigue are all rife . . . and you're in charge.

This scenario outlines topics encountered directly in public health medicine and addresses multiple learning outcomes by requiring students to consider public health contexts, increase their awareness of tensions in a multi-agency healthcare domain, understand the primacy of effective decision making for short- and long-term solutions, and operate within budgets. Additionally, this scenario instructs students in practicing effective detection, containment, confinement, and eradication of threats to public safety.

Scenario Two: Do No Harm

You are the sole doctor in charge of an Accident and Emergency Unit (A&E) in a busy metropolitan hospital. A patient presents himself at A&E, short of breath and in pain. What do you do? Remember that every test you order carries a cost and that every move you make takes time, costs money, and, at worst, may kill the patient.

Like the first scenario, this narrative scenario directly addresses learning outcomes in undergraduate modules, requiring students to consider relevant concerns in health management and patient admissions. Yet both of these scenarios read like game descriptions and thus serve to illustrate and address Gee's challenge in *What Videogames Have to Teach Us About Learning and Literacy* (2003): how might educators make formal learning opportunities more fundamentally game-like?

Developed from constructivist and PBL approaches, these scenarios value an engaged, reflective learner who is clearly situated in an immersive, social environment where actions lead to consequences that lead to other actions. However, these narrative scenarios also reflect key elements in successful gameplay; in doing so, they reflect a number of insights that have arisen from scholarly studies of gaming environments. Gaming studies by Turkle (1997), Bruckman (1992) and Gee (2003), for example, highlight the importance of contextual identity and a player's emotional relationship with game applications. Murray's *Hamlet on the Holodeck* (1997) similarly explores the process by which participants in mediated worlds become active, critical, and totally engaged agents within simulated environments, but it also postulates that simulated activities themselves signal the emergence of a new narrative form that is emergent in nature and defined by character interaction rather than plot. Ryan's *Narrative as Virtual Reality* (2001) further applies narrative theory by considering immersion an active condition controlled at least partially by the reader/player. Applied to learning contexts, this theory suggests that despite being immersed, learners may remain in control of a simulated scenario.

Meanwhile, the gaming community itself has long been aware of the high degree of commitment shown by players to games (Gee, 2003). Social structures have emerged from groups of like minded game players; such groups may take the form of competing "clans" or, equally, may evolve as groups of committed coders who develop characters, artifacts, or whole new levels to the original game. For example, issues of identity, roleplay, and social interaction formed the hub of text-based multiple user dungeons (MUDs) (Curtis 1992; Dibbell 1999). More recently, the phenomenon of Massively Multiplayer Online Role Playing Games (MMORPGs) has allowed tens of thousands of individuals to build identities in virtual environments, develop world building skills, forge allegiances and social bonds, become politically active, and invest enough time and money into such activities to cause virtual worlds such as Norrath—the setting of Champions of Norrath from Sony's Everquest—to generate significant real world economic consequences (Castronova 2003).

Contemporary game developers, it seems, are well aware that users need to be suitably contextualized, need to feel consequential, and need to feel the experience of the game or game world to be consistent, coherent, and intrinsic to their expectations. In return, the players spend a significant amount of time and money interacting with and within the world, instructing new arrivals to the game world, working to extend the boundaries–both in terms of size and technical scope–of the game, affecting the political, cultural and social fabric of the game world and, ultimately, informing the creators of the domain as to how to evolve the game itself. Such levels of enriched engagement with subject domains remain but a distant dream to much of the higher education community.

However, because the theories supporting the learning scenarios outlined above are not necessarily game-dependent, such existing teaching and learning practices within higher education contexts can feature some of the principles of good gameplay without employing actual games or game worlds.

Game-Informed Learning in Practice

Although the scenarios above employ some principles of successful gameplay, other current practices in medical undergraduate training in Edinburgh utilize a more thorough game-informed learning approach. Two of these learning applications involve final year medical students. In these applications, students participate in two separate simulated scenarios in which a patient's condition deteriorates, requiring students to apply their classroom training in resuscitation techniques with a mannequin. The third scenario involves a long-term simulation that asks students to address a virtual patient's increasingly complex symptoms throughout their undergraduate training.

In 2003, members of our team recorded and analyzed a selection of the simulated sessions for final year medical students and determined that the success or failure of the simulated activities depended on each scenario's use of good gaming principles (Begg and Ellaway 2003). For example, in one unsuccessful scenario the instructors did not assign clear roles or identities to the participating students and did not specify a starting point for the collaborative simulation. Some way into the simulation, an instructor also realized that the mannequin representing the patient had been prepared for the wrong scenario. This error resulted in the comical removal of a plastic fetus from under the bed clothes of the patient—a female in her late sixties. Moreover, lacking an immersive contextual framework, this scenario failed to engage the student performing the central role within the activity. She lifted the back frame of the bed, allowing the pillow to fall on the patient's face, swung the bed frame and bashed the patient's skull, and, having removed the frame, set about moving the patient down in the bed by pushing against the top of the head (Figure 1). None of these actions, it should be stressed, equate with sound medical practice.

This unsuccessful scenario was not experienced as real by those who were involved. A later scenario, however, revealed something quite extraordinary. For this scenario, the instructor assigned a specific role to every student in the group: one student acted as doctor in charge, another acted as anesthetist, another worked with the resuscitation trolley, and so on. The instructor presented the case authentically in the manner of a clinical presentation, and all participants began at the same time.

The student performing the central role on this occasion interacted directly with the patient, whose voice was played by the instructor. Tension built as the patient's condition began to worsen. The noises of the monitors grew more insistent as time began to run out and treatment options decreased. Through these elements, this scenario became more intensely immersive, just as a stronger immersive trance emerges in similar game situations (Ryan 2001).

The patient in this scenario was eventually stabilized, and the instructor offered feedback on the students' performance. Yet students had become so immersed in this scenario that they continued to monitor the carotid pulse of the patient—that is, the mannequin—throughout the debriefing (Figure 2). Unlike the first scenario, this scenario was (arguably) experienced as real.

In another context, such simulation activities might be called role playing games. Whether such simulations would maintain their level of seriousness and appropriateness within a medical curriculum if referred to as "role playing" rather than "clinical simulation training" is cause for debate in itself and is worthy of further investigation. Yet as an example of game-informed learning, this successful simulation clearly benefited from its integration of the immersive and engaging aspects of good gameplay. In this scenario, the students could be said to have "played their parts." The scenario was consistent and coherent, the students' roles were clearly defined, and they perceived their decisions as highly consequential to the outcome of the activity. Also, feedback was immediate and intrinsically true to the scenario being played out.

Another game-informed learning practice in the Edinburgh medical curriculum involves a Web-based Computer-Assisted Learning (CAL) application. Since students can access this application at their convenience, this scenario is self-directed rather than instructor-led. In this scenario, George Prentice, a virtual patient, has visited the local health clinic complaining of chest pains. Acting as George's doctor, each undergraduate medical student proceeding through the five-year degree program develops a long-term relationship with George as his condition grows increasingly complex.

Currently, George exists as a character within a series of CAL sequences (Figure 3). At the beginning of the scenario, George's condition matches the curricular content of the first year in the medical curriculum (in particular, respiratory medicine) and also integrates students' studies in basic biomedical science and medical sociology. Each student assumes the role of George's family doctor. Through textual, video, and animated sequences, students study model examination procedures, request tests, analyze results, and interact with the system by answering a variety of question types relevant to the case. As they consider George's case, students submit test requests and sample analysis forms, which are then processed in real time; likewise, students encounter George's "appointments" in real time.

In our team's analysis of this learning application (Warren et al. 2002, 2003), we discovered that higher achieving students made the most of the George program. This result might be explained by the fact that the application was voluntary, and since students initially considered the program a supplementary revision source, only those students who felt adequately prepared participated fully in the program. However, surveys of 40% of students chosen at random during the introductory session of the program indicated that 99% of students found the program easy to use and that 92% felt that it fit well with formal teaching. Moreover, through comparative analysis with marks from other examinations, we discovered that students' use of the program facilitated more successful learning across the whole cohort.

Conclusion

We have suggested that principles of successful digital gameplay can contribute towards learning applications without embedding curricular content in actual games. As the examples above illustrate, the success of some current learning applications in the medical curriculum at the University of Edinburgh may be defined by the extent to which these practices have been (however unconsciously) game-influenced. In particular, such learning activities are most effective when:

- The backstory gives an emotional "in" for context and character role.
- Intrinsic feedback enhances students' enjoyment and feeling of agency, increasing opportunities for learning by encouraging students' willingness to learn difficult material (Malone 1982).
- The ability to act in an emotionally engaging simulated situation without the serious consequences that such action might have in the real world (the "psychosocial moratorium" of Erickson) allows for repetition and improved performance as well as more committed performance from students (Gee 2003).
- Students assume identities within the application and perform accordingly.
- Students develop an emotional attachment to the character within the application that contributes to the learning experience by helping students to perceive the application as a real, situated experience (Ryan 2001).

Rather than perceiving games solely as a platform in which learning content can be delivered, educators might offer more effective learning opportunities by integrating the learning principles within games into teaching practice. Indeed, greater emphasis on student context and exposure to consequential activity within subject areas—principles intrinsic not only to successful gaming but also to established constructivist learning models—can provide especially effective, immersive learning experiences.

Although much of this paper has concerned itself with medical education where there is an established use of simulation activity, it would be a mistake to think that the lessons of game-informed learning are limited to such restricted areas of teaching and learning. In any situation in which one learns in order to *become*, the same lessons may likely apply—the need for context, for agency, for critical participation, and for intrinsic feedback remains valid across multiple subject domains. It is also true, as we have attempted to illustrate, that the adoption of simulation in itself is no guarantee of game-informed success. It is the appreciation of the processes at play rather than a simple acknowledgment of gaming that would appear to be the key to ultimate progress.

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