

THE PROGRAMMING GAME: AN EXPLORATORY COLLABORATION BETWEEN BUSINESS SIMULATION AND INSTRUCTIONAL DESIGN

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ABSTRACT

This paper describes a live-case project designed to teach instructional design students how to develop business simulation games. The paper addresses three themes in the ABSEL literature: principles of game design, an application of general principles to a specific problem (teaching game design), and an introspective comment on the kinds of collaboration ABSEL scholars might seek (between business management educators and instructional technologists) in an effort to increase the professional quality of their work.

INTRODUCTION

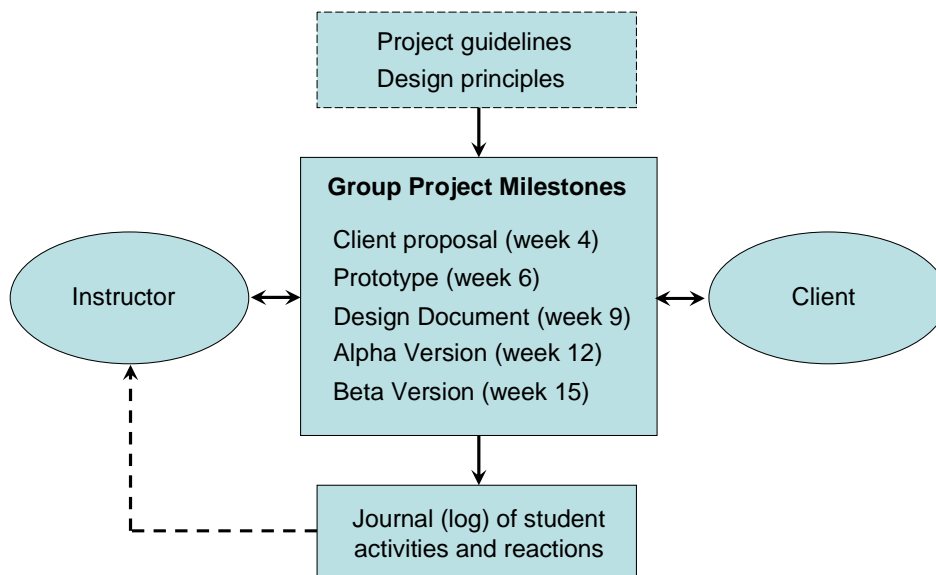
ABSEL studies tend to consist of three kinds of papers: papers addressing principles of design, papers describing actual designs that are of particular interest, and introspective studies regarding the nature of business

simulation and experiential learning as a discipline. This paper discusses a project that bridges all three categories: It describes the design of a project in which a game designer worked with a team of graduate students in instructional design to actually program a game. It discusses the principles of design by which the class (a game in itself) was constructed. The design of the class illustrates an educational environment that, while similar to other “live-case project” courses, addresses the unique topic of “game design.” Finally, it illustrates the first step in a larger project through which we hope to incorporate more knowledge regarding the implementation of business simulations and experiential learning, a topic that has received relatively little attention in the ABSEL literature.

A DESCRIPTION OF THE BASIC DESIGN

In order to make our discussion more concrete, let us

Figure 1: A Visual Representation of the Game-Development Exercise



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begin by describing the basic concept of the game development exercise. This is portrayed visually in Figure 1. The exercise is similar in concept to a “live project course” (see Burns 1990 for a review). Student teams were assigned to a live client (a game designer) and moved the game through a development process, from conception to the final alpha version of the finished game. At each step of the process, the instructor worked with the teams to review their work prior to submitting work to the client, thus providing feedback at each point and shielding the client from major errors.

As suggested by the upper-most box in Figure 1, the process was constrained by a rigorous set of project guidelines that assured uniformity and an orderly, professional method of dealing with clients. These are structured around the group project milestones outlined in the figure (along with the week in which they are due). The milestones, in turn, were explained operationally in a detailed syllabus and are explained in abbreviated form below.

The substance behind the project guidelines is the design principles that formed the principal subject material for the class. These were provided through the textbook, readings, and course lectures. They addressed the underlying theory of how people learn from games, and how this translates into game design, as suggested by the course objectives:

- ✓ Learners will be able to demonstrate understanding of principles, such as rules, goals and objectives, outcomes and feedback, conflict or competition and challenge or opposition, interaction, and representation or story, that should be present in a training game by applying and incorporating them both into an individual game project and into a group project that will involve an external client.
- ✓ Learners will be able to translate principles of game development, such as the creation of meaningful play (player actions have a meaningful effect on the game system) and conception of the magic circle (game environment), into a proposal for game development for topics requested by external clients and for topics chosen for individual game development.
- ✓ Learners will be able to balance the space of possibility (universe of all possible player actions and game reactions and the meanings they generate) so that they create meaningful play for the players, and do so by utilizing the resources they have available.
- ✓ Learners will be able to apply such pre-requisite knowledge as interface design, instructional system design (ISD), and authoring systems to the construction of appealing, attractive, and meaningful game environment and metaphor.
- ✓ Learners will be able to apply pre-requisite knowledge of ISD to the evaluation process so that

they are able to transform the beta version into the final product.

Finally, the students were also required to keep a journal, or log, of their work, as suggested by the bottom box of the Figure. The journals were to include details of hours worked for each phase of the assignment, difficulties encountered, clever solutions, and aspects of the project they most enjoyed. Journals provide a popular tool, both for facilitating the learning process by stimulating student reflection and for evaluating student learning. While Krishnamoorthy, Markulis, and Strang (1988) argue that there is little empirical evidence to support their efficacy, anecdotal studies from the education literature (Krishnamoorthy, Markulis, and Strang 1988) and the literature on simulation and gaming (e.g., Taylor 1998; McDevitt 2000) tend to support its usefulness. Experience from the course described in this paper support this position. Requiring students to journal each aspect of the process focused their attention on what they were trying to accomplish, how it was accomplished, the issues they had to face in the process, how much time it took, what they learned from this and how much they enjoyed it. Consistent with the observations of McDevitt (2002), this information was also very useful in providing feedback to the instructor.

Client proposal

In the section on the *client proposal*, the syllabus provided guidelines regarding how each group should conduct an initial needs assessment and how students were to comport themselves professionally in client meetings. It also provided a detailed outline and content requirements for the proposal itself. These included

- ✓ *Cover page*
- ✓ *Project definition*
- ✓ *Deliverables* (including main characteristics, quality measurement, date of delivery and sign-off for each deliverable)
- ✓ *Timeline* (including a Gantt chart mapping all project deliverables)
- ✓ *Team description* (short description of each team member and their role)
- ✓ *Risks* (potential problems, their impact on the project, and contingency plans to deal with them)
- ✓ *Sign-off page* (including each team member, the instructor, and the client).

The proposal was established as a very formal document, much as it would in an actual commercial project. The instructor reviewed and had to sign off on the document before it went to the client, thus providing additional quality control. This also protected the client from frivolous or confusing work, at the same time protected the integrity of the program.

Prototype

The prototype provides a basic model of the game, designed to demonstrate to the client the game’s concept, metaphor (if used), features and capabilities, and a special

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emphasis is given to the user interface. The prototype presents the client with the first exposure to the actual look and feel of the programmed game, albeit in preliminary form. An important aspect of a prototype is that it creates the first concrete impression of what the product would have on the client. Students are primed to the fact that a favorable first impression would put the client at ease and increase the probability of success of the project.

Design Document

The third milestone is the design document, providing a detailed description of the game, its objectives, market, technical specifications, and creative layout. Students are given a specific outline to follow:

1. *Overview*. This consists of a paragraph including a definition of the product, the parts that will be completed, how it will work, and how it will look.
2. *Purpose*. What are the product goals and objectives?
3. *Audience*. Who is the target market? How large? How diverse? How much do they know about the topic? How do they feel about it? In what context will the game be used?
4. *Technical specifications*. User needs, setup.
5. *Content inventory*. Content overview, content table.
6. *Interaction*. A navigational map.
7. *Evaluation plan*. What are the needs or criteria against which it will be evaluated? What population will be used to for the evaluation? How will be the evaluation be conducted (alpha and beta tests)?
8. *Appendix: Storyboard*. The creative layout of the game is summarized in a storyboard, as an appendix to the design document. It includes:
 - a. *Screen identification*. Screen/frame number and name.
 - b. *Screen elements*. Media files (sounds, narrative text, music, animation, video, graphic description and/or sketches).
 - c. *Screen action*. Sequence of the media appearance on the screen, description of action within the screen, special effects.

Alpha Version

The alpha version represents the first fully programmed version of the game, albeit without final refinements and debugging. It provides a preliminary product for the client to review and a test bed for formative evaluation, evaluation done during the development of the product.

Beta Version

The beta version represents an initial version of the final product, including a full set of features, data, and functionality. It provides a product that can be released to the client for testing by outside users in order to identify problems or flaws. Feedback from the beta test will provide

the basis for final debugging and release of the finished product.

THE UNDERLYING PRINCIPLES OF DESIGN

One of the relevant aspects of this project was its “recursive” nature. While we have a large number of studies addressing principles of game design, we see little describing the principles behind developing game designers. The difference is subtle, but powerful. It resides in the difference in knowledge and skills the two processes seek to develop. The objective of design is to create a learning environment that will foster knowledge and skills needed by managers in various parts of the business environment. The objective of developing game designers is to foster the knowledge and skills needed to create that learning environment.

The key question, of course, does not involve objectives, but process. Does the design of the course tell us something new about designs in general? Or does it simply apply well known principles to a new kind of situation, such as the principles associated with a live project course?

The answer is that, at the very least, the course raises an interesting philosophical question regarding the principle of recursion. A recursive process is one that operates on itself. Whatever it is about experiential learning that makes it useful for teaching people to manage effectively should also be useful for teaching people to teach people to manage effectively. The commonality of the process both simplifies and complicates our task. It simplifies by using one principle over and over again, rather than requiring us to develop new principles for each level of analysis; it complicates by requiring higher levels of abstraction. We can no longer think of specific educational processes, but general ones that take on different meaning, depending on what level of the recursive system we are considering. To illustrate, we might speak of our project as “gaming ‘gaming’.” “Gaming” is what we are doing in developing the exercise; “‘gaming’” is the topic of the class, which is to teach students how to do “gaming.”

As a practical matter, the complexity of recursion only turns out to be a problem in talking about the exercise. The students see the exercise as being very concrete, a project in which they learn how to create simulation games.

So, this leaves us to ask whether the simplifying nature of recursion has any benefit. If it does – if designing a live-case project to teach gaming is no different from designing a similar project to teach anything else – then we must argue that studying this course offers relatively little to our understanding of designs in general.

This topic merits some discussion. Feinstein, Mann, and Corsun (2002) argue that researchers in the area of experiential learning should be more precise in their use of the terms “simulation,” “gaming,” and “role-play.” Precision will determine the specific characteristics that make them unique and generalizable across applications.

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From a scientific perspective, it will enable us to develop theory to explain their relative effectiveness for different kinds of educational designs, and by extension, how to develop designs that will be effective.

We argue that our exercise is a game, and as such, it is subject to the same criteria our students use to evaluate the games they produce. Feinstein, Mann, and Corsun identify games as a tool for stimulating experiential learning. They cite Hsu (1989, p. 409) to define a game as “interactions among players placed in a prescribed setting and constrained by a set of rules and procedures.” Prensky (2001) elaborates further, specifying that a game should include rules, goals and objectives, outcomes and feedback, conflict or competition and challenge or opposition, interaction, and representation or story.

Games necessarily include rules, which specify the path of player’s actions and game’s reaction. Rules are also the element that makes replay possible. Salen and Zimmerman (2004) further explore the types of rules that are present in games and classify them as implicit, which are understood by the players but not written or explained; constitutive, which are the underlying formal structure; and operational, which are what we normally think of as rules, the guidelines used to play the game.

Games also have goals and objectives. These elements differentiate games from other forms of play. They also distinguish games from non-goal-based activity, like playing with a toy. In a game context goals and objectives enable the connection of their achievement with motivation (Prensky, 2001). Goals and objectives are also necessary to create what Salen and Zimmerman (2004) define as meaningful play. According to them, meaningful play occurs when players are provided with multiple opportunities to take intentional actions (non-random) or make decisions that have a clear, instantaneous, and integrated effect on the game system.

In addition, games should have clear outcomes and feedback. Their function is to provide players with measurement of their progress towards the goals. Outcomes and feedback constitute the collection of the game’s reactions to the player’s action. Feedback informs the learner of learning progress (Bates, 2001, Prensky, 2001). In games, feedback also is the motivating factor for the player to play over and over. If the feedback becomes meaningful to the player it will keep the player in the game even in situations when it indicates a very small fraction of progress. What some players find insignificant can become a mania to others (Aldrich, 2004; Csikszentmihalyi, 1991).

To be a game, an activity has to incorporate conflict or competition and challenge or opposition. These elements create the problem to be solved. They give meaning to the game play in the sense that playing the game becomes equivalent to solving the problems presented. They provoke the type of involvement that Csikszentmihalyi (1991) identifies as flow. Flow refers to a state of immersion that players get into when the game play becomes the only thing that counts. Others support this idea that effective games

take over the player and keep them for a long period of time (Bates, 2001; Rollings & Adams, 2003). To achieve flow, the amount of conflict or competition and challenge or opposition present in a game has to be well balanced to create a problem challenging enough to intrigue the player but not so difficult that the player becomes frustrated and leaves the flow state. That is, games must create a situation where students believe that their efforts have a reasonable chance of producing results (Yakonich, Cannon, and Ternan 1997). Many games automatically adjust the difficulty level to match players’ growing mastery of the play activity, thus extending the players’ interest and desire to continue playing and expanding their skills (Prensky, 2001; Salen & Zimmerman, 2004).

Games have to provide meaningful interaction. Each player action has to provoke a game’s reaction in order to keep the player’s interest (Bates, 2001, Prensky, 2001). In digital games interaction occurs between player and the computer system that hosts the game. It can also take place between players and other players. One important characteristic of interaction in game is non-linearity. For a game to supply different ways to play, it has to contain a non-sequential story (Rouse, 2001). In terms of interaction, Salen and Zimmerman (2004) add the concept of space of possibility, all the interactions contained in and formed by the game. The more varied and intricate the space of possibility is the more complex the development of the game will be and the more opportunities players will have to experience fresh, varied play.

Games have to integrate a story or a representation of some sort. The story or representation is what describes what the game is about. It also represents the game environment. In addition, it represents a metaphor. However, to be effective the representation of the story has to be realistic. The players need a play environment that enables them to mentally leave their normal world and become immersed in the virtual world of the game (Prensky, 2001, Summerfield, 2004).

All of these are characteristic of the exercise we have described. The difference, then, must be in the actual content of what the exercise is designed to teach. Following the logic of Anderson and Krathwohl (2001), as adapted by Cannon and Feinstein (2005), the task is to take a unique body of “inert” *conceptual knowledge* and transform it into dynamic *procedural* and, ultimately, *metacognitive* knowledge that our students can use to creatively attack the complex problem of simulation design.

In the specific context of the course we are describing in this paper, upper level master students taking a training game development course normally bring into their experiential mix a solid knowledge of instructional system design (ISD). They have usually had some contact with learning theory and some practice in the ADDIE cycle: analyzing, designing, developing, implementing, and evaluating instruction (Dick, Carey, and Carey, 2005). They often have some level of experience on interacting with clients and working with them to solve their organizational

problems by applying the principles of ISD. Even though the ISD principles that guide the proposal and implementation of solutions contain some of the elements that should be present in a game universe for an instructional application to be considered a game, such as goals and objectives, outcomes and feedback, and interaction, and even though the students have practiced translating their declarative knowledge of these instructional principles into implemented applications, they still do not find applying the principles of game design to game implementation an easy task. Some examples to clarify the reasons for this difficulty follow.

Gruber, Mandl, and Renkl (1996) refer to knowledge that is present but cannot be applied because it is inert for the person trying to utilize it. They posit three possible categories of explanation, metaprocess, structure deficit, and situatedness, for this difficulty in making the transition from theory to practice. For the first, knowledge may be inert because of inadequate metacognitive control, which means the person's process of accessing knowledge is for some reason not able to succeed in the given case. For the second, knowledge remains inert because of its structure; it is not applicable by the relevant person in the form in which it occurs. Finally, knowledge may be inert to a particular person because of the context in which it is encountered; the person sees the knowledge as bound to a certain context and is unable to extricate it for use elsewhere.

One of the defining characteristics of a game is that it is a system or group of systems (Salen & Zimmerman, 2004), which suggests another theory that is particularly pertinent to the development of training games. This theory holds that solving complex problems, which arise when working with a system or series of systems, necessarily involves the ability to develop and apply two kinds of knowledge: structural and strategic.

Structural knowledge occurs explicitly and implicitly. Explicit structural knowledge refers to knowledge gained from the "scientific method," the practice of creating and testing hypotheses, and emerges in three phases. First, a person studies the system and becomes able to recognize interrelationships among its parts. Second, the person develops hypotheses about how these interrelationships affect the system. Third, the person begins to predict what occurs when a certain element of the system performs its function. Implicit structural knowledge refers to inexplicable, intuitive knowledge that the person has gained through sustained, intimate relationship with the system. Much less is known about the acquisition of strategic knowledge in regard to this theory; experiments have been attempted, but success has been minimal because the variables involved are difficult to control (Funke, 1991). Drawing again on Anderson and Krathwohl's (2001) revised educational taxonomy, it is possible to compare strategic knowledge of how to select problem solving approaches that are appropriate to a particular situation. As contrasted with structural knowledge, it is more heuristic in nature, and hence, less regular and amenable to control.

THE PROCESS OF GAME DESIGN: A CASE FOR STRATEGIC PARTNERSHIP

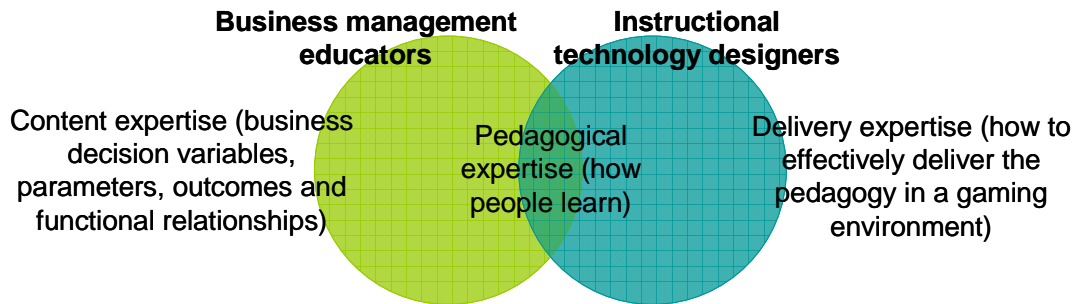
We noted earlier the surprising dearth of research regarding the process of game development. Of course, the process of game development is a fuzzy concept. Clearly, identifying and selecting principles of design is an important part of development, and there is no dearth of studies regarding these principles.

Perhaps the more relevant distinction is between "content" and "delivery." Modeling response functions would be a "content" issue, even though most of the discussion involves the process of how to develop an appropriate function. By contrast, concerns about providing proper information to users and thoroughly testing games (see Fritzsche 1975; Biggs and Halpin 1990) fall on the "delivery" side. They are concerns that every game faces, regardless of the content.

Most ABSEL papers that discuss the process of developing simulations fall somewhere between "content" and "delivery", but they tend to view the problem from the perspective of a "content" specialist, explaining how to deliver their concept effectively. For instance, Smith (1981) and Hall (2004, 2005) discuss how to develop simulation games, drawing largely on their own experience as people who have been active in developing simulation games for many years. Fritzsche and Cotter (1985) discuss the implementation of simulation games in a microcomputer environment, and Teach (2005) discusses the process of developing a "micro-simulation," a technique that provides very interesting possibilities for certain types of simulation problems. In both cases, the writers were "content" specialists, looking for a useful tool to address the tasks they had undertaken.

Our argument is that, notwithstanding the contributions these studies have made, we could secure a much more stable and sophisticated stream of "delivery" research by partnering with people whose professional expertise is "delivery," namely, instructional technologists. Figure 2 summarizes the distinction between the two types of professional expertise. To illustrate its application, consider a paper by Cannon and Ternan (1997), proposing what they call a "contextually anchored" simulation game. It sought to address business management educators' pedagogical concern that many students learn better and are more involved/motivated in a realistic learning environment. While business management educators might have intuitive notions regarding how this might be accomplished, or might even study the subject, it is typically quite far removed from their area of professional expertise. Again, if we want to become more professional in what we do, it makes sense to partner with people whose professional expertise complements our own.

Figure 2: Typical Domains of Expertise for ABSEL Scholars Coming from Business Management versus Instructional Technology Backgrounds



SUMMARY AND CONCLUSIONS

This paper speaks on three levels. First it describes a unique classroom exercise, discussing the use of a live-case project to teach the rather complex skills needed to move a simulation game design to a finished business simulation game.

At the second level, the exercise speaks to a number of enduring principles of design. Over the years, there has been considerable discussion in the simulation and gaming literature regarding the nature of learning objectives and how they might be served by various experiential teaching methodologies. We have characterized the exercise described in the paper as a game, analyzing it against the established criteria defining a game. We note that, in the absence of a gaming methodology, such complex material would likely be “inert” and not useful to our students. We then discussed the theoretical basis for explaining how the design makes knowledge more “dynamic” and useful.

On the third level, we use the exercise as an example of how we might develop strategic partnerships between the complementary disciplines of business management and instructional technology. In order for simulation and gaming to progress as a discipline, we need to be more rigorous and professional in our basic research and applied development efforts. The relevant knowledge base is simply too large to be efficiently mastered on an ad hoc basis. Linking business management with instructional technology combines two highly complementary sets of expertise.

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