

Revealing an Instructional Video Game Design Model

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January 14, 2009

Executive Summary

Games are an important teaching tool that have been part of our culture for a number of years. With the advent of video games, players are able to participate in experiences unavailable to them before. Some game developers are creating instructional video games, yet unlike their instructional technology cousins, there is no model to follow for the design and development of this medium.

This research will study a set of instructional video game developers and derive a model from ethnographic research. Based on existing instructional models and classic game design literature, the research team hypothesizes that an instructional video game model consists of the following five phases: planning, crafting, building, packaging and evaluation. The researchers will use constant comparison to validate and modify their hypothesized instructional game model.

The research will be conducted with a multi-sited ethnographic approach to answer “What are the design methodologies that professional instructional game designers follow to complete their instructional video games?” The researchers will collect qualitative data from leading instructional video game studios with the following methods: participant observations, interviews, and journaling. A case study about a particular job role will be created to better understand the human roles in the process. The data will be analyzed and will yield an instructional video game design model.

This study will be broken up into four phases. Phase one will be a multi-sited ethnographic study that will follow four instructional game companies’ teams through the design process of one instructional game and the analysis of that data. Phase two will be the collective case study research and the analysis of the data. Phase three will analyze the data collected through journals. The complete study should take two years with one primary researcher and several graduate assistants. Phase four will be the publishing phase and should take an additional six months beyond the study.

Intellectual Merit: The researchers will use a multi-sited, ethnographic approach to gather qualitative data from participant observations, case studies, interviews and journal analysis. That data will be analyzed to find the common steps that instructional video game designers and developers use to build their games.

Broader Impact: The result of the study will be an instructional video game design and development model that can be used by instructional technologists, educators, and video game developers.

Introduction

Statement of the Problem

Games have been teaching humans important skills for centuries. By definition, a game is a physical or mental contest, played according to specific rules, with the goal of amusing or rewarding the participants (Zyda, 2005). Based on this definition, it follows that sporting events are games. Some of our most popular modern sports can be traced back to people needing to learn skills necessary for survival: archery and the javelin throw for hunting, and wrestling to hand-to-hand combat. Today, we have new necessities for survival in a modern, Western culture: information retrieval, electronic communication, math, and language skills.

Along with new necessities for survival, we also have new ways to play games. In the early twentieth century, games like backgammon, chess, and bridge were played in homes. In the early twenty-first century, those games are still being played, but games that rely on computers, *video games*, are often seen in homes. Since their conception in the 1970's and their explosion in popularity in the mid-80's, video games have become a part of our Western culture.

Games are powerful teachers that have been schooling a generation of players for the last thirty years (Kapp, 2007). Some games have had explicit instructional goals and were developed by instructional game developers. In today's educational system, those instructional game developers and designers are extremely important because they are filling a role left empty in modern education. Prensky found that traditional teachers, who are "digital immigrants", have difficulty designing learning for a population that are native to new technologies (Prensky, 2003). Although technology adoption is often more prevalent in younger generations, designing instruction for a completely new medium has rarely been needed before. Until video games, instructional media constructed by digital immigrants has been evolutionary. For example, photography led to movies, movies led to video tape, and video tape led to optical media in computer devices. An instructor familiar with designing for instructional video on VHS tape will be able to design an instructional message for optical media with little change in methodology from previous experiences.

Because of this shift from passive media to interactive experience potential, professional game designers and publishers fulfill a need and are producing instructional games for students that are geared towards this generation's interests. But, how are they designing instructional games? Kafai believes that "a great deal of thought is spent by educational designers on content matters, graphical representations, and instructional venues," (2006, p. 4). Beyond that, there is not much in the literature

about *how* a game is designed, and subsequently, developed. There has been research on what a game needs to have in its design to be effective (Rieber, 1996; Dickey, 2005; Garris et al., 2002; Moreno-Ger et al., 2008) and on the design of a specific game (Quinn, 1996), but not about an instructional game design process.

Hypotheses

The hypothesis that the research can prove or disprove is: Instructional video games are designed with a multi-tasking, team-based design methodology that is a hybrid-process that combines generic instructional design models like the ADDIE model (Molenda, 2003) and classic game design processes (Salen and Zimmerman, 2003). This hypothesis was arrived at because each part of an instruction video game (the instructional material and the game play/design) has its own design methodologies. The information and outputs generated by following an instructional design model are very different than the inputs needed to build a non-instructional video game. Although the two disciplines overlap very little, instructional video games are being developed and some process is being followed.

The ADDIE model is described by Molenda as a “a colloquial term used to describe a systematic approach to instructional development, virtually synonymous with instructional systems development (ISD),” (2003, p. 1) and represents the following phases: analysis, design, development, implementation, and evaluation.

Crawford (1984) describes the game design sequence model as: choosing a goal and a topic, researching, designing, programming, play testing, and post-mortem. The game designer should choose a goal and topic of which the game will be based around and then researches needed information. In the design stage, the structures (input/output, game structure, program structure) are developed and refined. The programming phase sees the game realized in computer code and play testing reveals game deficiencies. This iterative approach to game design allows the developers to incorporate play experience by those outside of the design process (Salen and Zimmerman, 2003). The post-mortem phase consists of business activities like evaluating commercial and critical success.

A supporting reason for research is that models for instructional game development (Kidder, 1973; Garris et al., 2002; Paras and Bizzocchi, 2005) are often either models of an instructional game itself or instructional strategies that can be used in a game. This research will show the process used in the design of an instructional video game.

Based on this information, the hypothesized methodology for instructional game design is a multi-step, team-based, iterative process with the following phases: plan-

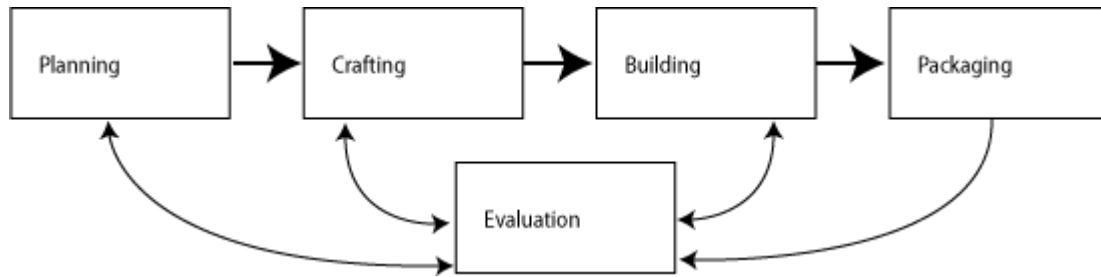


Figure 1: A graphical representation of the hypothesized instructional video game design model.

ning, crafting, building, packaging and evaluation. See Figure 1 for an illustration of the hypothesized model.

Planning

In the planning phase, the instructional content and learners are identified. The learning objectives are written. The type and genre of games ideal for the audience and supportive of the instructional goals and objectives are identified. This phase would require the following job roles: instructional systems designer and game designer.

Crafting

In the crafting phase, the bulk of the design is done. The instructional strategies used in the learning game are designed. The story used in the game is drafted. The game play and mechanics are designed in this phase. A working, paper prototype should be one of the deliverables at the end of this phase. The phase would require the following job roles: instructional systems designer, story writer, graphic artist, and game designer.

Building

Most of the instructional game development is done in this phase. Using the designs created in the crafting phase, the development team would build the game to specifications. This phase and the crafting phase are iterative and may be redone depending on the outputs of the evaluation phase. At the end of this phase, a playable version of the instructional video game should be completed. The building phase

would require the following job roles: instructional technologist, audio specialist, graphic designer, game programmer.

Packaging

This is the final phase of the process. The instructional video game is deployed to the target medium and available to the audience. After this phase, a final evaluation can occur. This phase requires the following job roles: instructional technologist, game programmer.

Evaluation

The evaluation phase is when the play testing, instructional efficacy testing, audience response testing, and post-delivery analysis occurs. The game is user-tested for its playability by the team and possibly a representative of the target audience. The evaluation phase can occur after the crafting, building, or packaging phases, and, the outputs of the evaluation phase can be used as inputs into any one of them. The following job roles are required for this phase: game play tester, quality assurance tester, instructional evaluator, instructional systems designer, and business representatives.

Research Question

What are the design methodologies that professional instructional game designers follow to complete their instructional video games?

More specifically:

- What is the process that instructional game designers currently follow to design and develop instructional video games?
- What job roles make up an instructional video game design and development team?
- What tasks does each job role perform when designing and developing instructional video games?

Research Plan

Research Approach

In order to illuminate the instructional video game design process, a multi-sited ethnographic approach is proposed. Multi-sited ethnography was first described by George Marcus as best used when something cannot be accounted for ethnographically by remaining focused on a single site of intensive investigation (1995). Blomberg, Burrell, and Guest (2002) describe ethnography as rooted in anthropology but useful to study interdisciplinary fields. They describe the key principles of ethnography's use in design as: using natural settings, being holistic, being descriptive, and experiencing from a member's point of view.

Using the natural setting allows the researchers to see the activities being studied in their actual place. This research will be conducted in the studios of existing instructional game companies around the United States. This initial engagement will allow the researchers to immerse themselves fully in the instructional game design industry for a period of time. The proposed sites for the study are:

- Two instructional game development companies in Hunt Valley, Maryland.
- One instructional game development company in New York, New York.
- One instructional game development company in Northern California.

The researchers will spend their time with the study participants during the initial phases of the instructional game development schedule: from the start of the project to the end of the development phase, which will be referred to as the design and development process.

Research Methods

The selected qualitative methods are: Multi-sited participant observations, collective case studies, interviews, and journal recordings. Qualitative methods like these have been used in previous studies of computer systems (Hughes et al., 1994) and will be instrumental in identifying the instructional game design and development process. Other research into instructional systems design has recommended multi-method approaches because, according to Moallem, "they allow researchers to apply triangulation of data, and they are also more likely to capture the complexity of the phenomenon" (1998, p. 39). Curtis, Krasner, and Iscoe believe that qualitative analysis of the design of software, which is what instructional video games are, is

valid because “software systems are still generated by humans rather than machines, their creation must be analyzed as a *behavioral* process.” (1988, p. 1269)

Atkinson (1994, p. 249) outlines several questions that should be addressed when using ethnography:

- “Whether the researcher is known to be a researcher by all those being studied, or only by some, or by none
- how much, and what, is known about the research by whom
- what sorts of activities are and are not engaged in by the researcher in the field, and how this locates her or him in relation to the various conceptions of category and group membership used by participants
- what the orientation of the researcher is; how completely he or she consciously adopts the orientation of insider or outsider.”

The researchers in this study will be known to all participants and company employees as researchers. The research collected will not be available in its raw format to participants to protect anonymity among co-workers. While researchers are in the field at the sites, they will only participate in instructional game design activities which should reinforce the reasons for being there. The researchers will strive to adopt the orientation of participant outsider.

Research Design

Participant Observations

Participant observations of the instructional game design teams will be the first portion of the research. Although the researchers will be part of the day-to-day work of design teams, they will act as more as observers than participants.

The researchers will observe the formal meetings, the ad hoc meetings, and correspondence. Because each company will be on a different schedule, the study of each site can go on in parallel. The materials from these observations will be descriptive and not evaluation-based. The researchers are interested in the day-to-day activities of the instructional game companies and not the perceived performance of individual team members.

This holistic approach will allow the researchers to see the activities in the larger context and from the point of view of the participants. The results of this study will guide the research design of the next section.

Collective Case Study

A collective case study will allow the researchers to analyze one instructional game design role in-depth across each of the companies. Robert Stake defines a collective case study as a number of cases that are studied to investigate a phenomenon, population, or general condition (Stake, 2005). Case studies have been used before to identify a process. For example, one collective case study was used to identify a search process for users of information systems (Kuhlthau, 1988).

Although each company will have its own process for developing instructional games, they should have similar job roles.

The researchers are interested in identifying one role that experiences the design and development process from the beginning of the project to the end of the development cycle. This research will be done after the multi-sited participant observations. The case study will be an opportunity for the researchers to investigate a role identified in the analysis of the observational data that is influential through all stages of the design process. Benbasat, Goldstein and Mead believe that this methodology is “well-suited to capturing the knowledge of practitioner and developing theories from it” (Benbasat et al., 1987, p. 370). The collective case study of one job role that experiences the entire process will create a better understanding of the design process and provide a basis for the interviews. The case studies will be continually judged for relevance and will be re-evaluated if necessary (Stake, 1995).

Interviews

After the participant observations and collective case studies have been analyzed, the researchers will have a greater domain knowledge of the instructional video game design and development process. This conceptual knowledge is considered important to the interviewing process (Kvale, 1996). Using this insight, the researchers will conduct interviews to answer the questions that the previous phases of research revealed. Interviews will give the researchers a chance to ask questions of the participants outside of the instructional game design environment. This will have two advantages:

1. It will reduce distractions from the environment.
2. It will create a neutral setting for the participants to discuss items in confidence.

The interviews will be semi-structured and will follow Kvale’s recommendations on interviewing (Kvale, 1996). Although the researchers will develop the questions after the participant observations and case study analysis based on findings, the interviewers will strive to answer the following questions:

- How are instructional video games designed in your company?
- What process do you follow when designing instructional video games?
- Why do you follow those processes?

There will be a series of questions to prime the discussion but the researchers will have the flexibility to explore questioning based on the participants' answers and create a meaningful dialogue. The interviews will be recorded and transcribed.

Journaling

One way to understand the tasks performed by those in the instructional games design process is to have the participants make journal entries of their daily activities. Their daily activities include:

- meetings attended
- upcoming due-dates
- tasks performed
- milestones achieved
- processes followed

The journal will be a secure, online database that the participants will be able to make entries in during the game design and development phases. The participants will be asked to make entries once a day with the option to make more. The entries should take less than five minutes to complete and not get in the way of the participants' work duties.

The web-based form will remind the participants of the types of information the researchers are interested in and provide an area for open comments. If the participants do not make daily journal entries, the journaling system will send them an email reminder.

Because the journals will be web-based and secure, participants may have less anxiety about being honest because of a misplaced journal falling into the wrong hands.

The journaling software will be developed using PHP as the server-side middleware and MySQL as the database backend. The journal will use basic XHTML to display the front-end to the user. This combination of XHTML, PHP, and MySQL will provide the research team with a highly-customizable, institutionally supported, free solution to capturing data.

Data Analysis Plan

The data analysis will occur throughout the research. The plan follows the following steps:

1. Code the data from the participant observations.
2. Code the data from the case studies research.
3. Code the data from the interviews, and journals.
4. Using the participant observations as the research baseline, compare and contrast the results of the interviews with the journals.
5. Compare the interview—journal results with the in-depth findings of the case studies.

Following this method should identify common practices between instructional game designers.

Coding

The research team will code the data from the observations. It is believed that the observations will produce the following types of data: texts, audio, and video. The text data will come from the correspondences of the team and the field notes of the researchers. The audio and video will be recordings of planned and ad hoc meetings. The analysis of this data will be done shortly after it is collected from all sites. The findings of the multi-sited ethnographic study will influence the research design of the collective case studies.

The research team will begin developing a list of codes during the observations. These codes will be used as a starter list and will be expanded upon as the text is studied.

The data from the case studies will be in similar forms of the multi-sited participant observations. The study of the job role, identified in the participant observations as being of interest because of its involvement in every phase of the instructional game design process, will produce significant amounts of textual data. The researchers will code correspondence, documents, participant notes, and field notes to understand that job role fully. The discoveries of the participant observations and collective case studies will guide the research design of the interviews.

The interviews and journals will be analyzed after all have been completed. The researchers will code the field notes from the interviews as well as the recordings

of the interviews. The recordings will be transcribed into text by a transcription service. Those transcriptions will be verified by the research team.

The members of the research team will then code each of the transcriptions. Based on Miles and Huberman's (1994, p. 64) suggestion, each transcription will be coded by two different researchers and "intercoder agreement should be up in the 90% range." If the results of each member's coding is statistically different, a third researcher will code the data. The journals will be reviewed and check-coded in the double-researcher method similar to the transcriptions.

Analysis

Once all data sources have been coded, analysis can begin. The first step is to identify all similarities between the different instructional game designers and publishers. By analyzing the data, patterns of workflow, team structure, and milestones, a process will emerge. These findings will be synthesized into a working instructional game design process.

The second step will be to identify any differences between the observations (multi-sited ethnographic study and the case studies) and the self-reporting (interviews and journaling). If there is a commonality to what is over- or under-stated in the self-reporting, that could be an insight into the design process. One recent study showed that people will over-report something that would be considered negative if absent, even if it means that they would be unable to get help because they have too many resources (Martinelli and Parker, 2006). Because of this, we can infer that activities that are over-reported are viewed as important by the participants even if they don't necessarily do them. These activities that are viewed as important, when compared with the observed behavior, may illustrate the gap between the working instructional game design process and an ideal instructional game design process.

Timeline

This study will be broken up into four phases. Phase one will be a multi-sited ethnographic study that will follow four instructional game companies' teams through the design process of one instructional game and the analysis of that data. Phase two will be the collective case study research and the analysis of the data. Phase three will analyze the data collected through journals. The complete study should take two years with one primary researcher and several graduate assistants. Phase four will be the publishing phase and should take an additional six months beyond the study.

Phase One: Participant Observations and Analysis

The longest phase of the study will be this one and it is estimated to last one year. Because the length of time that each group takes in the design phase of building instructional games varies, the estimated time for the research is eight months. The final four months of the phase will be saved for analysis of the data collected during the ethnographic research. This analysis will determine which job role should be researched with collective case studies.

The participants will begin recording their work habits in online journals during this phase. That activity will last until the end of phase two.

Phase Two: Collective Case Studies and Interviews

The second phase of the project will be the research for the collective case studies as determined in phase one. In this phase, interviews of the job role being investigated, as well as other interviews, will be conducted and transcribed. At the end of phase two, the data for the case studies will be analyzed and coded. This phase should take four months.

Phase Three: Final Analysis

In phase three, the research team will code the transcriptions from the interviews conducted in phase two and will analyze and code the content from the online journals. This phase should take five months and will include the identification of the gap between the working game design process and the ideal game design process.

Phase Four: Publishing

Although most writing will occur within the first three phases, this fourth phase will allow the researchers to put together the materials as outlined in the dissemination plan.

Feasibility

The lead researcher on the study is Dr. Gregory H. Walsh, PhD from the Institute for Interactive Technologies at Bloomsburg University. Dr. Walsh earned his degree at the University of Maryland's College of Information Studies in 2012. His specialized field of research has been instructional video games. In addition, Dr. Walsh has extensive industry experience in the field of instructional technology. He has not

only studied instructional games, but, he has developed them for corporate clients like Black & Decker and Milk, as well as government agencies like the United States Department of Agriculture and the Institute of Museum and Library Services.

Dr. Walsh has previously done a qualitative research study on the use of instructional video games in the classroom. That study led to a rubric for teachers to evaluate off-the-shelf instructional games in their classroom and a process for implementing them in their curricula (Walsh, 2012). The results of that study were published in the *Journal of Deus Ex Machina*, the field's definitive journal. Another study led by Dr. Walsh found a correlation between interactivity and learning in off-the-shelf instructional games (Walsh, 2013). During these studies, Dr. Walsh was able to build relationships at leading instructional design publishers around the country.

Because the instructional game industry is so competitive, gaining access to instructional game developers may seem challenging. Some companies may fear having company secrets or sensitive data fall into the hands of competitors. That is why the participants will be well informed of the research methods and confidentiality that are key to this study. Because the outcome of the research is to identify a generalized instructional game design process based on multiple sites, there is little-to-no chance that an individual company's trade secrets will be published. Besides confidentiality, the time commitment may be a concern of participants in the instructional game development field. This research requests that participants keep a daily journal of activities and progress and that may be seen as a large commitment of time. On the contrary, the journals should take less than ten minutes to update daily. The research team is interested in only a limited number of events and the recording of those events need not be time consuming. The research team will provide several types of sample journal entries to demonstrate structure and depth of detail.

Once their fears are alleviated, some instructional game developers may even see this as an opportunity to gain more exposure in their respective markets.

Dissemination

As the interest in serious games and instructional video games continues to increase, the need for the identification of an instructional game design model increases. The game design model could be useful for: instructional game designers, teachers, students, and training professionals. The results of the study will be submitted to the following journals: *Human-Computer Interaction*, *Simulation & Gaming*, *Journal on Educational Resources in Computing*, and *First Monday*.

To compliment the journal submissions, the research team will submit their work

to several conferences like CHI and Educause. The submissions will be to the paper, and the workshop categories, if applicable. If chosen, the workshop will cover the following topics:

- Research - Statement of problem, research methods
- Conclusions from study
- Instructional Game Design Model
- Practical applications of the model
- Examples of the model in use

The findings will be the part of a graduate class at Bloomsburg University that discusses Instructional Game Design. The class will be offered online as a special topics class. It will be available to anyone meeting the University's requirements to take classes. The class will cover topics like the history of the use of games in learning, the use of instructional video games in modern education, and the findings of this study.

The class will also be offered as open courseware so anyone who wishes to experience the materials will be able to for free. As part of the class, the research team will create a web site as a repository of all the project findings. The instructional game design model, the study results, and in-depth descriptions of the research methodologies will all be located there. This site will be available from the Institute for Interactive Technologies' main web site as well as the open courseware.

The final part of the dissemination plan will be an eBook published through the Institute for Interactive Technologies. The eBook will be freely available. This document will collect the study's findings, as well as, feature essays by prominent academic and industry leaders in instructional games development.

Impact

This impact of this study will be interdisciplinary. The following fields will be affected:

- Instructional Technology
- Computer Science/Software Engineering Education
- Interaction and Game Design

Instructional Technology

Instructional Systems Design (ISD) facilitates the creating of instructional tools and content to help facilitate learning most effectively. Instructional Technology is a subset of Instructional Systems Design that focuses on the development of technologies and media for learning. The ISD field has been studying games and simulations in learning since the 1960's (Kidder, 1973). In fact Kidder, Horowicz, and Kiselewich created an instructional simulation design model that is made up of two phases, "the first concerned with the acquisition of basic skills and knowledge, and the second concerned with an application, elaboration, and liberalization of the first phase." (Kidder, 1973, p. 2). They assumed that the first phase would take place in the classroom and the second phase would occur in the simulation. This study will reveal a game design process that updates this idea with something that encompasses both phases into one instructional experience.

Instructional technologists will also find the instructional game design model identified in this study useful because they may have no experience designing games. The process may reveal best practices and proper team dynamics to create a successful custom instructional game for academia or industry.

Software Engineering

The field of software engineering will find the study useful because it illustrates a process that can be extrapolated to other software design situations. There has been a recent interest in the use of game design as a software engineering education tool (Claypool and Claypool, 2005; Wallace and Nierman, 2006). The instructional game design process that is revealed in this study could be used as a template for software engineering classes.

Interaction and Game Design

The results of this study will also be useful to the interaction and game design fields. The instructional game design process will be of particular interest to those who are currently designing or would like to design instructional games. The model that will be revealed in the study is a hybrid of the instructional design and game design models. Although experts in interaction design, game designers may have had little to no exposure to instructional design before they attempted to build an instructional game.

Summary

This research will define an instructional video game design model through an ethnographic approach. The research will utilize the following methods to study leading instructional video game studios:

- Participant observations
- In-depth case study
- Interviews
- Journaling

By analyzing the data, patterns of workflow, team structure, and milestones, a process will emerge. These findings will be synthesized into a working instructional game design process.

This study will be broken up into four phases. The complete study should take two years with one primary researcher and several graduate assistants.

The impact of the study will be interdisciplinary and will impact instructional technology, software engineering, and the field of interaction and video game design.

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