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Aligning Game Activity with Educational Goals: Following a Constrained Design Approach to Instructional Computer Games

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Abstract: We discuss the design, creation and implementation of an instructional game for use in a high school poetry class following a commitment to an educational game design principle of *alignment*. We studied groups of instructional designers and an interactive fiction computer game they built. The game was implemented in a 9th grade English classroom to see if the designed alignments were realized in the classroom. Results from observations and collected design artifacts suggest the alignment theory created extra challenges and rewards for the game designers. They encountered tensions between creating an exciting game-like atmosphere with inventive programming techniques while remaining loyal to the narrative structure and instructional goals. Game-play transcripts and interviews with middle school participants offered additional insights into the successes and failures of intentional efforts to bring about educational game *alignment*.

Introduction

Is what we learn by playing computer games truly beneficial, worthwhile, and valid? Shaffer, Squire, Halverson, and Gee (2004) write that games are changing the way we learn by giving players the opportunity to participate in different game-created worlds and to learn by doing. Education researchers suggest the use of computer games may help transform the way students think about their world (Holland, Jenkins & Squire, 2003; Steinkuehler, 2003; Wolf, 2001). Certainly the study and use of computer-based games for learning has been established within numerous contexts (e.g., Rieber, 1996; Vilmi & Malmi, 1996; Barab et. al, 2005). While some research has shown that games are changing the way people learn and think about their environment, games may not be the answer to all educational questions. Clark, Nelson, Sengupta and D'Angleo (2009) discuss in a recent National Academy report how games for education have become increasingly popular, particularly in science education, and are now considered viable tools for learning. However, they also report, "It is one thing to create a fun and engaging game that students will want to play. It is another to create one that will also teach them the intended concepts" (p 49). While many games are being used for educational purposes, not all educational games are better than traditional classroom instruction. Instead, research is necessary to indentify when a game is appropriate for learning, as well as what aspects of the games benefit learning outcomes (Ketelhut, 2009). Researching the game design process can assist in understanding what game attributes, designed with purpose, may afford good learning opportunities. The process of building an educational game can be a unique pedagogical process in itself, and researching what can be learned about design and development under specific constraints helps inform that pedagogical process. Here, we argue that games may provide more direct learning benefits if the *beneficial potential* that games offer can be effectively organized into the game activity itself. We consider this a productive kind of design constraint, and refer to it as *activity-goal alignment*. We then explore this notion by researching an example of an activity-goal aligned educational game through an iteration of design and development framed within design-based research. We examine the effectiveness of this iteration by reporting results of the game used in a 9th grade English classroom.

This paper is organized in a way that reflects a design-based research (DBR) process embodied within the Integrative Learning Design Framework (Bannan-Ritland 2003). First, discussion is presented with regard to how DBR can be used to understand the influence of activity-goal alignment as an educational game design constraint. Parts of the ILDF, *informed exploration*, *enactment*, and *local impact evaluation,* are presented as an applicable instance for the design, development and implementation of an instructional game. Accordingly, the presentation of this information requires exploration of not only the specific design constraints both theoretical and practical, but also the effort of testing the effectiveness of the design through a preliminary examination of the end product in context.

Specifically with regard to the *exploration* and *enactment* portions of IDLF, we researched the following questions:

1. How is the theory of activity-goal alignment implemented for instruction through the game genre of Interactive Fiction?
2. Why is Interactive Fiction a good testing ground for the alignment theory, and how do teams interact to pursue instructional goals through game activity?
3. What kinds of game-like activities are designed to ensure successful alignment, and what instructional goals lend themselves well to game play?

We then consider the phases of *exploration* and *enactment* based on content learned (e.g., English, computer science), perspective (teacher and student), and a combination of game design theory and instructional design theory.

The ILDF Framework

Design-based research is an approach for researching issues relating to pedagogy and learning effects. The research is performed in a way that does not require comparative experiments but rather relies on an iterative process of design, development, and implementation. “Design-based research involves defining pedagogical opportunities and outcomes and creating learning environments that seek to address these. In design-based research, the emphasis is on the pedagogy more than the tools being employed” (Oliver, 2007, p. 6). The iterations are performed over a period of time to test, refine and

better understand the pedagogies and contexts in which they are used. Wang and Hannafin (2005) have described DBR as "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (p. 6). Within this case, an iteration of DBR was used to help understand the influence of the alignment theory as an educational game design constraint. DBR methods are helpful for understanding the experiences of instructional designers during game design and how that information can enhance future design efforts. DBR methods were used so the researchers of this project could work within a class-based setting to assist in determining the successes and failures of the alignment theory in practice.

Our specific approach, aligning within the Integrated Learning Design Framework (ILDF), embodies many of the elements within DBR (see Reeves, Herrington & Oliver, 2005; Lewis, Perry and Murata, 2006) in the prescription for studying the design of an instructional game. The approach is grounded in active-learning principles (such as analysis, synthesis, and evaluation) and applied to objective-aligned instruction (e.g., Barab et al., 2005; Dede et al., 2004). Bannan-Ritland (2003) in her presentation of the ILDF drew clear connections between traditional *design* modalities (e.g., Dick and Carey, 1990) in the way design research combines the creative elements of development with "appropriate adherence to standards of quantitative and qualitative methods in education" (p. 21). While the ILDF is meant to provide a program-level perspective based on large-scale interventions, offering a smaller-scale intervention using this framework can make a significant contribution to informing the design and redesign of educational content--in this case computer games--through iterative means. The value of using the ILDF approach lies within identifying the factors that impact one emerging design approach (activity-goal alignment) to instructional games. Then, we may consider how the expectations of learning and use of the game were filled (or unfulfilled) during classroom-based implementation, helping inform the original design decisions.

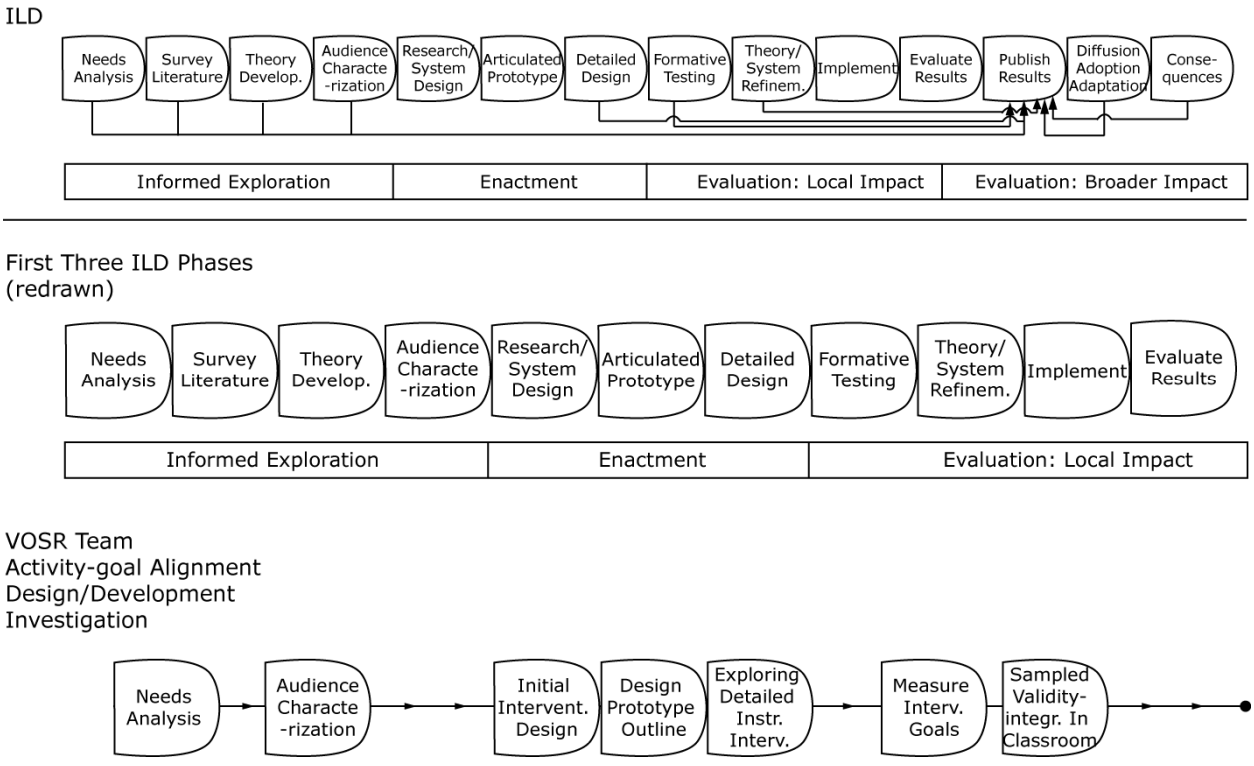

Figure 1. The IDLF framework (redrawn from Bannan-Ritland 2003) as instantiated through this instance of activity-goal alignment. Methods of informed exploration, enactment, and local impact evaluation are described through a case of educational game design, development and implementation.

Following the model that Bannan-Ritland proposed (as seen in Figure 1), this study stops at evaluation measures at the local-impact stage, first exploring the initial step of informed exploration, followed by enactment. Informed exploration includes problem identification, a background of supporting literature and the problem definition. The designers described in this research completed the requirements for the informed exploration stage by performing a needs analysis and an audience characterization from a user-centered design set of considerations, meaning the wants and needs of the game players were of primary consideration during preliminary data gathering. The designers reviewed educational gaming literature and consulted with the English teacher about his needs and the needs of the students.

The enactment stage for the game design included an initial intervention design, an outline of a design prototype and an exploration of a more detailed level of instructional intervention. The

development in this phase was influenced by continually evaluating the different parts of the game and intent of the actions built within the game. The designers would often exchange test sections of the game with other designers to help identify the representation of key instructional aspects built into the game. The evaluation considering the local-impact of the design provided a measure of how well the intervention satisfied the goals of the *clients,* in our case, the classroom teacher who uses *Spoon River Anthology* in his poetry education unit (Masters, 1915). Our intervention then sampled for ecological validity, through an investigation into the success of game integration into classroom practice. That is, we researched what students learned from playing the game during their class while they used it as part of their teacher's assigned activity. The implementation included iterative data collection and analysis that then "…informed changes in theoretical conjectures and research design as well as… redesign" (Bannan-Ritland, 2003, p. 23). In other words, the process we followed for redesign at the end of an iteration further informed our primary theory of designing educational games for activity-goal alignment.

Theoretical Background

The Problems of Using Computer Games to Teach and Learn

For the specific purposes of assessing the use of computer games in formal learning environments, we categorize computer games into three general areas to communicate that different games provide different opportunities and challenges and therefore need to be understood and applied in unique ways (see Shelton, 2007).

The first category includes computer games designed for entertainment purposes that are *repurposed* into instructional lessons as part of a learning exercise. These games are designed principally for entertainment, with presumed little regard for any designed instructional goals to support student learning activities in formal educational settings. For example, *SimCity 3000* and *Age of Empires* are commercially available games that are used as teaching tools in the classroom. These games are used to teach governing rules of models (e.g., community planning and geographic placement of services) and to improve thinking skills (B.E.C.T.A., 2001). The games' entertainment value has been used to motivate the students to participate in the learning activity, and the game activity has been repurposed into a lesson.

The instructors have either customized their own lessons based on these games, or implemented with the assumption that game play alone was sufficient. The downside of this approach has been that much of the substantial *learning* that is reported is secondary or unintentional (e.g., Kiriemuir, 2002; Hayes, 2002). Secondary or unintentional learning occurs when a player learns concepts or skills not associated with the goals of the activity. Examples of unintentional learning are acquiring social skills from participating in the game environment, learning how to better use the controls of the game, or gaining an understanding of what abilities the arch nemesis has (e.g., Dalgarno & Lee, 2010; Oliver & Carr, 2009).

A second category of computer games includes those designed for educational purposes that rely on *reward* systems to motivate students in the learning activity. The reward systems are not associated with learning activity, but rather as a means to an end so that the player is rewarded for correct behaviors. These games often come in the form of basic skill practice, such as typing, and where the reward system may become the focus of the game or a distraction from the learning activity. One example is the organic chemistry game developed by Bradley (2005) that uses a first person shooter game engine to encourage the student to seek a fast solution to a maze. Students choose the correct path by walking towards doors that have pictures of *correct* diagrams of complex molecules. Other examples in this category are drill-and-skill games like *Jumpstart*. These games certainly may help improve in the way practicing repetitive procedures can reinforce recognition and response times, and if that is their purpose, reach some level of success (Miller, 2005). However, maintaining motivational levels through such *reward* systems have limited appeal in reaching instructional goals that include complex conceptual information or that prescribe reflection on one's activities. DeCastell and Jenson (2003) have suggested that the mis-alignment of the end-to-the-means with what it takes to get there constitute enough distraction to completely disengage the player from enjoyable activities.

The third category of computer games for education we recognize are those that are specifically designed for learning but either lack game-like attributes associated with high levels of game motivation or contain overwhelming levels of game-like attributes that ultimately distract the players from the learning objectives (Kirriemuir & McFarlane; Kiriemuir, 2002; B.E.C.T.A., 2001). In addition to

problems with alignment and rewards, instructional computer games have a problem of keeping the attention of the player because the game does not contain the attributes needed to be fun or motivating to play. Previous research suggests attributes of games that make them motivating and entertaining include fun, stimulated curiosity, fantasy elements, clear objectives, and challenge. (Koster, 2005; Tews, 2001; Crawford, 1997; Wolf, 2001; Kirriemuir, 2002; Miller, 2005). Results of these studies suggest that if motivating attributes of computer games can be designed into the game itself, student interest and motivation for sustaining play may remain at a high level.

Research suggesting why this third category of games has failed to reach its expected potential also suggests what might be done to develop games that lead to effective learning. Shute et al. (2009) have suggested the potential of using computer games for instruction may be observed by understanding the problems associated with their design. Working to align game activities with instructional goals may help balance the motivations for playing the game. Findings from this research suggest that the problems with some games may not be found in the idea of gaming but how the games are structured or aligned with their learning objectives.

Designing and Developing Game Activity for Alignment with Goals

We address the question of aligning the structure of the games with the learning objectives by examining the challenges faced by learning technologists. Researchers who have studied the integration of computer games designed as part of an instructional exercise have reported their success and limitations. Further studies continue to investigate new ways of implementing computer games as teaching tools in both formal and informal learning environments (Klopfer & Squire, 2008; Squire, DeVane & Durga, 2008). Designers of instructional computer games must address issues concerning the format of game play and how to avoid attributes that may distract from the learning activities. Reviews of games designed to hold educational value, such as the popular *The Oregon Trail*, have noted that such distractions may significantly decrease any positive outcomes of learning through play (see Bigelow, 1997). So what are the primary design issues instructional technologists face when beginning their

design? Brown and Duguid (2000) suggest that learning about something is limited to gaining information, whereas learning to become something requires both information and experience. For example, learning about being a doctor and learning to become a doctor are two very different things. When designing games, instructional technologists should try to design instructional tools that help the learner become something. Being an active participant in one's learning in an instructional game is accomplished by aligning the game's activities with the intended instructional goals.

For example, *Supercharged!* is an educational game designed to teach students about electromagnetic fields. Squire, Barnett, Grant, and Higginbotham (2004) reported that it was a challenge, when playing *Supercharged!*, to get some students (primarily boys) to achieve a deep understanding of the non game-like components of the activity. Some students felt more compelled to *win* the game, rather than be concerned with the activity associated with w*inning*. Therefore, attempting new strategies or playing the complementary levels to learn about electromagnetic fields was less interesting. *River City* represents players as an avatar in a virtual world with the purpose of finding out what is causing the disease in the local town (Clark & Dede, 2009; Dede, Ketelhut & Nelson, 2004). When beginning the game, the players may choose the name of their avatar as well as their character. The creators of the game designed a particular character after Ellen Swallow, the first woman to graduate from MIT with a chemistry degree, with the intent of increasing motivation for female players. While these game-like characteristics were added to enhance the experience of the player and create high levels of motivation, they also have the potential to distract from the learning activity in the same way reward system games do. For example, both *Supercharged!* and *River City* are examples of computer games designed for learning that have enjoyed some success for learning outcomes. However, the motivation attributes of each of these games were not necessarily designed to be balanced with the instructional activities, and some disconnect was reported with how students approached their designed learning activities and their motivation for playing.

This idea of aligning game activities with learning goals is meant to improve educational game design so that learning experiences for the players will be considered engaging from the perspective of the

learner and successful from the perspective of the instructor. It addresses the problem with the first category of educational computer games by designing the games specifically with instructional objectives in mind and creating games whose primary purpose is for learning. Designing for activity-goal alignment ensures that a correct balance of game-like attributes are included for motivation, but that the activities within the game are meaningful, and therefore exist as more than just a means to an end. The game includes motivation-inducing attributes of challenge, proclivity, and uncertainty, yet directs them toward the learning goals, thus differentiating them from games within the second and third categories mentioned previously (see Scoresby & Shelton 2007; Shelton, 2009). Gibbons and Fairweather (2000) offer similar advice when designing for instructional simulations in waves. It is important to look for alignment of activities with instructional goals, and that the design of the environment and model structure match the *action* of instructional goals. The design should ensure that problem solving in the environment offers the correct types of practice with desired instructional support. If designing and developing in a series of iterations consistent with activity-goal alignment is achieved, we theorize that the instructional game that results will be highly motivating and be useful for learning. In essence, the learning will be fun.

Utilizing Interactive Fiction as the Case for Attempting 'Alignment'

Games can exist within virtual worlds or environments that can give the player a feeling of presence with high levels of engagement (McMahan, 2003; Scoresby & Shelton, 2010). Games have been utilized to address different types of learning as well as a variety of subject matter ranging from history to engineering and mathematics (Papastergiou, 2009; Squire, 2008). The interactive nature of games lends itself readily to a supporting role in teaching. One exciting possibility is the use of games in experiencing a classic text in a new media form. For example, interactive fiction (IF) is a new media form that provides players the opportunity to experience text in a way that provides a blend of entertainment and education (Short, 2005).

Generally, IF is a game format that tells a narrative or story by offering a text-based description of a series of locations, non-playing characters and rich description. The player interacts with the

narrative through a computer program that parses the text responses of the player and advances the game accordingly. The player is a character within the story and the story progresses through the actions of the player. Traditional IF games have come in the form of text adventures such as the *Zork* trilogy and *Hitchhiker's Guide to the Galaxy* in the early 1980s, but there remains a faithful subculture of writers and programmers of IF to this day. In the majority of IF games there are numerous puzzle-solving scenarios that help the player advance within the narrative. Consequently, IF requires that the player gives more to thought than to action (Granade, 2005). IF also creates an explorable world that is experienced through text (Short, 2005). The nature of IF and its potential to experience traditional text in new ways make it a suitable candidate for learning experiences using classic works of fiction (Scoresby, Duncan & Shelton, 2006; Shelton, 2009). Montfort (2003) offers the opinion that one clear match between IF and classic texts is the idea of "text-in and text-out." The interface of IF in its text-based form offers a basic level of symmetry, consistent with experiencing text in its native paper-and-ink format (Deshrill, 2004; Montfort, 2003).

Additionally, IF can provide successful learning experiences with classic texts by reinforcing and augmenting the instructional aims of the English classroom. Reading comprehension and fluency, poetic devices, literary analysis, character motivation, and examination of narrative and plot structure can all be explored. IF can offer the benefit of maintaining the original published form of the text. It may not be necessary to edit, condense, or otherwise alter the original text. Along with traditional learning goals, we feel that it is possible to experience further learning outcomes that may be unintended but nonetheless beneficial to the player. These outcomes include problem solving, spatial reasoning, and increased confidence. IF is portable as well as scalable so that it may be incorporated into classroom activity, group-work, or as a stand-alone product for an individual. Ladd (2006) has written that using IF to teach computer science has resulted in positive outcomes by teaching programming fundamentals combined with creating a project that is both motivating and difficult. We suggest that instructional technologists, armed with activity-goal alignment theory as their guiding tenet will be able to incorporate IF with classic text instruction for English.

Methods

The research followed the design, creation, and implementation of an instructional game utilizing instructional theory driven by the idea of aligning game activity with instructional goals. The *informed exploration* portion of the IDLF framework focuses on the game's design and creation by following a group of designers as they become mini-content experts in the field of English education, and apply and modify *traditional* design guidelines to each of their instructional products. The designers were self-selected graduate students who registered for an instructional game design course at a four-year research university. All seven designers enrolled in the course agreed to participate in the research and were assigned to one of two design groups consisting of three and four designers apiece. The design group with three members consisted of two females and one male; the other group had four males. All of the designers, ages 23 to 31, had casual game playing experience. However, none of the seven designers could be described as avid computer gamers. Two of the seven designers had some game playing experience with interactive fiction or text-based games and the others had heard of interactive fiction but had never played. None had ever designed or developed an interactive fiction game. The designers were tasked to contrive, create, and implement an IF game for 9th grade English, transforming a classic text, *Spoon River Anthology* by Edger Lee Masters, into a new media product. The text is a compilation of epitaphs (poems) of the inhabitants of Spoon River, a fictional town. The epitaphs include information about the people, their lives in Spoon River, their relationships with others, and often how they died. With this text implemented within IF, the *enactment* portion of the IDLF framework consists of how the designers expected to build a game with learning goals normally associated with the reading and analysis of a 9th grade English class. Analyzing the way the 9th graders played the game, and their resulting experiences of exploring content through activity aligned with the lesson plan objectives, constitute the *local impact evaluation* of the IDLF framework.

IDLF: Informed Exploration

The design groups worked to create modules of a computer game based on the *clusters* of characters found within the book. Each cluster included a series of characters with interrelationships that connect them to each other through an issue. For example, a cluster might consist of one character charged with a crime that he did not commit, which connects him to the judge who sentenced him, the attorney who represented him, and the character who actually committed the crime. The designers worked within teams to build-out storylines and narrative that connect instructional objectives (e.g., reading comprehension, character analysis, and critical thinking). The designers then built a storyline that forces the player to understand the relationships within the cluster, and use knowledge about each of the characters to resolve the *issue* by solving puzzles. In the above example, the designers built a puzzle around helping the restless spirit of the wrongly imprisoned character by visiting those other characters in the cluster, gathering important information from each, and correcting the public record of the crime. Design teams then coordinated with each other which clusters they were designing, the overall aspects of the game that required consistency (e.g., scoring, classes of non-playing characters, locations) and the instructional structure that required consistency (e.g., assessment strategy, embedded coaching). Data collection of the designers followed the group through 18 weeks of design-development iteration.

The initial design and development took place in classroom settings and private computer laboratory based settings, both within groups and between groups. The groups met in the classroom setting to discuss game design and theory, such as, what kinds of overall narrative elements to include in the game design. The design groups developed the game in private computer laboratories, scheduled as needed. Data were gathered through participant observation and notes, semi-structured interviews and artifact analysis consistent with methods of natural inquiry (Guba & Lincoln, 1983). The interview questions were designed to identify the process the designers used in creating the game as well as the reasons why they made particular decisions. The following are examples of the questions used to guide the interview and discussion pertaining to the game design process:

1. How did the alignment theory affect your design experience?

2. What challenges did you face while designing the games?
3. How did you adjust your design when group challenges arose?

Researchers used techniques consistent with design experiments to analyze data to help inform our understanding of how teams of developers utilize unfamiliar design theory and apply it within a project-based setting (A. L. Brown, 1992; Dede, 2004). Because this was a pilot setting, researchers were concerned with the process of taking a computer game with activity-goal alignment theory from design to creation, and the area of accomplishments and challenges experienced by the student groups. We used a constant comparison technique to analyze how designers changed their design procedures to accomplish design and development tasks (Glaser & Strauss, 1967), and borrowed techniques based in artifact analysis (Engestrom, 1990; Bannon & Bodker, 1991) to incorporate how the product they developed embodied aspects of design decision and constraint based on the activity-goal alignment process. The research activity evolved based on underlying perspectives, or expectations, from the designers as they participated in design and development, paying special attention to how designers thought like teachers who might use this game in their classrooms to teach, and thought like 9th grade English students who would use this game inside and outside formal learning environments.

We prepared data for analysis based on the kinds of design and development strategies that emerged from their activity, studying what effects *group* had on design and development procedure and outcome, and we studied how the process of design and decision manifested itself within the game artifact. Data were analyzed through the review of game content within the multiple waves of development (see Figure 2). Analysis within waves allowed the research to progress by bringing to light how the story or different in-game activities evolved during development. Individual group members were interviewed to find reasons behind the changes in their design. Design evolution data and interview data were then compared with notes of the group observations. Exemplary analysis is described in the following section.

IDLF: Enactment

The results of the enactment portions were drawn from an initial understanding of how instructional designers approach traditional design and development. Most designers reported an initial model-based approach using methods from traditional instructional design (e.g., those of Merrill, Gagne, Dick and Carey) and methods from traditional game design (e.g., those of Crawford, Hollings, Prensky). The design followed an iterative design-to-development process followed closely the procedure outlined in Figure 2.

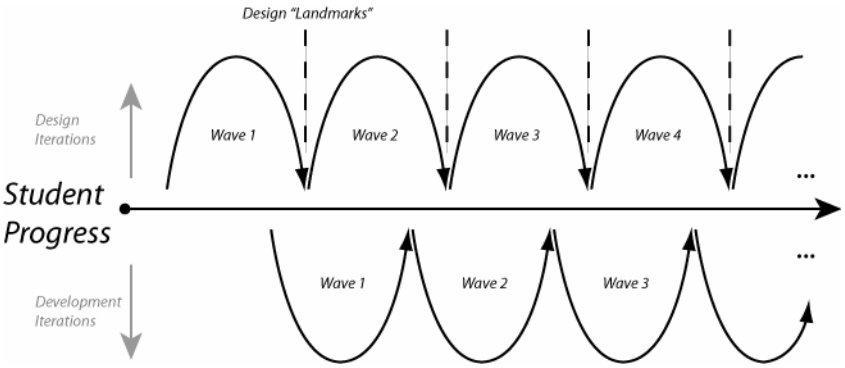

Figure 2. The design-development process that evolved for the activity-goal alignment game.

Design commenced in wave-like fashion, each wave primarily working to fully develop the relationships of the cluster, the artifacts needed for game activity, and compliance with goal-activity alignment. Subsequent waves addressed design details discovered from development issues from previous waves. For example, during the design of Wave 2, issues from the development side of Wave 1 helped inform and contribute to further design details of the cluster from Wave 1. After Wave 1 of development where groups programmed the first cluster as a separate module, the other group tested it for completion, clarity, logic and aesthetic qualities. During subsequent development iterations, groups concentrated on cleaning-up programming on modules from previous waves based on group feedback, while concurrently developing a new cluster. These modules remained separate through the first four

waves of development; subsequent development includes the integration of the modules into a master-plan that provides in-game location consistency and final testing of multiple modules as a single game.

The process of iterative design-to-development is not necessarily novel in itself. This type of design process is described in model-layer design for instructional simulations (e.g., Gibbons & Fairweather, 1998) as well as many other prescriptive models that tend to be more behavioral in approach. Consistent with these approaches were the efforts of the designers to revisit the learning objectives during the design process. During decision making periods regarding technology and environmental constraints of the activity, designers would revisit questions regarding student experience as they related to instructional goals. For example, at different points within the process, designer groups asked questions:

- How does choosing a text-only version of the game affect the level of motivation of the player?
- How do the non-playing characters' actions effect what the learner does during game play?
- What kinds of social action might take place around game play, and how can this action be utilized within decisions that impact the instructional goals of the game?

What *is* somewhat novel is the designers' return to addressing the points of interplay between design decisions for the sake of the game, and the activities added for the sake of the learning objective. For example, adding game-like elements for the sake of engagement, that have little if any instructional value, were often a source for frustration within the groups. Individual members who were more inclined with the programming aspects of the game often pushed the group toward making neat things happen in the game, regardless of instructional alignment. An example of this would be a rotating room. As the player enters the room and somehow sets off a trigger, the room would rotate--changing the direction the player came in and possibilities of going out. The game designers felt that the rotating room game activity did not align well with the desired learning objects, so they decided to remove this aspect of a game play and add it at the end of the game as a bonus action. This way the student players would not get stuck or lose time in a rotating room trying to solve game play issues. Another example is the narrative that was being developed for the story. One student designer suggested that the player character be a private investigator

trying to resolve all of the problems between the characters in the game, which ultimately was decided to carry too much baggage with it for the sake of the instructional components.

Conversely, those group members (designers) who were more used to traditional task design tended to push the group toward activity based on learning goals, without regard to integrating game-like activity within them. There were far fewer examples of this event, but one example had to do with deciding whether or not to integrate all of the 240 or so epitaphs. The questions were asked, “How this would benefit the learning experience?” “Would including all epitaphs enhance or distract from the interaction of the players?” Most felt that to stay true to the original text, somehow the entire book should be reproduced within the game, even if the decision to do so might not align with all game-like activities. To do this, the designers created a secret area within the game that contains the rest of the epitaphs that are not a part of the main game. Players may access this area after they have resolved all of the issues and solved one final problem. Again this was done so players would not spend time reading the epitaphs and fail to participate in the learning activities of the game. For development, it was a case of compromise.

Generally, the designers had to strike a balance between these constraints in order to come to a viable solution, one that aligned game activity with learning goals (see Table 1).

Table 1. Examples of learning goals the game-based activities partnered with them.

Game-based Activity	Learning Goal Activity
The students must put paper, which shows Jack has learned to write, on top of Marshal's grave. For more points break jug and place the pieces on top of grave.	Reading comprehension from reading the epitaphs and narrative text.
Find Somers as a non-playing character (NPC). Put a headstone recognizing him in the cemetery, where he currently has an unmarked grave. Solve poetry puzzle in order to get clues and solve issue for	Reading comprehension: understanding literary terms and character analysis

Somers.	
Students will explore and find different things to put on headstone.	Students will have to ask themselves, "What is Masters saying about happiness?" What makes a person happy?
Find the plaque in the printing press and the screwdriver and screws in the tool shed.	Students will sense the importance of the message. They will realize that this man was tarred and feathered, and the plaque was stolen in an attempt to silence the message.

The first activity in the table provides an example of how the designers conceived and developed using the prescribed process. In the first example, the activity of placing the paper on the grave or breaking the jug and placing the pieces on the grave have a purpose of teaching reading comprehension. The goal is accomplished by the player being able to take meanings from the epitaphs and narrative text and apply them to a game-like task. Texts provided within the game describe artifacts that may be used in solving the issue between the characters. The players must read these texts, analyze what purpose the artifacts might have, and apply that understanding in an activity.

This second example activity is meant to help students learn about poetry that contains figurative language like similes and metaphors. To solve the puzzle, the player will have to identify what simile or metaphor is being used and the purpose of it within the context of the game. Once solved, they use this information in a puzzle that will help them resolve the non-playing-character's pain. Reflection about the character and his motivation is a large part of instruction. The third example activity is meant to have players reflect on what the author intended in the epitaphs he wrote. Reflection upon the meaning of the epitaph is necessary to solve the puzzle. Critical thinking is a part of reflection that will help the students find the meanings needed. The designers attempted to have the player reflect on what the author was trying to convey through the epitaph and at the same time, reflect on what it means to them.

The final example describes a game-based activity designed to cause the player to reflect on what information is missing and what information is needed to complete the missing pieces. Once this is accomplished, the player will use the *completed* information to figure out what the intended meaning of

the message is. The designers of this activity wanted to convey what the meaning of the message applies to beyond the game itself. This activity was designed to help the player take the meaning of the message outside of the game and consider it in other contexts.

The designers reported success with this process in a number of ways. A specific example of this is forcing the player to read the epitaph on the tombstones they come across in order to find out who the gravesite belongs to. The teams decided to implement this mandatory reading to give themselves more control of the instruction of the player. If this did not happen, the players could come to a gravesite to find out who is buried there and move on without reading about and reflecting on what the epitaph read.

IDLF: Evaluation: Local Impact

The interactive fiction game *Voices of Spoon River* (*VOSR*) was implemented in a 9th grade English classroom in spring 2006. Two classes of students played *VOSR*, one having 27 students and the other 21 students. All but two students agreed to participate in data collection and analysis procedures, though all students participated in the poetry unit and played *VOSR*. The students attended a middle school generally considered to be within a middle class urban neighborhood in the western United States. Many students had experience playing Internet or console games as an entertaining activity and only one student had previous experience with interactive fiction. Data was collected and analyzed from 25 males and 21 females. Researchers observed the students while they played, interviewed them after their play, and collected all game transcripts for later analysis. The instructor administered pre-game and post-game assessments that included questions about past experiences with computer games. Through pre-game assessments, most students reported that they enjoyed playing computer games and the remaining students were indifferent. *VOSR* is a game used as a supplemental teaching tool to aid in teaching poetry, and for this particular poetry unit, the teacher taught tone, comprehension, character analysis, and critical thinking about what the meaning in each poem.

Implementation

The game was played in a computer lab at the school, each student having his or her own computer to play the game. The game designers developed a lesson plan for the teacher for this unit on

teaching poetry. A post-lesson assessment was developed by the game designers in conjunction the teacher that could be used to help assess student learning. Because the poetry consisted of free-verse epitaphs, a comprehensive list of poems was provided to the teacher to be used as a handout for students. The teacher eventually used his own lesson plan, applying a portion of the assessment to student grades, and used the provided epitaph handouts for his students.

Before game play and class discussion, the participating students were given a survey to gather some demographic information. Other questions asked the students if they like to play computer games and what kind of games they liked to play. After game play, the students were given an assessment and were asked questions like: "Did you like playing *Voices of Spoon River*?," "What did you like about playing this game?," and "What didn't you like about this game?" This allowed us to see if *VOSR* contained the same type of gaming elements as commercially successful games identified as making it motivational to play. The assessment also contained questions about the different issues within the game that needed to be resolved, about the epitaphs and their meanings, and about the different characters that the student players learn about while playing. These questions were aimed at addressing the students' level of reading comprehension, character analysis, and critical thinking.

Example questions included:

Who was the town drunkard?
- *A. Judge Somers*
- *B. The Town Marshall*
- *C. Chase Henry*
- *D. All of the above*

Why was the ghost of Judge Somers found hanging out at Chase Henry's grave?
- *A. He liked Chase Henry*
- *B. Chase's gravesite was a nice place to visit*
- *C. Chase was a good friend*
- *D. The judge was jealous that Chase had a tombstone and he didn't*

Reviewing the assessments helped us determine the 9th graders' ability to comprehend what they read, their analysis of the characters' motivations, and their critical thoughts about why things were said or done within the game.

The first day of game play the students spent their time exploring the environment and getting used to interacting with the game. For example, it took some time for the students to learn how to navigate the game. In IF, to navigate the environment, the player types "go north" to go north. Many students would type "go to gravesite," referring to a place rather than specifying a direction. Some students had played a type of IF game previously, so they were able to explore the environment faster than the players who were new to this genre. Experienced IFers were able to resolve issues faster than other students as well. Familiarity with the genre did not seem to impact the success of the students in making progress in the game, however, as the majority of the students resolved the most issues on the second day of game play regardless of gaming experience. Most students were able to resolve at least three of the six issues in the two days of game play. By reviewing the game transcripts, we could see what each student did during their game play activity.

Implementation Results

The purpose of implementing *VOSR* in the 9th grade classroom was to evaluate the game designers' efforts when using the alignment theory as a design constraint. To study the effects of a game built with alignment theory on student learning, we looked at how the game-based activity was aligned with specific learning goals and what the 9th grade players did during their gaming activity. Through analysis of game and interview transcripts, we found that most of the student players tended to explore the game environment in order to gather information and find game artifacts. While being interviewed, some of the students stated that they would just walk around in the game looking for things. When asked why, they said that when they found an item it would help make a connection to the information they had gathered. For example, by reading the epitaphs alone, students could not distinguish the game winning activities. After finding an item within the game, students said things just "fell into place" or "it just clicked, and I knew what to do." On the other hand, some students fell into a category where they had success in resolving issues within the game by trial and error or by referencing skills learned from playing other games—meaning that they implemented problem solving skills that they have learned from playing

other games. These particular students did not perform the actions that were aligned with the learning objectives, showing us that more time should have been spent on some areas in the design phase before starting development. In this section, we provide a few excerpts of the analysis as representative of the two groups previously explained. We first examined the Judge Somers issue as outlined in Table 1 above as an example of when students found an artifact and thing "fell into place." In doing so, we identified expected outcomes as designed by the game developers and unexpected outcomes as performed by students (see Table 2).

Table 2. An example of a learning goal, the game-based activities partnered with them, and activity outcome.

Game-based Activity	Learning Goal Activity	Activity Outcome
Find Somers as a NPC. Put a headstone recognizing him in the cemetery, where he currently has an unmarked grave. Solve poetry puzzle in order to get clues and solve issue for Somers.	Reading comprehension: understanding literary terms and character analysis	Expected: Students found a tombstone and used a wheelbarrow to haul and dump it on an empty spot to mark the Judge's plot. Unexpected: One student tried pushing the wheelbarrow up some stairs because she thought the Judge was located there.

Within *VOSR*, the character of Judge Somers is buried in an unmarked grave. To resolve his issue, players needed to find a tombstone and take it to his unmarked grave. In the course of the game, players will encounter the judge in a photography studio where he appears to stop them from going up some stairs until they first resolve his issue. After the judge gives the instructions, he disappears. Because of this experience, Stephanie, a student player, thought that the judge's ghost was upstairs. Examining her game transcript, she tried multiple times to push the wheelbarrow with the tombstone in it up the stairs.

NOTE: the text after the > symbol is the typed-in responses of the player. All other game transcript text is produced by the computer game.

Line #	Game Transcript	Analysis Notes
1971	Penniwit's Photography Studio	Stephanie knew that Judge Somers wanted a tombstone and tried to take it to where she thought he was located.
1972	This looks like an old photography studio where photographs were	
1973	developed. On the walls, you see some different photographs of	
1974	people and places. You see some stairs leading upward, and to the	
1975	west is Main Street.	
1976		
1977	>push wheelbarrow e	
1978	You can't go that way.	
1979		
1980	>push wheelbarrow up	
1981	Not that way you can't.	
1982		
1983	>dump wheelbarrow	
1984	You probably won't be able to pick the tombstone back up once	
1985	you dump it. Better wait until you are in the right place first.	
1986		
1988	>go up	
1989	A ghost in black flowing robes, wearing a white wig, appears in	
1990	front of you and says, "There's something you must do first before	
1991	you can continue!" The ghost then disappears.	
1992		
1993	>dump wheelbarrow	
1994	You probably won't be able to pick the tombstone back up once	
1995	you dump it. Better wait until you are in the right place first.	
1996		
1997	>push wheelbarrow w	Stephanie giving up and pushing the wheelbarrow west out of the photography studio.
1998	You push the wheelbarrow with you into the Main Street.	
1999		

In her post-game interview, Stephanie explained, “I didn’t know where the tombstone was supposed to go. I thought that it had to go to the ghost but it didn’t; it had to go to the empty spot.” She left the wheelbarrow in Main Street for a while. After finding the empty gravesite, she made the connection that it was the place for the tombstone. She then went directly to the wheelbarrow and pushed it to the unmarked grave and resolved the judge’s issue.

Even though Stephanie attempted an unexpected action by giving the gravestone directly to the ghost, she was eventually able to finally resolve the issue as the designers had in mind. However, another student acted in accordance with what the designers expected for this issue. Melissa was able to find the clues and solve the problems that led her to ultimately resolve Judge Somers’ issue.

1137 1138 1139 1140 1141 1142 … 1167 1168 1169 1170 1171 1172 1173 1174 1175 1176 1177 1178 1179 1180 1181 1182 1183 1184 1185 1186 1187 1188 1189 1190 1191 1192 1193	After reading Chase Henry's epitaph, you look up and see a ghost appear. >talk (to the ghost) …[moving forward in the transcript] The ghost looks at you and says: "If you really want to help me, let me show you..." What the Dickens! The ghost has transported you to somewhere else. Empty Spot This is a grassy spot of ground. You can go to the north, south, east, west, northeast, and northwest. You can see a ghost here. >talk (to the ghost) The ghost looks at you and says: HOW does it happen, tell me, That I who was most erudite of lawyers, Who knew Blackstone and Coke Almost by heart, who made the greatest speech The court-house ever heard, and wrote A brief that won the praise of Justice Breese? How does it happen, tell me, That I lie here unmarked, forgotten, While Chase Henry, the town drunkard, Has a marble block, topped by an urn, Wherein Nature, in a mood ironical, Has sown a flowering weed?	Melissa meets the ghost of Judge Somers and talks to him. He explains his issue that needs to be resolved. The ghost of Judge Somers helps make the connection by taking the player to the “Empty Spot” or unmarked gravesite. Judge Somers recites his epitaph to Melissa because he does not have a headstone where it can be displayed.

At this point, Melissa has spoken to the ghost and examined the empty spot of ground. It is unclear as to if she has made the connection between “empty” and a new place to put a tombstone. However, once she discovers the tombstone, she makes every effort to capture it and transport it directly to the empty spot, despite the vast locations she has already visited.

1335 1336 1337 1338 1339 1340 1341 1342 1343	>examine (the work bench) A tombstone is sitting on top of this work bench and captures your eye. >examine tombstone While examining this tombstone, you can tell that it was going to be a masterpiece. Something happened, and the mason was not able to finish his work. He was only able to engrave "Here Lies...".	Melissa discovers a tombstone on the workbench for the first time.

1344		
1345	>take	
1346	(the marble tombstone)	
1347	It looks too heavy to carry. Maybe you could push it into something.	
1348		
1349		
1350		In this interim, Melissa finds a nearby wheelbarrow.
…	…[moving forward in the transcript]	
1410		
1411	>push wheelbarrow e	
1412	You push the wheelbarrow with you into the Mason Shop.	
1413		
1414	Mason Shop	
1415	This is a shop where the master mason carved headstones. You see an exit to the west that leads out back. Main Street is to the east.	
1416		
1417	You can see a well used work bench here.	
1418		
1419	On the work bench is a marble tombstone.	
1420		
1421	>push tombstone into wheelbarrow	Melissa using the wheelbarrow to carry the heavy tombstone.
1423	The marble stone falls into the wheelbarrow with a dull thud and a poof of dust.	
1424		
1425		
1426		
		In this interim, Melissa directs the wheelbarrow directly to the empty spot.
…	…[moving forward in the transcript]	
1516	>drop tombstone	
1517	You haven't got that.	
1518		
1519	>give ghost tombstone	Melissa attempting to give the tombstone to the judge.
1520	(first taking the marble tombstone)	
1521	It's too heavy to lift from the wheelbarrow.	
1522		
1523	>tip wheelbarrow	
1524	marble tombstone:	Melissa succeeds in placing the tombstone on the unmarked grave.
1525	You tip over the wheelbarrow and the slab falls to the ground.	

In her interview, Melissa talked about how the activities of the game helped her understand what items needed to be used and what needed to be done in order to resolve the issue.

152	Interviewer: Let's talk a little more about the headstone and the plaque.	
153	Give me your thought process, how were you able to figure out that the	
154	headstone was related to the judge and that the plaque went on the	
155	headstone? Kind of tell me your thought process.	
156		
157	Melissa: I was just looking around the town randomly and the empty	
158	lot you know, "I was like that is kinda weird that there is an empty lot	Melissa explaining what she thought and did that helped her work through what needed to be done in order to resolve the issue
159	there for no reason." And so I went to the place where the headstone	
160	was found and I was reading it you know and I kinda thought that	
161	because there is no name and I thought that maybe there is somebody	

162 163 164 165 166 167 168 169 170 171 172 173 174 175 176	else you know and I went through and got the wheelbarrow and then I got the stone in there and I thought that I'm supposed to take this somewhere obviously and so I was just thinking and I thought the empty lot and I brought it there and that is when I met the ghost and I was talking to him and that is when he said "you found my stone and everything and he said I need thing." I went back and read his epitaph and I then I went to the courthouse and saw the plaque but it took me a while to because I had to find the screwdriver and everything and I went and got the plaque off and I put it all together. Interviewer: So it kind of was all… Melissa: It kinda comes and gets there like through the middle I would know something and there would be some things that were unclear but if I went back and read the epitaph I would kinda piece it all together.	of Judge Somers. Melissa's reasoning consistent with the alignment theory as designed.

She talked about how walking around the town of Spoon River helped her make connections between items and the actions that needed to be performed to resolve the issue.

> I would go through and I would first read an epitaph and something wouldn't make sense, but then I would go through the game and I would find an object and think, "Oh, that is what it's for," and then it would come together and then I would understand it.

Both Stephanie and Melissa demonstrated a functioning example of the designers' attempt at aligning game activity with instructional objectives. Because Stephanie had not yet performed all game activity needed to find necessary information, she had come to the incorrect conclusion of taking the tombstone to the ghost of Judge Somers and not the empty gravesite. However, Melissa had performed all of the necessary game activities and was able to perform the correct solution. Although their methods were different, they both demonstrated that game activity led to fulfilling at least one of the learning objectives.

The next excerpt is an example of how a student was able to solve an issue by using problem solving skills while not following the intended activities that were meant to be aligned with the learning objectives. This example failed in achieving alignment during the solving of the Mrs. Sibley issue. To solve the Mrs. Sibley issue in the game, the player needed to find a shovel and use it to dig up a small coffin and bury it next to the grave of Mrs. Sibley, reuniting her and her baby once again. When the player examines Mrs. Sibley's gravesite, the player sees an empty hole in the ground next to the headstone. While further exploring the surroundings, the player finds a mound of dirt that covers the

baby's coffin. After playing the game for a while and gaining experience on how to perform actions within the game and solve problems and issues, a student David was able to resolve this issue without reading the epitaph of Mrs. Sibley.

2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712	Gravesite You are in a secluded section of the cemetery. At your feet is a sad-looking headstone. An unscalable wall runs along the east side. Cemetery plots lie north, south, and west. Next to the headstone is a freshly dug hole about the size of a bread box. >x hole Really, what else can you say about a hole? It looks like it's just begging to be filled up with... something. >put coffin in hole You gently place the coffin in the infant's grave and push dirt over it. The ghost of Mrs. Sibley suddenly notices you. "You found it and brought it to me!" she cries in joy as she kneels over the tiny grave. Her spirit slowly fades into nothing. You know one more spirit has found rest. [Your score has just gone up by five points.] [You have 6 issues left to resolve.]	*Note: If a player enters a gravesite and does not examine the headstone, he or she will not have read that particular epitaph. Once the headstone is examined and the epitaph is read, the gravesite will then read Mrs. Sibley's gravesite. Because this example still says gravesite, this player did not examine the headstone or read the epitaph.* David resolving the issue without performing some of the game-based activity.

David had found some clues and solved other puzzles that allowed him to gain access to a shed where he found the shovel. While exploring the environment, he came across the dirt, dug it up, and found the small coffin. Putting the coffin in his inventory, David walked around Spoon River until he came to gravesite that had a hole in the ground next to it. He examined the hole and then placed the coffin in the hole, thus resolving Mrs. Sibley's issues without reading her epitaph. David had performed all but one of the game activities needed to gather all information. He showed his ability to problem solve by making connections between game artifacts. This example shows that without the proper aligning of game activity with the desired outcome (reading comprehension of Mrs. Sibley's poem), players can succeed in the game, but will not reach the intended learning objective.

Parras and Bizzocchi (2005) discuss the importance of reflective activity as also aligned with game play, and thus within the course of achieving instructional goals:

> In educational game design it is important to ensure that learning takes places within the realm of play, even if learning is only made possible through reflection. To do so, reflection must appear to the learner as one of the many in-game goals that drive the game-play.

There exists some evidence suggested by the transcripts of in-game reflection of character motivations and connections with one another, in fact, the genre itself allowed for such reflection due to its nature of having to wait for player input for narrative progression. It may very well be the case that the game genre itself dictates the effectiveness of activity-goal alignment during game play, a point recently discussed by Dickey (2006) and worth further exploration for subsequent study.

Discussion

Through the lens of the informed exploration, enactment, and local-impact evaluation provided by the IDLF framework, the research in this paper described 1) how an educational game was designed and developed by using the alignment theory as a guide during an iterative process, and 2) how affective the alignment theory was when implemented within a classroom lesson. When using the alignment theory as both a design guideline and constraint, it was at times a struggle for the game designers. The designers spent a significant amount of development time trying to understand what makes a good game and how games have been used in educational settings. With this background as a basis for their understanding of the instructional objectives, this group of game designers hoped that the intended use of the alignment theory would result in a successful game and ultimately, a successful learning experience for those who played it. Observing the designers-as-game-players allowed researchers to see aspects of interest and motivation while playing. Analyzing student interviews and game transcripts gave insight into how the alignment theory worked as a game design tool and as an educational experience. There are extracted examples of alignment between game-based activity and learning goals and instances of non-alignment as well. The non-alignment examples found during the data analysis of this study indicated that the understanding of activity-goal alignment theory needs to be revisited. The next steps in this process include formulating recommendations for redesign that address the non-alignment examples as based in activity-goal alignment theory. Short of this formulation, the findings indicated that the alignment theory is only as strong as these game designers and their ability to match the game-based activity to the

intended learning goals. Certainly, additional cycles of design, development, implementation and evaluation are necessary to strengthen the game and assist in the understanding of alignment theory as a game design paradigm.

The designers in this research implemented a design process of aligning game-activity to sustain high levels of motivation while aligning that activity with those of the instructional goals. In various capacities they struggled to integrate their design while keeping game-based elements balanced with objectives relating to reading comprehension, character analysis and reflective activity. However, the resulting game product proved to be one that the designers felt stayed true to the original activity-goal alignment theory. They felt like doing so created extra challenge for them during design, but are optimistic about the learning outcomes once the game has been implemented for its intended context. The implementation will commence in the next phase of research; a new group of IT designers will look at data collected during the implementation to consider issues regarding re-design and re-development of the game. A prudent area of research will be aimed at collecting and analyzing data to consider how motivational the game was for students to play.

One designer reflected on the experience, "I thoroughly enjoy the challenge of trying to come up with a fun puzzle that accents a learning objective. It's much harder than coming up with a fun puzzle, or designing good instruction. You have to do both, simultaneously…." Balancing the integration of game design activities and learning objectives can be difficult. We suggest educational game designers avoid designing activities that are included only perceived as *fun* and contain little or no instructional value. Fun activities may enhance the level of fun or challenge, but at the same time distract the player from achieving the objectives. The initial design of the game in this study found success through the articulation of learning objectives when storyboarding. This way, designers kept instructional goals close-at-hand when building activities that were also deemed entertaining. When brainstorming possible in-game activities, designers organized activities by their relationships to the learning objectives. Physically drawing connections between the activity and learning objective and discussing how the activity aligns with the learning objective was an observed, helpful design activity. Similar to software design processes,

the designers tested incrementally and often. They had novices play the game and watched what they did. Looking for connections between players' actions and the learning objectives informed whether or not the designed activity that helped the players learn. If the learning objective was not achieved, then the activity was revisited and adjusted to improve the alignment to the learning objective.

Implementing the game in a 9th grade English classroom allowed a perspective of how the alignment theory works. The opportunity to study the game in a classroom setting also provided insight into how the designers' intended purpose of adding motivational gaming elements to an educational game would make the game fun to play. After game play, the researchers spent time with the teacher of the class and discussed the lesson and what he thought of the experience that day. On one occasion, the teacher stated how glad he was that the students were forced to read the epitaphs in order to learn about the different characters in the game. He discussed a particular instance when the player needs to know a specific word in order to answer a riddle presented to them by a ghost. The player must comprehend what is in a particular epitaph in order to find the answer to the riddle.

Because this game was implemented with one teacher and his students, the game-playing results may only apply to the students that participated in this implementation. If another 9th grade English class were to play this game, it is possible that game-play results may be different. We also assert that this research is not generalizable to all graduate student game designers and that these findings may apply only to the participants of this study. However, we hope that future student and non-student educational game designers can use these finding in an effort to improve the potential for learning in the games they create.

Our presence as observers may have been a possible limitation on this research. Because we trained the 9th grade students on how to use the game, these students may assume that we were advocates, which may have influenced the students' answers to the interview questions. For example, some of them may have embellished their use of some features, while others may feel reluctance to admit that they did see any value in the activity. Because we only followed a single iteration of implementation, we cannot identify how recommended changes to the game's design would affect student performance or strengthen

the activity-goal alignment. Certainly, the design-development theory should be tested with other genres that use different types of gaming environments to test in other situations and with other teachers.

Recognizing these limitations, studying design and development activity helps inform theory by identifying and integrating new prescriptive activity based on the results. The intention is for research to help instructional technology designers in the next round of *Spoon River* game development and in the next level of implementation in the classroom. In subsequent development phases, research should address in more detail both what students learn from the game and how their motivation is affected in a *broad impact evaluation* (see Figure 1). Teachers of instructional technology may then incorporate more effective design and development practices for their students of educational game design. Is the learning activity from the developed games as expected, or do the players' instructional goals change during course of game play? A useful approach would include a comparison between learning through an aligned instructional game and a traditional pedagogical approach aimed at the same objectives. *Broad impact* implications also help inform teaching practices for instructional technology designers who attempt to apply both game design and instructional design theory in their projects, inside and outside of the classroom.

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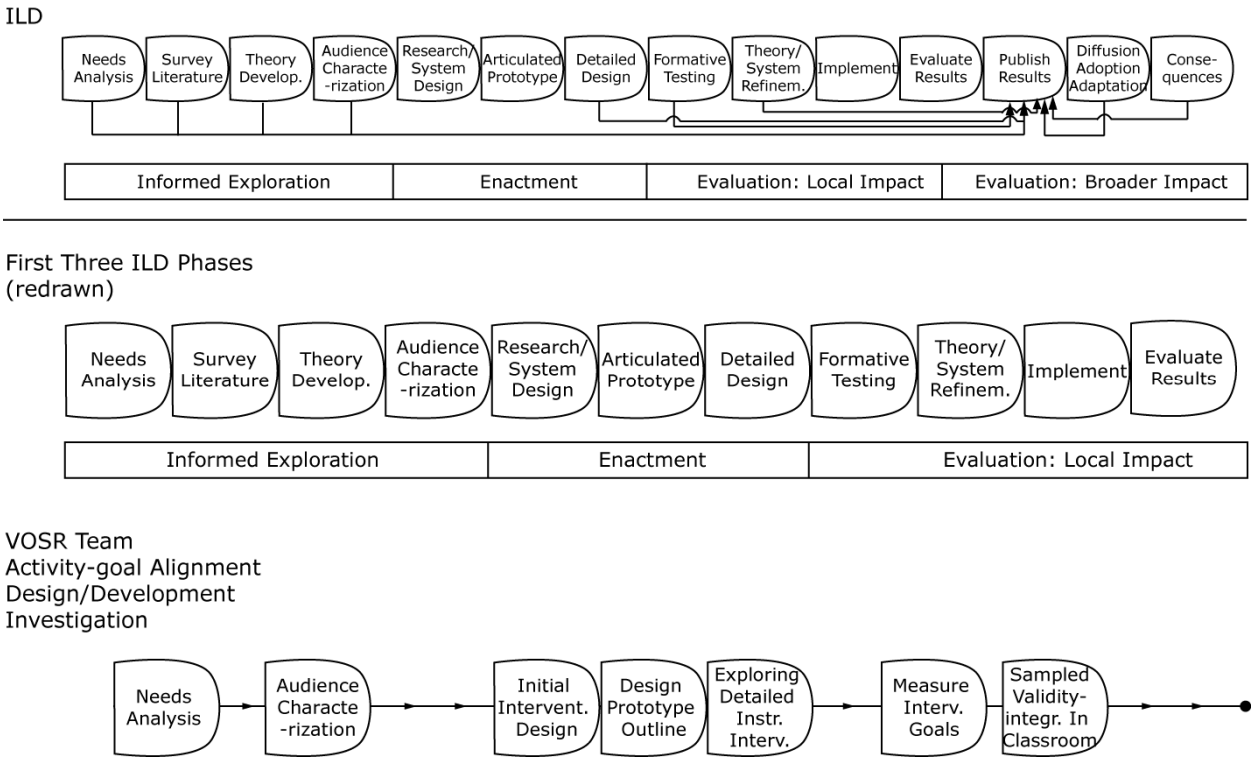

Figure 1. The IDLF framework (redrawn from Bannan-Ritland 2003) as instantiated through this instance of activity-goal alignment. Methods of informed exploration, enactment, and local impact evaluation are described through a case of educational game design, development and implementation.

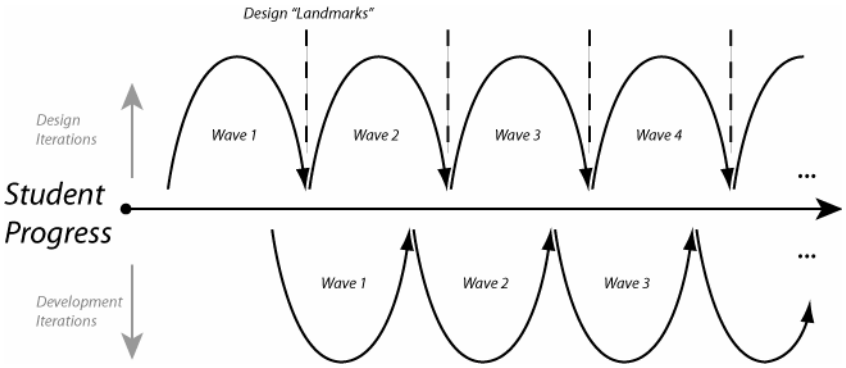

Figure 2. The design-development process that evolved for the activity-goal alignment game.

Table 1. Examples of learning goals the game-based activities partnered with them.

Game-based Activity	Learning Goal Activity
The students must put paper, which shows Jack has learned to write, on top of Marshal's grave. For more points break jug and place the pieces on top of grave.	Reading comprehension from reading the epitaphs and narrative text.
Find Somers as a non-playing character (NPC). Put a headstone recognizing him in the cemetery, where he currently has an unmarked grave. Solve poetry puzzle in order to get clues and solve issue for Somers.	Reading comprehension: understanding literary terms and character analysis
Students will explore and find different things to put on headstone.	Students will have to ask themselves, "What is Masters saying about happiness?" What makes a person happy?
Find the plaque in the printing press and the screwdriver and screws in the tool shed.	Students will sense the importance of the message. They will realize that this man was tarred and feathered, and the plaque was stolen in an attempt to silence the message.

Table 2. An example of a learning goal, the game-based activities partnered with them, and activity outcome.

Game-based Activity	Learning Goal Activity	Activity Outcome
Find Somers as a NPC. Put a headstone recognizing him in the cemetery, where he currently has an unmarked grave. Solve poetry puzzle in order to get clues and solve issue for Somers.	Reading comprehension: understanding literary terms and character analysis	Expected: Students found a tombstone and used a wheelbarrow to haul and dump it on an empty spot to mark the Judge's plot. Unexpected: One student tried pushing the wheelbarrow up some stairs because she thought the Judge was located there.