A Communication Framework: A Babel Fish for Instructional Game Designers

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ABSTRACT

"…if you stick a Babel fish in your ear you can instantly understand anything said to you in any form of language." *Hitchhiker's Guide to the Galaxy.* Designing serious games for learning is undoubtedly the most complex, multi-disciplined technology-based challenge existing in our training world and is increasingly popular for military training. Somewhat of a rift has developed between game designers (including developers, graphic artists, and designers) and instructional designers. Some assert that instructional designers take all of the fun out of a game (Aldrich, 2005) and some accuse game designers of creating only "eye candy" (Squire, 2008). As part of a larger study for the Office of Naval Research, Capable Manpower Future Naval Capability Program, we are examining learning game design. In particular, we are studying how the various disciplines conceptualize serious game design and how to facilitate communication among the disciplines. This will lead to a model for learning game design that accommodates the needs of all learning game design disciplines. This paper describes our efforts to understand the perspectives of different design disciplines and the impact on a communication framework for instructional game design.

ABOUT THE AUTHORS

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INTRODUCTION

Designing serious games for learning is undoubtedly the most complex, multi-disciplined technology-based challenge existing in our training world and is increasingly popular for military training. Somewhat of a rift has developed between game designers (including developers, graphic artists, and designers) and instructional designers. Some assert that instructional designers take all of the fun out of a game (Aldrich, 2005) and some accuse game designers of creating only "eye candy" (Squire, 2008). Our own learning game design team experiences suggest that each discipline involved in learning game design has its own considerations and priorities – all important to the design process. However, we struggle to understand each others' perspectives. It is clear that the design process needs to be examined and modified to facilitate learning game design. As part of a larger study for the Office of Naval Research, Capable Manpower Future Naval Capability Program, we are examining learning game design. In particular, we are studying how the various disciplines conceptualize serious game design and how to facilitate communication among the disciplines. This paper describes our efforts to understand different design disciplines and the impact this has on a communication framework for instructional game design.

To initiate discussions among the learning game design disciplines, a Community of Interest was begun and had its first meeting in December 2009. Participants included representatives from industry, academia, and the government. A wide variety of disciplines were represented including game design, cognitive science, instructional design, software development, game development, management, and graphic design. To initiate discussion among disciplines, attendees were assigned to small interdisciplinary groups (each group having at least one game developer, one instructional designer, one government representative, and one management representative). Small groups were asked to discuss the challenges of learning game design and to come up with a top five list. Then they were asked to discuss the factors that make a learning game successful and to come up with a top five list. The most frequent responses from the groups are shown in Table 1.

Table 1. Small Group Activity Results

Top Factors for Success	Top Challenges
• Subj matter expert input	• Resources
• Assessment and feedback	• Application of the science of learning
• Implementation	• Integration with current training
• Multidisciplinary approach	• Multidisciplinary design

Three of the four top factors for success were also top challenges; application of instructional elements, implementation considerations, and using a multidisciplinary approach. While each deserves study, we focus here on how various disciplines approach learning game design.

BACKGROUND

The Instructional System Design (ISD) process is a basic problem-solving process (define the problem, develop a plan, implement the plan, then evaluate and adjust); its purpose is to create an environment that will bring about learning (Dick, Carey & Carey, 2009). The ISD process assumes that we can reasonably predict how variables will impact learning and we can manipulate those variables to ensure that learning objectives are met by the learner. The decisions at each step of ISD require an understanding of the science of learning, making application of the process more difficult than it appears. ISD is not meant to be used as a linear process. And in fact, Dick, Carey, and Carey

(2009) describe the Concurrent ISD Process used in rapid prototype development that uses multiple cycles of planning, development, implementation, and revision occurring at the same time. ISD is intended to be applicable to any instructional intervention and is used widely.

Many game design models focus on an iterative approach. Salen and Zimmerman (2004) describe an approach to game design that emphasizes a cycle of prototyping, play testing, evaluation and refinement. Feedback from these successive iterations of the game help the designer(s) refine the game. Rouse (2005) also advocates an iterative process, building the game incrementally, play testing to see what "feels" right, and then making the desired adjustments. Rouse (2005) describes the nature of entertainment game design as "highly unpredictable" and concludes there can be no one efficient and predictably effective game design process. Salen and Zimmerman (2004, p. 12) are referring to entertainment games when they state, "Even a veteran designer cannot exactly predict what will and will not work before experiencing the game first hand." The game development process assumes it is not possible to anticipate effective play in advance and therefore, the iterative design approach works best. The only way to know that the game is achieving its goals is to play the game (or have others play it) and assess the experience.

One can see where disconnects may occur when the instructional design and gaming disciplines begin to merge to design instructional games together. Each discipline is confident in its approaches, each is sure its designers will attain the goals of the learning game.

While several learning game design models or frameworks have been proposed (Fanning, 2008; Gunter, Kenny, & Vick, 2008; Garris, Ahlers & Driskel, 2002; Squire, 2006), no one learning game design approach has gained wide acceptance and most learning game design teams use ad-hoc approaches. We believe this may be due to the multi-disciplinary nature of the design problem, and the various perspectives that are brought to bear during design. As our Community of Interest confirmed, a multidisciplinary design team is essential to effective learning game design, but this is also our greatest challenge. A robust learning game design framework must address these differences.

INITIAL DATA COLLECTION

We began our study with an initial data collection at our first Community of Interest meeting in December 2009. The purpose of this data collection was to explore the issues that would be further examined in the final Learning Games Design Survey. We provided a multidisciplinary group of serious game designers with a serious game design scenario and asked them to respond to six open-ended questions regarding their approach to the design problem. Respondents were asked (in the context of the design scenario):

1. What elements would make this a good, pedagogically-effective game?
2. What else do you need to know to design this game?
3. What priorities would you consider in your design?
4. How would you decide what game behavior to reward/penalize?
5. What disciplines are needed to design/develop the game?
6. What artifacts or documents would be developed?

Responses to these questions provided a foundation on which to base follow-up survey items.

We grouped the twenty-one respondents by discipline, based on their demographic responses to facilitate our qualitative data analysis; instructional disciplines (n=6); gaming disciplines (n=8); and management (n=7). Data were then analyzed by establishing categories of responses and then calculating the frequency of the categories. While there was much variety in responses, we identified the frequency of categories across disciplines and within each discipline.

Responses suggested how the different disciplines approach the design of instructional games. For example, when asked to list the elements of a pedagogically-effective game, 83% of the respondents from the instructional disciplines and none from the gaming disciplines cited learning objectives. However, 50% of respondents from the gaming disciplines and none from the instructional disciplines cited scenarios. This suggested that when designing a serious game, the instructional disciplines focus on learning objectives in contrast to the gaming disciplines that focus on scenarios. There was not strong agreement (>50%) in any area among all respondents; no one response was provided by more than 33% of the respondents. The only area where there was strong agreement across disciplines was the need to include the instructional

design discipline in learning game design (62% agreement).

The results of this survey suggested there are areas of disagreement among disciplines and provided a foundation on which to develop the next set of research goals. The follow-up data collection clarifies:

- Definitions of certain terms
- Goals of different disciplines
- Paradigms used by the disciplines in the areas of authenticity, design, feedback, fun, and goals.
- Priorities.

LEARNING GAMES DESIGN SURVEY

Participants

The survey was distributed to the Learning Games Design Community of Interest. This group is made up of eighty-nine members, representing a variety of game design disciplines, and organizations (government, industry, and academia). Forty-four responded to the survey for a response rate of 49%. Respondents represented the following disciplines; management (7%), gaming discipline (31%), instructional/education disciplines (44%) and other (18%). There was also a variety of gaming experience; simulations (36%); entertainment games (27%), and instructional games (38%).

Procedure

A pilot survey was developed first. Questions were based on the initial survey results, follow up discussions during a Learning Game Design Community meeting, and from learning game design references (e.g., books, articles, and research studies). References helped to identify statements in the areas of authenticity, design, feedback, fun, goals and game design. For example, Gunter, Kenny, & Vick (2008) found disagreement in term definition between the gaming and instructional disciplines, particularly the terms interaction, engagement, and immersion. Squire (2008, p. 17) stated "A common misconception about games and simulations is that they are perfect representations of reality." These assertions were translated into items to determine the degree to which our multidisciplinary groups would agree.

The on-line survey development tool provided a URL that linked to the pilot survey, enabling respondents to complete it on-line. The URL was sent to an intact instructional game design team (n=20). There were seven respondents (35% response rate); two from the instructional disciplines, four from gaming disciplines, and one from management. We examined their responses (including comments) to identify items that were consistently left blank, yielded ambiguous information, or were misunderstood. The pilot survey was updated to create the Learning Games Design Survey

The survey asked participants to:

- Provide demographic information (discipline, years experience, and game-type experience).
- Rate the importance of twenty-two game elements in making an a game instructionally effective using a 4-point Likert scale (1=not at all important, 2=somewhat important, 3=important, and 4=very important).
- Rate the degree to which they agreed or disagreed with thirty-three statements regarding game design using a 6-point Likert scale (1=strongly agree, 2= disagree, 3=tend to disagree, 4=tend to agree, 5=agree, and 6=strongly agree).
- Indicate how often they would expect a list of twelve game design elements to change when using an agile approach to instructional game design/development using a 4-point Likert scale (1=never, 2=rarely, 3=sometime, 4=frequently).
- Select one of four statements that best define four terms; immersive instructional game, high-fidelity, adaptive instructional game, and engagement.

The URL for the Learning Game Design Survey was emailed to individual members of the Learning Games Design Community of Interest. The link was also posted on the group's website. A reminder was sent out after one week to individual members and also posted on the website. A last reminder was sent out after two weeks and the survey was kept open another week.

Analysis

Respondents who selected "other" as their discipline were put into one of the two discipline categories (instructional or gaming) to facilitate data analysis. We looked at their self-reported discipline as well as the reported years of experience in each of the experience

item categories and made the final determination of discipline category. In one case, we were able to contact the respondent and ask him/her to identify the appropriate category. Three respondents identified management as their discipline. We examined their years of experience and placed them into either the instructional or gaming discipline groups. [i]

Data from the survey were analyzed quantitatively to answer the two research questions 1) Are the responses on each item different by discipline and if so, how? And 2) Are the responses on each item different by game type experience and if so, how? To answer the first question, we ran independent t-tests with discipline group as our independent variable; IDG (instructional discipline group) and GDG (gaming discipline group). The second question was answered by performing an ANOVA by game type experience; IGE (instructional game experience), EGE (entertainment game experience), or SimE (simulation experience).

Findings and Discussion

Findings from the survey are presented by the five categories of survey items; goals, authenticity, design, feedback, and fun. In each section we highlight those findings that indicated either strong agreement among all respondents, departures from past research or significant differences based on the respondents' disciplines or gaming experiences.

Goals

Part of being a cohesive team is having shared goals. We hypothesized that goals would differ based on discipline and past experience. While respondents agreed that various goal factors were important, the strength of that agreement varied by discipline and gaming experience. These differences call attention to different perspectives that may well affect what a team member is willing to sacrifice during an iterative design process.

Responses to items relating to learning objectives identify potential areas for tension during the design process. To gauge how our respondents value learning objectives, we included five different survey items. The first item asked respondents to rate the importance of learning objectives in an instructionally effective game. While thirty-eight (95%) respondents rated learning objectives as important or very important, we found statistically significant differences when the data were analyzed by discipline (t=2.04, p<.05) and by game type experience (F(2,17.77)=4.53, p<.05). The IDG respondents rated learning objectives as being more important (M=3.83, SD=.38) than GDG respondents (M=3.47, SD=.74). And the EGE rated learning objectives lower (M=3.27, SD=.77) than the SimE (M=3.85, SD=.38) and the IGE (M=3.27, SD=.79) groups.

Thirty-one (78%) respondents rated the second item, communicating clear learning goals to the player, as important and when we analyzed these data by game-type experience we found differences in the three groups (F(2,37=4.47, p<.05). The EGE rated communicating learning goals to the player as being less important (M=3.27, SD=.79) than the SimE (M=3.85, SD=.38) or IGE (M=3.88, SD=.34) groups.

Next, we asked respondents to rate their agreement with the statement "The first step in instructional game design is determining the learning objectives." Ten (26%) of our respondents agreed with this statement. There were no differences by discipline, but when we analyzed the data by game type experience there was a difference among the three groups (F(2,27.05, p<.05) with the IGE group more strongly agreeing (M=5.87, SD=.35) with this statement than the EGE group (M=5.36, SD=.674).

Fourth, we included an item with the statement "Learning objectives are the primary drivers of an instructional game design." Thirty-five (97%) respondents tended to agree to strongly agree with this statement. When analyzed by discipline, there a significant difference was identified (t=2.81, p<.05) with the IDG more strongly agreeing (M=5.76, SD=.54) than the GDG (M=5.07, SD=.92).

And fifth, we asked about changing learning objectives during the design process to accommodate a scenario design. Twenty-five respondents (31%) agreed that learning objectives could be changed during the design process; and when analyzed by discipline, differences between discipline groups were evident (t=-2.68, p<.05). Specifically, the GDG agreed more strongly (M=3.93, SD=1.07) than the IDG (M=2.67, SD=1.53).

Altogether, these five items suggest that our respondents recognize the important role of learning objectives in the design of learning games. Respondents with an instructional background tended to feel more strongly about learning objectives than respondents with gaming backgrounds. Communicating learning goals was particularly important to

respondents with instructional backgrounds. Respondents with an instruction background felt more strongly about establishing objectives as a first step in the design process than other respondents. And, they more strongly agree that learning objectives are the primary drivers in an instructional game and that they should not be changed to accommodate scenario design.

We also examined the issue of goals by including items that addressed instructional game evaluation. As Dick, Carey and Carey (2009, p.xxiii) explain "The nature of the goal will drive the instructional strategy and evaluation." Our assumption is that what our respondents find important in an evaluation provides some indication of the valued goals of the game. Nineteen (53%) respondents agreed that usability is the most important aspect of instructional game evaluation. Analysis of the differences between discipline groups (t=-2.64, p<.05) indicated that the GDG (M=3.93, SD=.73) more strongly agreed with this statement than the IDG (M=3.00, SD=1.34).

Thirty-three (92%) responded that they tend to agree to strongly agree that a good instructional game must produce measurable learning outcomes. Differences between the two discipline groups were identified (t=2.61, p<.05) with the IDG agreeing more strongly (M=5.57, SD=.746) than the GDG (M=4.72, SD=1.20). Similarly, thirty-four (94%) tend to agree to agree on a related item that stated "Achieved learning goals are the most important aspect of instructional game evaluation". While there were no differences by discipline, when the data were analyzed by game-type experience differences between the three groups were detected (F(2,33)=10.512, p<.05). The IGE (M=5.73, SD=.46) and SimE (M=5.42, SD=.90) groups more strongly agreed than EGE (M=4.33, SD=.87) group.

Twenty-nine (81%) responded that they tend to agree to strongly agreed that game goals and learning objectives must align. However, when analyzed by discipline, differences were revealed (t=3.26, p<.05) with the IDG more strongly agreeing (M=5.29, SD=1.10) than the GDG (M=3.93, SD=1.44). When analyzed by game type experience, a significant difference (F(2,33)=4.12, p<.05) was found; the IGE more strongly agreed (M=5.40, SD=1.06) than EGE (M=3.89, SD=1.453).

The findings from the goal items suggest that there are some differences in how the disciplines think about game goals. Respondents with an instructional background tended to find achieved learning goals and measurable learning outcomes more important in game evaluation than did respondents with a gaming background. And those with a gaming background tended to find usability as important in game evaluation. When it came to aligning game goals and learning objectives, respondents with instructional background tended to find this more important than those with a gaming background.

Authenticity

Authenticity refers to the realistic nature of a game that may be manifested in several ways, often referred to as types of fidelity. Environmental fidelity refers to the objects in the environment (e.g., realistic buildings, streets, and animals) and/or the authenticity of tools or apparatus used in the game. Authenticity may also refer to cognitive fidelity, indicating the degree to which the player must use the same thinking skills required for real-world tasks. Task authenticity requires that tasks in the game mirror tasks in the real-world. When asked to select the statement that best characterizes a "high-fidelity" instructional game, respondents overwhelmingly selected cognitive authenticity over the other definitions. Specifically, twenty-seven (75%) respondents selected authentic thinking, seven (19%) selected authentic gaming environment, two (5%) selected authentic game tasks and none selected authentic tools. There were no significant differences between disciplines or among game type experiences for this item. Differences, however, were detected on several other items relating to the use of fantasy and the representations of realism in a game.

Although thirty-four (90%) respondents were in agreement that fantasy has a place in instructional games; responses to another question seemed to qualify the use of fantasy and highlight differences between disciplines. Those from the IDG were more likely to indicate that fantasy must provide a useful metaphor than those from the GDG (see Table 2). The two disciplines differed in their level of agreement on two additional items related to the use of reality. As shown in Table 2 the IDG was more likely to emphasize the role of realistic representations.

Table 2. Differences in Levels of Agreement with Authenticity Items by Discipline Group.

Item	*IDG n=22* *M (SD)*	*GDG n=15* *M (SD)*	*t**
Effective instructional games provide true representations of reality.	3.55 (1.41)	2.53 (1.19)	2.29
Fantasy in instructional games must provide a useful metaphor.	4.64 (1.36)	3.73 (1.28)	2.26
The more realistic instructional games are, the more compelling and immersive they are.	4.14 (1.32)	3.00 (1.31)	2.58

*$p < .05$, Items were rated on a six-point scale, with 1=strongly disagree, 6=agree.

Similar differences were found between discipline groups when asked to rate the importance of an effective game mirroring real-world job tasks. There was a significant difference between discipline groups (t=1.67, $p < .05$); with the IDG rating it more important (M=3.13, SD=.80) than the GDG (M=2.33, SD =2.67) on a four-point scale.

Analysis of authenticity items by game experience revealed significant differences in responses regarding real-world tasks and the importance of an authentic environment. Statistical comparisons indicated (F(2,37)=10.99, p<.05) that the EGE group rated the importance of mirroring real-world task significantly less important (M=1.91, SD=.70) than the IGE group (M=3.31, SD=.70) or SimE group (M=3.08, SD= .95). Significant differences by gaming experience were also found on importance of an instructional game providing an authentic environment (F(2,37)=4.33, p<.05). In this case, the SimE group rated it more important (M=3.08, SD=.76) for learning games to provide an authentic environment than did the EGE group (M=2.09, SD=1.04).

Given the overwhelming agreement that high-fidelity in a game refers to authentic thinking, we conclude that respondents expect learning game activities (regardless of levels of other types of authenticity) to exercise authentic thinking skills. But exactly how to design those experiences and the degree of realism may vary according to the designer's discipline and game type experience. The data suggest that respondents with an instructional perspective, particularly those with simulation experience, tend to want more realism in instructional games than respondents with a gaming perspective. Respondents from the learning industry are likely concerned with transferring what is learned in the game to the real-world environment. And a widely accepted strategy for facilitating learning transfer is to increase the fidelity of the training environment so that the features are common to the performance environment (Bransford, Brown, Cocking; 1999).

Design

This category encompasses various aspects of learning games, including the use of characters, graphics, target audience, animations, interfaces, use of reflection, and the delivery platform. Respondents (n=40) agreed that incorporating well-developed characters (68%), using dynamic graphics (60%), adapting the game to player performance (68%), allowing for learner control (58%), and accommodating novices and experts (83%) are important elements for game design with no differences between disciplines or game type experiences.

While 70% of the respondents agreed that providing opportunities for reflection is important, when analyzed by game-type experience, a significant difference was detected (F(2,37)=5.91, p<.05). The EGE group rated opportunities to reflect on learning significantly less important (M=2.55, SD=.93) than the SimE (M=3.46, SD=.88) and the IGE groups (M=3.50, SD =.52). This finding highlights a strength of a multidisciplinary design team. Team members with an instructional background understand that reflection is a key tenet in experiential learning theory (Beard & Wilson, 2002; Kolb, 1984) and that it is necessary for learners to modify their thinking as a result of their experiences. They are likely to push for such opportunities in learning games. Team members from the entertainment industry can use their knowledge and experience to integrate such opportunities in engaging ways.

Respondents were asked to indicate how often they expected game design items to change when using an agile approach to instructional game design/development. A pattern appeared whereby respondents with an instructional background tended to expect design elements to change less frequently than respondents with a gaming background. When statistically analyzed by discipline, significant differences were identified in four items that supported this response pattern and are summarized in Table 3.

Table 3. Differences in Expected Change Frequency Items by Discipline Group.

Item	*IDG n=22* *M (SD)*	*GDG n=15* *M (SD)*	*t**
Game mechanics	2.48 (.93)	3.14 (.54)	-2.69
Graphic user interface	2.24 (.94)	3.07 (.62)	-3.16
Look and feel of the game environment	2.24 (.77)	2.93 (.62)	-2.81
Character profiles	2.48 (.75)	3.14 (.66)	-2.70

*p<.05, Items were rated on a 4-point scale with 1=never and 4=frequently.

Analysis of these items by game-type experience revealed an additional difference in the expected frequency of changes to the number of players in the game (F(2,33)=6.05). The SimE group expected more frequent changes to the number of players in the game (M=3.08, SD=.67) than did the IGE group (M=2.13, SD=.64). The game type experience groups also differed significantly in how frequently they expected character profiles to change (F(2,33)=12.72). While the IGE expected less frequent changes (M=2.13, SD=.64) than both the EGE and the SimE, the EGE expected less frequent changes (M=3.00, SD=.50) than the SimE (M=3.25, SD=.62).

Past research has suggested differences between disciplines in their definition of terms often used in reference to learning games, including "immersive" and "engagement" (Gunter, Kenny, & Vick, 2008). In two separate items, respondents were asked to select the statement that best characterized "an immersive instructional game" and "engagement in context of an instructional game". Half of the respondents (n=18) selected "a rich environmental context" to characterize an immersive instructional game, nine (25%) selected "players are constantly challenged", seven (19%) selected "learning in an emotionally compelling context", and two (5%) selected "constantly interacting with other players". With respect to defining engagement, twenty-two (61%) of the respondents selected "the player is always thinking about something in the game". Seven (19%) selected "the player is always feeling". Four (11%) selected "the player is always learning", and three (8%) selected "the player is always doing". There were no differences among disciplines or game-type experience.

Feedback

Learning games provide highly interactive experiences that engage learners in ways to promote understanding; however, shaping those experiences is a complex process requiring assessment and feedback. The challenge is to integrate assessment and feedback effectively without disrupting the game play. Feedback is a critical component of an instructional design strategy. Our respondents recognize this as thirty-two respondents (80%) indicated that it is important to assess performance throughout an instructional game. Thirty-five (88%) of our respondents rated letting the players know when they are right or wrong during the game as important to an effective instructional game.

Respondents were asked to rate their agreement with five items addressing feedback. When these items were analyzed by discipline, there were no significant differences in the way the two groups responded. Both discipline groups agreed that is OK to stop the game to give feedback to learners (M=4.41, SD=1.19) or to provide hints (M=4.51, SD=1.07). Both disagreed that explicit feedback is too disruptive to game play to be used in a learning game (M=3.03, SD=1.12). Contrary to game design literature (Prensky, 2007) both groups disagreed with the statement "Penalties should not be used in an instructional game" (M=2.54, SD=1.15) and disagreed with the statement "Natural feedback is the only feedback needed in an instructional game" (M=2.68, SD=1.25).

When analyzed by game-type experience, two items that focused on when it is appropriate to stop game play revealed differences among game-type experience groups; each time the EGE was less likely to favor stopping the game than the IGE or SimE groups. Specifically, the EGE group less strongly agreed (M=3.73, SD=1.42) that it is OK to stop the game to provide performance feedback than the IGE (M=4.87, SD=.92) and SimE (M=4.50, SD=1.00) groups (F(2,35)=3.40, p<.05). Similarly, EGE respondents less strongly agreed (M=3.91, SD=1.14) that it is OK to stop the game to provide hints than SimE respondents (M=4.58 SD=1.0) and the IGE respondents (M=4.93, SD = .88) (F(2,35)=3.38, p<.05).

Thirty-one (86%) respondents expected guidance or hints given to players to change frequently during the process of game design and twenty-four (67%) expected the feedback strategy to change frequently. There were no significant differences in responses between disciplines or game-type experience with

regard to how often hints given to players would change. However, the IDG (*M*=2.61, *SD*=.59) did not expect the feedback strategy to change as frequently as the GDG (*M*=3.14, *SD*=.66). This finding was also reflected in the results of an analysis by game-type experience ($F(2,33)=3.42$, $p<.05$) where the IGE respondents expected the feedback strategy to change less frequently (*M*=2.53, *SD*=.52) than the EGE respondents (*M*=3.22, *SD*=.83).

In summary, both discipline groups acknowledge the value of feedback and in interrupting the game to provide feedback, even through penalties and explicit feedback that are necessary because natural feedback may not be sufficient. Respondents from the entertainment games background, however, were less likely to support interrupting a game for feedback than respondents with other backgrounds.

Comments accompanying these items suggested that respondents with a gaming background focus on using feedback to motivate the learner whereas those with an instructional background consider the instructional value of feedback. For example, a respondent with simulation experience commented "The key to maintaining interest in a game is through feedback and recognition." And a respondent with instructional game experience wrote, "Simple "penalties" don't offer much of an instructional benefit…". We acknowledge the relationship between motivation and learning, but comments suggest this may be a point of departure among multidisciplinary design teams that warrants further examination.

Fun

A game is assumed to have an element of fun, but what about an instructional game; how do multidisciplinary design teams mix fun with learning? Koster (2005) states that fun from learning is a organic response – when we achieve comprehension (e.g., solve a problem) it makes our "brains feel good" (p. 40) due to natural chemical processes. Therefore, he asserts it is the act of solving "puzzles" that makes a learning game fun.

Thirty-one (76%) of the survey respondents rated fun as important in making a game instructionally effective. When analyzed by discipline we found no difference between the two groups. However, when analyzed by game-type experience we found a difference among the groups ($F(2,37)=4.02$, $p<.05$). The IGE respondents rated fun less important (*M*=2.94, *SD*=.77) than EGE respondents (*M*=3.73, *SD*=.65).

The survey included a series of seven "fun" items that asked respondents to rate their agreement on each. Respondents agreed that it is important for learners to enjoy playing an instructional game (*n*=34, 92%), an engaging game is a fun game (n=34, 92%), and a game doesn't *have* to be fun to be instructionally effective (n=24, 65%). Differences by discipline were found in four items as shown in Table 4.

Table 4. Differences in Levels of Agreement with Fun Items by Discipline Group.

Item	*IDG n=22* *M (SD)*	*GDG n=15* *M (SD)*	*t**
With instructional games, learning comes first, fun second.	4.45 (1.60)	3.29 (1.49)	2.20
A learner who is having fun is more likely to learn from an instructional game than someone who isn't having fun.	4.00 (1.57)	5.07 (.92)	-2.30
It is better for instructional gamers to think of themselves as "players" rather than "learners".	3.55 (1.34)	4.86 (1.23)	-2.96
With instructional games, fun comes first, learning second.	2.18 (.91)	3.50 (1.35)	-3.52

*$p<.05$, items were rated on a six-point scale with 1=strongly disagree, 6=strongly agree.

When "fun" items were analyzed by game-type experience a significant difference was detected on one item ($F(2,34)=8.70$, $p<.05$). IGE (*M*=4.67, *SD*=1.29) and SimE (*M*=4.50, *SD*=1.45) respondents strongly agreed that learning comes first and fun second in instructional games. However, EGE respondents disagreed (*M*=2.50, *SD*=1.35).

Overall, responses to these items suggest that gamers tend to emphasize the role of fun while the instructional group tend to emphasize learning. It is important to note that the data *do not* show that fun is not important to our survey respondents; however, fun in an instructional game is not as important to respondents with an instructional background as those with a gaming background. Perhaps if we could agree that fun is a natural response when we achieve

comprehension as Koster (2005) suggests, fun would gain prominence from the instructional perspective.

CONCLUSION

This research provides insight into the differences that shape the design decisions of practitioners from different disciplines and inform a framework for communication among game designers that has implications for a learning game design model (see Table 5).

Overall, respondents were in agreement on many elements that contribute to an instructional game; however, differences in the relative importance of certain key elements (such as goals) and processes (such as frequency of change) in relation to others may result in different priorities and expectations when making game design decisions. It is the small differences in the magnitude of their agreement that may translate into priorities for decisions or difficulty in understanding why changing one element (e.g., a learning objective) is any different from changing another (e.g., a character profile). The initial framework proposed in Table 5 aims to inform a robust serious game design model to promote communication and to mitigate these potential misunderstandings.

Future research needs to focus on further distinctions among disciplines and open the lines of communication to explore the subtle differences and the rationale behind them. Strategies to improve communication may include more disciplines in the early design decisions. Squire (2008), for example, described how one gaming company uses artists to conduct the design analysis so that they can create a visual metaphor of the player's experience that is easily understandable by the entire design team. Communication may well be the first step in developing a usable interdisciplinary game design model. But communication involves more than the simple translation of terms that a Babel fish might offer; communication requires understanding of the expectations, principles and research upon which team members base their actions.

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[i] One respondent was a manager who had no experience in either of our discipline groups so we did not use that data in the analyses by discipline, however, this respondent's data were analyzed by game-type experience

Table 5. Implications of Findings for a Communication Framework and Design Model.

Key Agreement	Key Disagreement		Implications for a communication framework	Implications for a learning game design model
	Instructional Background	Gaming Background		
Goals: • Communicating learning goals is important. • Learning objectives are the primary drivers of a game design. • Game goals and learning goals must align. • Attained learning goals are important in game evaluation.	• Learning objectives remain stable during design. • Measurable learning goals are an important element of evaluation.	• Learning objectives can be changed during design. • Usability is important element of evaluation.	• Demonstrate alignment of learning objectives with game goals. • Solicit multidisciplinary input in prototype evaluation criteria. • Agree on criteria for setting learning objective priorities.	• Set learning objective priorities early in the design process. • Adhere to established priorities. • Iteratively refine game goals to support prioritized learning goals.
Authenticity: • Tasks should align with required cognitive thinking. • Fantasy is OK in instructional games.	• Fantasy should provide a useful metaphor.	• Fantasy should make the game more compelling	• Discuss virtual environment choices in context of impact upon associated cognitive skills.	• Prioritize cognitive thinking requirements early. • Clearly connect cognitive requirements and the use of fantasy.
Design: • Design elements can be modified. • Engagement means that players are constantly challenged. • An immersive game has a rich environmental context. • Target audience needs are important.	• Expect less frequent design changes • Reflection is important in the game.	• Expect more frequent design changes • Reflection is less important in the game.	• Agree that changes to the game design may have impact on multiple design elements. • Discuss the instructional implications of changes to gaming mechanics and vice versa. • Determine the role of reflection in meeting the specific goals of the game.	• Design game mechanics iteratively in context of up-to-date instructional elements. • Require approval for all changes by a lead game designer and lead instructional designer.
Feedback: • Feedback is a critical component of the game. • Natural feedback is not sufficient.	• Use to reinforce learning • OK to interrupt the game for feedback	• Use to motivate learner • Minimize interruptions for feedback	• Agree that feedback will be instructionally valuable and motivate the player. • Agree on criteria for interrupting the game.	• Feedback decisions must meet these requirements as part of the iteration testing.

Key Agreement	Key Disagreement		Implications for a communication framework	Implications for a learning game design model
	Instructional Background	Gaming Background		
Fun: • A learning game should be fun. • Learners who are having fun are more likely to learn.	• Learning is more important than fun.	• Fun is more important than learning.	• Reconcile recommended design changes with regard to fun.	• Refer to learning priorities when making changes to gameplay.