Fourth Frame Forums:
Interactive Comics for Collaborative Learning

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ABSTRACT

In this paper, we describe Fourth Frame Forums, an application that combines traditional four-frame comic strips with online web-based discussion forums. In this application, users are presented with a four-frame comic strip where the last dialogue balloon of the fourth frame is left blank. By typing a statement into this dialogue balloon, the user creates a new discussion thread in the forum, where the user's dialogue choice can be critiqued and discussed by other users of the forum. We argue that Fourth Frame Forums provide an elegant and cost-effective solution for online education and training environments for communities of learners. We provide examples from the domain of US Army leadership development, and compare Fourth Frame Forums to alternative methods of story-directed simulation and training.

Categories and Subject Descriptors

H.4.3 [**INFORMATION SYSTEMS APPLICATIONS**]: Communications applications – *bulletin boards*

General Terms

Human Factors.

Keywords

Discussion forums, Collaborative learning, Comics

1. DESIGN OBJECTIVES

Contemporary computer-based education and training systems are effective to the degree in which they can incorporate four complimentary design characteristics:

Situated learning: Conceptual knowledge is a product of the activity, context, and culture in which it is developed and used [2]. Accordingly, computer-based education and training should present students with situations that mirror the contexts in which their acquired skills will be exercised.

Guided instruction and tutoring: The acquisition of knowledge and skills is demonstrably more effective when learners are given one-on-one feedback and coaching by an experienced tutor [1].

Multimedia: Multimedia presentations can help people learn certain types of information, particularly when they encourage dual coding of the information, when the media support one another, and when learners have low prior knowledge or aptitude for the subject matter [8].

Narrative environments: Stories about one's experiences and the experiences of other are the fundamental constituents of human memory, knowledge, and social communication [9]. Accordingly, computer-based education and training should be set in narrative-rich environments that support the learner's memory of the experience as a story.

Remarkably, the adoption of these four design characteristics has become nearly commonplace in contemporary research on immersive learning environments (e.g. [11], [4], [5]). However, also commonplace is the stratospheric costs associated with developing these prototypes, which typical include the labor of computer programmers, scriptwriters, 3D modelers, animators, voice talent, and sound engineers. Even worse, very little of this development effort is ever reused across multiple education and learning applications, making situated, guided, multimedia, narrative learning outside of the financial reach of the vast majority of educators who would like to use these approaches to meet their own education and training objectives.

In this paper, we explore a practical research question: What is the minimal computer-based education and training application that supports situated learning and guided instruction in a multimedia narrative environment?

Our design solution is an application called Fourth Frame Forums, which combines traditional four-frame comic strips with online web-based discussion forums. Fourth Frame Forums present realistic situations to learners using the narrative multimedia genre of the comic strip, allow them to make decisions in the form of character dialogue, and support traditional and peer tutoring through a modified discussion forum mechanism. In this paper we describe Fourth Frame Forums using examples from the education and training domain of US Army leadership skills. We then describe the innovative authoring methodology that training developers can use to create their own Fourth Frame Forums.

2. FOURTH FRAME FORUMS

A Fourth Frame Forum is a web-based education and training application built on top of a traditional threaded online discussion forum website. Like these traditional systems, the site is divided into individual *forums*, each containing topic *posts* from different users, which are then discussed in threaded *replies* from other users and/or moderators. However, each of these three elements takes a different form and plays a different role.

First, each individual forum in the Fourth Frame Forums application is built around a graphical comic strip, an *episode*. These episodes are presented as four-frame comic strips depicting a realistic fictional situation where characters are faced with a difficult problem or with a contentious issue. Typically, the first frame sets the context, the second frame presents a problem to be resolved, and the third frame develops the problem to the point where some decision must be made. In the fourth frame, one of the characters makes a decision by saying something to one of the other characters. However, the dialogue balloon of this character is always left blank, to be filled in by the users of the forum.

Second, Fourth Frame Forum changes the mechanism by which user posts are created in the discussion forum. Users make all posts by deciding what they would say if they were in the same situation as the character in the fourth frame, and typing these words directly into the blank dialogue balloon. In addition, the user provides an explanation for why they believe their decision is the best given the situation by typing into a textbox just under the episode. After typing both the dialogue and the explanation, the user clicks a submit button. A new post is generated at the top of the discussion forum, where the dialogue is listed as the title of the post and the explanation is the text of the post. In addition, the filled-in fourth frame of the episode is graphically displayed on the left side of each user's post.

Third, the mechanism for replying to the posts of other users remains unchanged, but takes on a significantly different function than seen in traditional discussion forums. Instead of providing answers to posted questions, the purpose of the reply mechanism in Fourth Frame Forums is to provide critical feedback and coaching to users through traditional and peer tutoring. From other users, these replies are meant to encourage debate and discussion about the best decision given the situation, where users question the appropriateness of other users' posts and defend the correctness of their own. Our intention is that instructors and other educators would moderate the discussions in Fourth Frame Forums, providing constructive feedback for each user's post, encouraging discussion, raising related issues, pointing users to additional learning materials, and resolving disputes.

Figure 1 shows our prototype implementation of the Fourth Frame Forum application, which was created by modifying the "aterr" open-source threaded forum system (http://chimaera. starglade. org). New episodes can be added to the system in a data-driven manner by providing a graphic image of the four-frame comic strip and the pixel coordinates of the fourth frame and its blank dialogue balloon. A set of four example episodes was authored for skills related to US Army leadership development, using the authoring methodology described in the next section.

3. AUTHORING METHODOLOGY

The key to the success of Fourth Frame Forums as a learning technology is the quality of the content of the episodes. While the aesthetics of the visual design may play some small part, the quality of the content will be largely determined by the characteristics of the situations that are depicted and the pedagogical relevance of the decisions and issues that these situations bring up. Accordingly, some repeatable authoring methodology is necessary to guide educators and training developers in creating content for Fourth Frame Forums that is relevant to learning goals and that fosters rich debate and discussion among users. In developing our own episodes, we have found it particularly useful to follow a modified version of an authoring methodology we developed for *Outcome-driven Simulations* [3], a type of branching storyline design for training
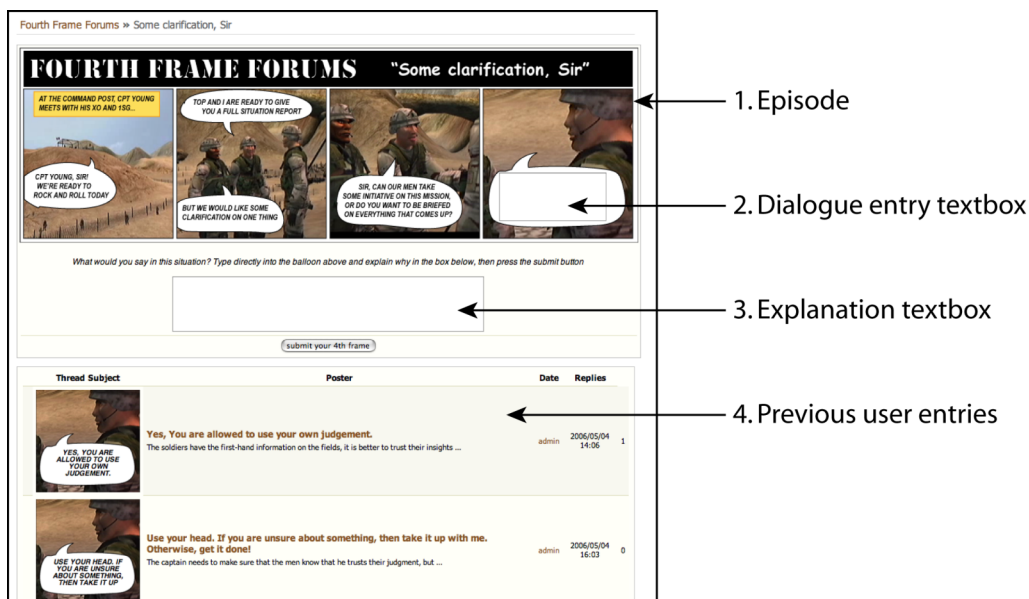

Figure 1. An example forum page from the Fourth Frame Forum application

applications. In this section we provide an abbreviated description of this methodology, with examples of how it was used to create four Fourth Frame Forum episodes in support of an education and training in the area of US Army leadership development.

In many ways, leadership in the US Army is similar to the vast majority of complex skills that are difficult to learn in any other profession or subject area, in that the required knowledge is largely tacit – difficult to explicitly articulate and often acquired only through direct experience. Many have argued that non-fictional accounts of personal experiences told as stories are an effective means of communicating tacit knowledge [10]. Accordingly, the authoring methodology that we employ for Fourth Frame Forums begins with the analysis of a real-world story. Its underlying point is made explicit, and a fictional situation is developed where a decision must be made that hinges on whether the point is accepted as true.

The first step is to gather one or more first-person anecdotes from practitioners of the skills that are the subject of the learning application, where these stories appear to be intuitively related to the learning goals of the educator or trainer. In the domain of US Army leadership, we collected a large collection of stories by interviewing former US Army company commanders. For example, one of the stories we collected concerned the low morale of non-combat units in the US Army, describing a specific incident where a support unit performed poorly and put themselves at risk due to low sense of self-importance.

The second step is to explicitly identify the underlying point of each story. Following a theory proposed by Schank & Abelson [9], we characterized the point of each story as a pair of English statements, one that defines the expectation that was held by the storyteller, and one for the new belief that is held by the storyteller as a result of the violation of this expectation through their experience. For example, the point of the story of a low-performing non-combat unit was formulated as follows:

Expectation: Soldiers understand that every type of unit within the Army is important and will take pride in their work
Expectation violation: A sense of pride and importance must be developed in low-performing non-combat units

Each Fourth Frame Forum episode presents the user with a decision to be made concerning how to react to a situation. In order to turn the point of a story into a decision to be made in a fictional situation, we imagined hypothetical situations where the point would have bearing on the best decision choice. If one believed the point of the story they would do one thing, and otherwise they would do something else. For example, we recast the previous point as follows:

Situation: A non-combat unit has been attached to a company you command and they are not performing well
Choice supported by the point: Work with the soldiers in the unit to develop a sense of pride and importance
Choice rejected by the point: Wait for unit morale to improve as the soldiers naturally realize their importance to mission

Having formulated a hypothetic decision, the four frames of an episode were then defined. For each frame, a few short sentences were written to describe a set of fictional characters, their actions and dialogue, and key events that create a need for a decision. Typically, the first frame would set the context of the situation or of the activity where learned skills are to be executed. The second frame introduces a problematic issue that must be addressed. The third pushes the problem to the point where a decision needs to be made. The fourth is the resolution, which is indicated by the empty dialogue balloon of one of the key characters. When a series of episodes are to be created for a single education and training application, then characters in these frames can be selected from a reusable cast, even with personalities and mannerisms that develop across episodes. For the decision formulation above, we decided that the decision could concern what to do with a poor performing unit that is attached to an infantry company, presented in discussions between a first sergeant and an executive officer.

The final step in authoring an episode was to realize the episode description as a four frame graphical comic using the conventions of the genre [7]. Artistically inclined developers may choose to hand-draw the episodes in the traditional manner of comic strip creation, whereas others may find it easier to start with photographs of posed character models that can be edited using commercial drawing applications. In developing four example Fourth Frame Forum episodes in support of US Army leadership development, we chose to start with single frames of a series of machinima-style cut-scene videos of 3D virtual characters taken from an existing training application [3]. Individual video frames were selected that approximated the intended descriptions of each comic frame, cropped to focus on the relevant characters and

Figure 2. An example Fourth Frame Forum episode

actions, and then edited to include narrative and dialogue balloons using a commercial drawing program. Using this approach, we created each of the four example episodes in a matter of hours. A similar approach could be taken with live-action video or film clips depicting real or fictional people. Figure 2 presents the Fourth Frame Forum episode that was generated from the point and decision formulated above.

The resulting four-frame comic was then exported as a web-friendly graphic, and imported into our Fourth Frame Forum prototype application. To enable in-balloon text entry and customized posts, it was also necessary to input the exact pixel locations of the blank balloon and the entire fourth frame.

4. RELATED WORK AND DISCUSSION

In several superficial respects, the Fourth Frame Forums application has much in common with the Comic Chat application developed by Microsoft Research [6], where chat participants are dynamically visualized as comic book characters using standard conventions of the genre. In both cases, the applications are built on top of Internet based communication forms (discussion forums and chat rooms). In both cases, users are presented with comic frames where the text that they type appears in a visualized dialogue balloon. However, the Comic Chat application was designed to be a visualization tool for unstructured dialogue between human participants, where the content of the dialogue is emergent and arbitrary. The Fourth Frame Forums application is specifically designed to be a learning technology, where authored content is used to drive a discussion among web participants toward a specific learning topic.

That being said, the sophistication of the Comic Chat application point to a number of possible approaches to improving the Fourth Frame Forums application. First, the Comic Chat application performed some shallow analysis of the user dialogue statements in order to tailor the visualization of the user's character in the comic, e.g. the appearance of emoticons in the user statement were used to select among possible character expressions. Dynamically changing the expressions of the fourth-frame character would help users differentiate between submitted posts in a long list. Second, the Comic Chat application offers a quick and cheap approach for *authoring* the graphic visualization of a designed comic strip. Replacing the space aliens and talking animals used in Comic Chat with a cast of character tailored to a specific learning domain could enable developers to visualize complete Fourth Frame Forum episodes in a matter of minutes.

In addition to reducing the costs associated with visualization, it may be productive to investigate ways of reducing the costs of other aspects of the Fourth Frame Forum authoring methodology. Primarily, our future research interests are in developing technologies to aid in the automated collection, retrieval, and analysis of first-person anecdotes of experiences (stories) related to the learning objectives. Needed are robust technologies for separating story and non-story textual content, matching stories to the learning objectives to which they are related, and supporting the characterization of the underlying point of a story and the decision that it motivates.

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