Adapting a Commercial Role-Playing Game for Educational Computer Game Production

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ABSTRACT

Educational games have long been used in the classroom to add an immersive aspect to the curriculum. While the technology has a cadre of strong advocates, formal reviews have yielded mixed results. Two widely reported problems with educational games are poor production quality and monotonous game-play. On the other hand, commercial non-educational games exhibit both high production standards (good artwork, animation and sound) and diversity of game-play experience. Recently, educators have started to use commercial games in the classroom to overcome these obstacles. However, the use of these games is often limited since it is usually difficult to adapt them from their entertainment role. We describe how a commercial computer role-playing game (Neverwinter Nights) can be adapted by non-programmers, to produce a more enriching educational game-playing experience. This adaptation can be done by individual educators, groups of educators or by commercial enterprises. In addition, by using our approach, students can further adapt or augment the games they are playing to gain additional and deeper insights into the models and underlying abstractions of the subject domain they are learning about. This approach can be applied across a wide range of topics such as monetary systems in economics, the geography of a region, the culture of a population, or the sociology of a group or of interacting groups.

EDUCATIONAL COMPUTER GAMES

Educators are aware of the motivational power of simulation-based gaming and have diligently sought ways to exploit that power (Bowman, 1982; Malone & Lepper, 1987; Cordova & Lepper, 1996). Advocates of this approach have been captivated by the potential of creating immersive experiences (Stadsklev, 1974; Greenblat & Duke, 1975; Gee, 2003). The intent was to have students become existential player/participants operating within a virtual world with goals, resources and potential behaviors shaped by both the underlying model and the players' experience and choices (Colella, Klopfer & Resnick, 2001; Collins & Ferguson, 1993; Rieber, 1996).

Contemporary exponents of educational gaming/simulations have drawn their inspiration from modern video games (Gee, 2003). Like earlier proponents, they have been captivated by the ability of well designed gaming simulations to induce the immersive, "in-the-groove" experience that Csikszentmihalyi (1991) described as "flow." They contend that the scaffolded learning principles employed in modern video games create the potential for participant experiences that are personally meaningful, socially rich, essentially experiential and highly epistemological (Bos, 2001; Gee, 2003; Halverson, 2003). Furthermore the design principles of successful video games provide a partial glimpse into possible future educational environments that incorporate what is commonly referred to as "just in time /need to know" learning (Prensky, 2001; Gee, 2005).

Unfortunately, educational game producers have not had much success at producing the compelling, immersive environments of successful commercial games (Gee, 2003). "Most look like infomercials, showing low quality, poor editing, and low production costs." (Squire & Jenkins, 2003, p11). Even relatively well received educational games such as *Reader Rabbit*, The *Magic School Bus*, *Math Blaster*, and *States and Traits* are little more than "electronic flashcards" that simply combine monotonous repetition with visual animations (Card, 1995; Squire & Jenkins, n.d.; Squire & Jenkins, 2003).

Approaches to educational gaming/simulation can range from the instructivist in which students learn through playing games (Kafai, 1995) to the experimentalist in which students learn through exploring micro-worlds (Rieber, 1992, 1996) to the constructionist where students learn by building games (Papert & Harel, 1991). Advocates of the latter approach have been in the minority but the potential power of the game-building technologies and their potential as an alternative form of learning or expression is drawing increasing attention from the educational gaming community (Kafai, 2001; Robertson & Good, 2005). We have done some preliminary work with all three of these modes, with most of efforts focused on constructionist approaches (Carbonaro et al., 2005; Szafron et al., 2005). In this paper, we show how our constructivist approach can be adapted to create instructivist classroom materials.

On the instructivist side, there are three basic approaches. First, simply use games that were created as educational games such as Reader Rabbit etc. and incur all of the problems manifested in this approach. Second, use commercial games, such as Civilization III (a historical simulation game) (Squire, 2005). However, it can be difficult for the educator to align a commercial game with specific educational topics or goals. Third, adapt a commercial game to meet specific educational goals. This is the approach we describe in this paper. We describe how the same game-building tools we put into the hands of students can be used by educators to easily adapt commercial CPRGs to create instructivist classroom materials in the form of educational computer games.

COMPUTER ROLE-PLAYING GAMES

Popular computer role-playing games are available in may forms as single-player (Oblivion, SIMS[1]), small-scale networked multiplayer (Neverwinter Nights, Dungeon Siege) or massively multiplayer online (World of Warcraft, Everquest, GuildWars). In each of these cases, the computer role-playing game has high production values and richness of interaction that can hold the interest of millions of game-players around the world. One of the goals of our research is to leverage the quality and popularity of role-playing games into better games for educational use in the classroom.

A CRPG typically contains a game engine that renders the graphical objects and characters, and manages sound and motion. A single game engine is re-used across multiple game adventures and enhanced for future games. The game engine typically dispatches game events to scripts that support interactions between the player character (PC) and game objects. These interactions vary for each game adventure and programmers must write the scripts that control them. For example, when the PC opens a specific chest in an adventure, a script can cause the doors of the enclosing room to lock and some creatures to be spawned.

A set of computer aided design (CAD) tools is created and used by authors, artists, musicians, voice actors and other skilled craftspeople to create content such as backgrounds, models, textures, creatures, props, sounds, and music that are shared across game adventures. Adventure designers also use these tools to create individual adventures, calling on programmers to script the interactions. Two examples of such tools are the Aurora Toolset for Neverwinter Nights (BioWare Corp. 2006) and The Elder Scrolls Construction Set (TES) for Oblivion (Bethesda Softworks, 2006).

USING A COMPUTER ROLE-PLAYING GAME TO STUDY A CLASSROOM TOPIC

Recently, educators have begun to use the CAD tools available with CRPGs to construct custom educational software that combines the high-production values and richness of interaction of a commercial computer game with their specific educational goals. We briefly describe three educational games that have been built using the Neverwinter Nights (NWN) game.

Revolution (http://educationarcade.org/revolution) is a multi-player game, created at MIT that places students in Williamsburg in 1775 on the eve of the American Revolution (Squire & Jenkins, 2003). It allows the player to experience the event by role-playing a character with a particular gender, class and political view. The educational goal is to aid in the understanding of American history.

The Aurora Toolset has also been used to construct a "Journalism" game (Paul, Hansen & Taylor, 2005) for College Journalism students. The protagonist is a rookie reporter working for the Gazette in a small American city called Harperville. The journalist searches for clues to a train derailment by investigating multiple sources. The educational goal is to teach journalism students to expand the list of potential sources they use when developing a story.

As a third example of using NWN to construct an educational game, a multidisciplinary group of researchers from geography, psychology, and computer science at Carleton University developed a prototype NWN module set in the Antarctic (Woods et al., 2005). The goal of this game is informal learning about scientific process, global warming and the Antarctic environment.

In this paper we present an economics game as an example. The game contains a series of commerce models that can be discovered and explored by the player. The *fixed price* commerce model is the simplest model in the game. In this model, each item has a fixed price and the item is both bought and sold for the same price by all merchants. Players learn that different items have different prices, but no profit is made by buying and selling items. Players quickly learn this model by buying and selling items.

In the second model, called the *mark up* model, each merchant has a selling percentage for all items sold and a buying percentage for all items bought. These percentages are the same for all items sold by a given merchant, but vary from merchant to merchant. For example, the base price for the book titled "The Adventures of Sherlock Holmes" is 40. The store "Wexman Supplies" has a selling percentage of 100% and a buying percentage of 30% so he sells a copy of "Holmes" for 40 and buys a copy for 12. However, the store "Langston Store" has a selling percentage of 130% and a buying percentage of 45% so he sells a copy of this book for 52 and buys a copy for 18. Players are not told the buying and selling percentages or even that they are in play. Instead they learn the model experientially and can even discover the fact that each merchant has a fixed but different selling and buying percentage. While exploring this model in the game, students also can discover that there are situations that can be exploited. For example, "Discount Bob" has a selling percentage of 80% and a buying percentage of 20%, whereas "Exclusive Sal" has a selling percentage of 150% and a buying percentage of 85%. A player can buy from Bob and sell to Sal to make a profit. As we know, this is an unsustainable model and it motivates the third model in the game – the *supply and demand* model.

In the *supply and demand* model, the item prices are dynamic. Each time a copy of an item is bought from a merchant, the price goes up by a certain percentage and each time a copy is sold to a merchant, the price goes down by a percentage. There are actually two supply and demand models, a local one and a global one and both are in the game. In the local model, buying from a merchant only affects the prices for that merchant. In the global model, it affects the prices for all merchants. The global model represents a situation where merchants closely monitor the pricing of other merchants. Again, students discover these models as they explore in the game environment.

[1] Although the SIMS was not originally regarded as a role-playing game, newer versions allow the player to identify more closely with a character in the game and experience a more personal and direct interaction with the other characters that more closely resembles a role-playing game.

USING EXISTING TOOLS TO ADAPT A CRPG FOR CLASSROOM STUDY

CRPG authors use sophisticated tools to create story content for game adventures. The same tools can be used to create educational games. The Aurora Toolset is the principle tool used to create adventures for the Neverwinter Nights (NWN) game. An author begins by using Aurora to create one or more areas by selecting tiles from pre-built tile-sets. The author then uses Aurora to place physical objects (placeables, items, and doors) and creatures from libraries at specific locations in the area and to customize them. The author can create interactive conversations and attach them to specific creatures using Aurora. The author can also select sound effects and music from libraries and can place them at locations in the area so that when the PC triggers them, the appropriate sounds are played.

For example, to create the economics game, the author first creates a town area that has several shops where merchants buy and sell items. The interior of each shop is a separate area. Figure 1 shows a store named "wexmansupplies" in a shop area. It shows how the selling percentage (labeled Sell Mark Up) and the buying percentage (labeled Buy Mark Down) are set. It also shows how the inventory of this shop is selected. The author has indicated the price of the selected item and the effect of applying the selling and buying percentages to a book with base price 40.

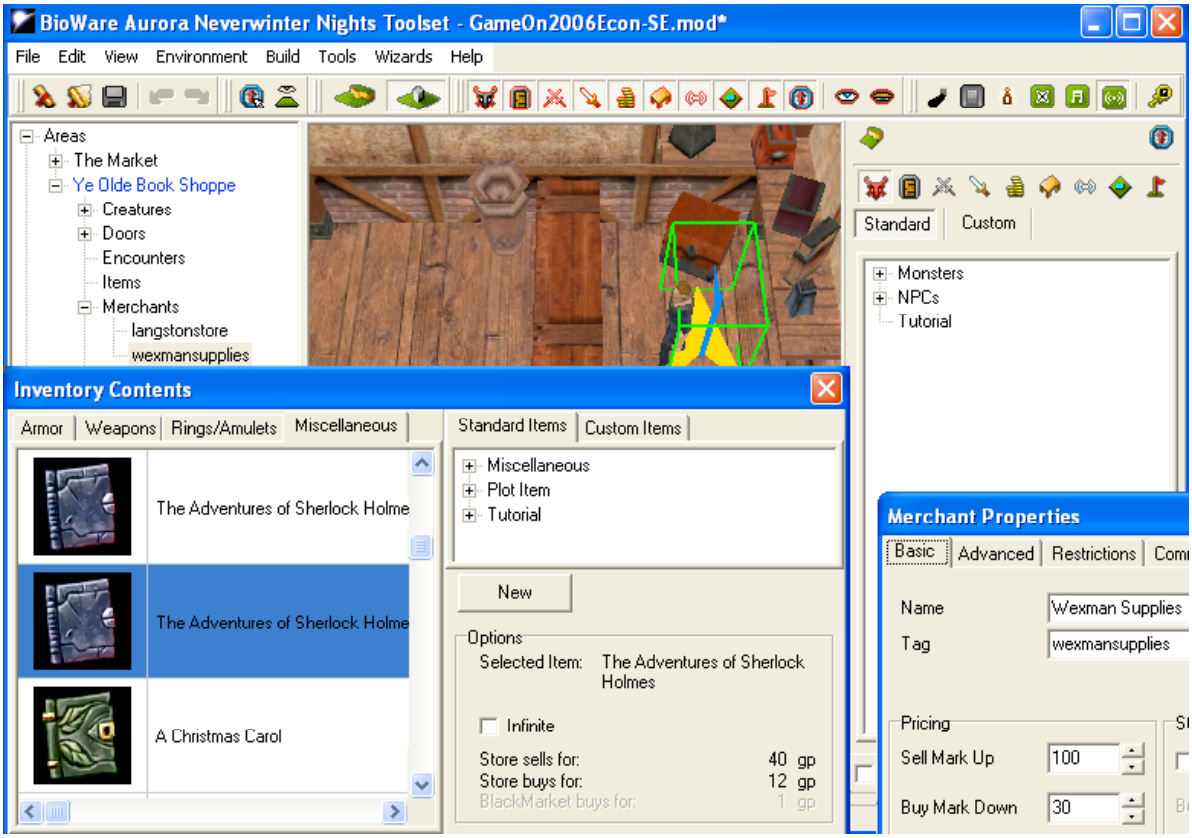

Figure 1 A Shop Area with Merchant Inventory

THE CHALLENGE OF SCRIPTING

Sometimes an educator can easily adapt a commercial game for a specific educational goal by using the toolset supplied with the game. For example, the *fixed price* model for our economics game can be incorporated into NWN simply by setting the selling and buying percentages to 100 for each merchant that adopts the model. The *mark up* model can be incorporated by setting different selling and buying percentages for each merchant. However, there comes a point where more extensive adaptation must be done to accommodate the goals of the educational game. For example, there is no easy way to incorporate the *supply and demand* model into NWN without writing scripts.

Unfortunately, it is difficult for non-programmers to write and attach scripts. For example, Figure 2 shows part of the script written to implement the *supply and demand* model in the economics game. The scripting in this example consists of 66 lines of NWScript code to implement the model and 23 lines of code for each item that is bought and sold using the supply and demand model. As well as writing the script, the author must figure out that this script must be attached to the "OnAcquireItem" event of the Module object. In addition, two other scripts whose sizes are greater than 50 lines each must be written and attached to conversation nodes in the game to intercept a normal *mark up* transaction and initiate a *supply and demand* transaction so that the player can discover that this model is in play and learn how it works, as shown in Figure 3. Unfortunately, this need for scripts to achieve more complex educational goals has precluded most educators from adapting CRPG games to educational computer games.

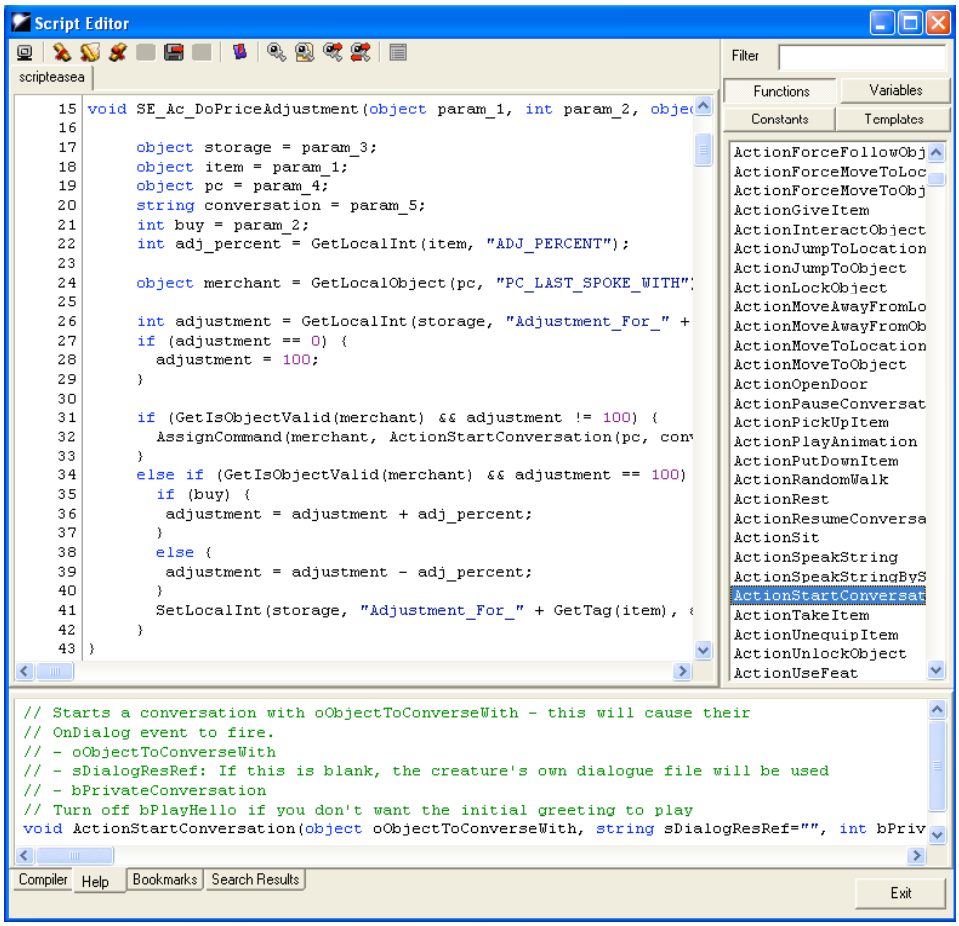

Figure 2 Part of the Script for the Supply and Demand Model

Figure 3 A *Mark Up* Model Dialog

SCRIPTEASE: A SOLUTION TO THE MANUAL SCRIPTING PROBLEM

The Economics game described in this paper primarily uses conversations with merchants to teach its topic. However, NWN is a fully immersive interactive game in which the PC explores the world and interacts with objects when the player clicks on them or chooses interaction options from context-sensitive pop-up menus. Scripts can configured for over a hundred interactive events including when a door is unlocked or opened, when an item is acquired, when a prop (placeable) is used or destroyed, when a container is disturbed, when a point in a conversation is reached, etc. This wide variety of interaction modes can support a broad range of educational topics including economics, geography, history, culture, languages, ecology, sociology and psychology, since the game world simulates the interaction of the PC and the environment with such high fidelity.

We have created a tool called ScriptEase (http://www.cs.ualberta.ca/~script) that can be used by game authors to generate scripts for NWN game stories (McNaughton et al., 2004b). This tool allows an author to select patterns and adapt them to tell a particular game story. A pattern encapsulates a commonly occurring idiom in a CRPG adventure. One common example is to create a situation in which the doors lock and a creature is spawned whenever the PC removes a jewel from a particular chest. A second example, is a guard that patrols near a guarded chest, occasionally checking to see whether the guarded item is still in the chest, sitting on a bench to rest every once in a while, and challenging or attacking the PC if the PC gets too close to the chest. A third common example is a dialogue in which a non-player character (NPC) greets the PC in a particular manner during their first conversation, but remembers the PC and greets the PC differently during subsequent conversations. A fourth example is a quest to retrieve an item and take it back to the quest giver. Since each of these patterns occurs frequently across CRPG adventures, it is useful to identify these patterns and re-use any investment that is made to help support the scripting necessary to realize them in a game adventure. ScriptEase allows an author to identify such patterns in a catalog, create instances of them while creating an adventure, adapt them to the context of the adventure and then automatically generate the appropriate scripting code that implements them.

We have identified four kinds of patterns that occur often in CRPGs: encounter patterns (McNaughton et al., 2004a) behavior patterns (Cutumisu et al., 2006), dialog patterns and plot patterns. The four examples listed in the previous paragraph are respective examples of each of these kinds of patterns. An encounter pattern describes an interaction between the PC and game objects – e.g. the consequences of removing a jewel from a chest. A behavior pattern describes the behavior of an NPC – e.g. a guard. A dialogue pattern is a template for a common idiom of conversation – e.g. a progressive dialog. A plot pattern describes a frequently occurring quest – e.g. retrieve an item. We have developed a mature pattern catalog for encounter patterns containing more than 60 patterns (Onuczko et al., 2005) and a preliminary catalog for behavior patterns containing 9 patterns (Cutumisu et al., 2006). We are currently developing pattern catalogs for dialogue and plot patterns.

Although we have previously used ScriptEase to enable student authors to author interactive stories as an educational experience, this is the first time we have tried to use ScriptEase in the context of creating custom educational games to be played by students in the classroom.

To create a prototype of the economics game, we used the Aurora Toolset to create an area containing a market and to create individual stores and merchants. We specified selling and buying percentages for these merchants and filled the inventories with items. We then used ScriptEase to create some patterns that support the *supply and demand* economic model. Figure 4 shows some instances of these patterns.

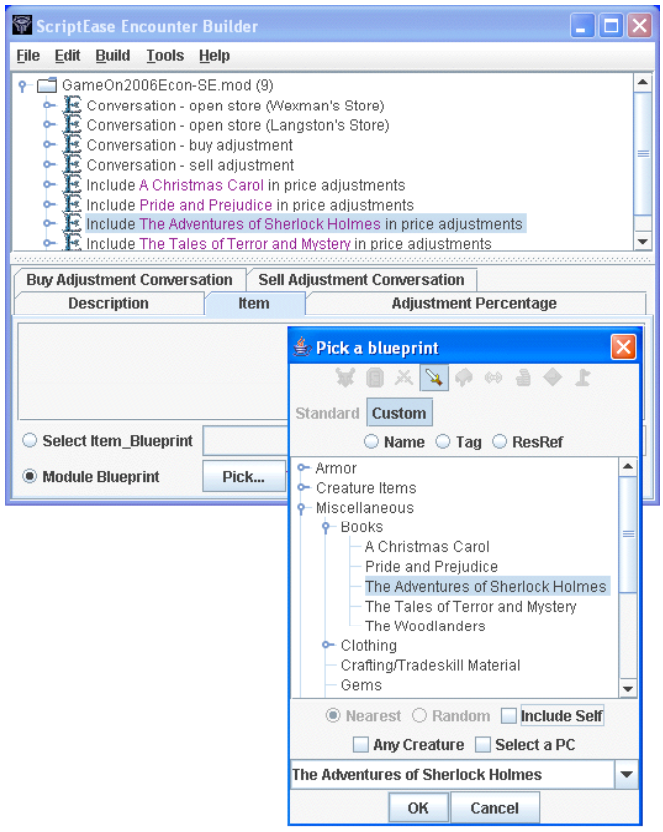

Figure 4 ScriptEase Pattern Instances for the Economics Game

Four patterns are necessary to support this model. The first pattern is a *Conversation – open store* pattern, which has two options, a store and the a conversation node of the owner of the store. When this conversation node is reached a store inventory window is opened that allows the player to select items for the PC to purchase. Figure 5 shows the conversation with node (2.) selected and Figure 6 shows the inventory window for the store and the inventory window for the PC. An instance of the *Conversation – open store* pattern generates the scripting code that opens the inventory windows when the player selects this conversation node. The PC can then purchase items by dragging them from the store inventory to the PC inventory. In Figure 6, the PC has bought one book (title not shown) and is about to buy a second book, whose title is "A Christmas Carol". The code for supporting dragging from the store window to the PC inventory window is built-in to NWN and does not have to be generated by ScriptEase.

Figure 5 A Merchant Dialog where the Script for the Conversation Node Selected Will Open Inventory Windows

Figure 6 Inventory Windows the PC can Use to Purchase Items From a Store

The second pattern is *Conversation – buy adjustment*, which has three options that are all conversation nodes – the first node of a conversation that indicates that the item being bought is subject to the supply and demand model (the first statement shown in Figure 3), along with the two conversation nodes where the PC agrees to the purchase or declines the purchase (shown as 1. and 2. in Figure 3). The third pattern is similar and is used for selling. The fourth pattern is an *Item bought/sold - price adjustment* pattern whose four options are the item, the percentage to adjust the price when each new copy is bought or sold, and the two conversation files that contain the conversations for adjusting the price up or down when it is bought or sold. An instance of this pattern generates a script that is fired when an item is acquired (after it has been dragged from the store inventory to the PC inventory) and this script opens the conversation dialog shown in Figure 3 to describe the adjusted price.

Finally, we created multiple instances of these patterns and adapted them for the game by setting the options. For the screenshot shown in Figure 4, there are two *open store* instances, one for each store, one *buy adjustment* pattern instance and one *sell adjustment* pattern instance that are shared by all merchants, and one *Item bought/sold - price adjustment* instance for each item that is subject to the supply and demand model. The instance for "The Adventures of Sherlock Holmes" item is highlighted along with the dialog box that the author uses to pick this item.

When the author selects *Save and Compile* from the ScriptEase *File* menu, all of the NWScript code required to implement this game is generated and stored in the module file. The game is now ready to play in NWN.

USING SCRIPTEASE IN THE CLASSROOM

Although the economics game described in this paper was not created by an educator with no programming skills, it could have been. To support this statement, we briefly describe how ScriptEase has been used by high school students with no programming skills to create interactive stories using patterns that are no less complex than the four patterns used in the economics game.

We conducted a pilot and several studies in which grade 10 high school English classes used the Aurora Toolset and ScriptEase to author interactive stories in the NWN game world. The specific goals of these studies are not germane to this paper. Each class was introduced to the concept of an interactive story and given the assignment to author an interactive short story that could be "played" in NWN. In each case study, the high school student authors took part in a two-day workshop conducted at the University of Alberta. The workshop consisted of two tutorials (total time 6 hours), along with some limited time (2 hours) to start their interactive short story. The first tutorial showed them how to play a NWN game story (Szafron et al., 2005). The second and third tutorials described in that paper show how to construct an interactive story for NWN using the Aurora Toolset and ScriptEase. These two tutorials were actually combined into a single tutorial after the pilot and before the studies. We learned from the pilot that students would prefer to learn how to create some game objects with the Toolset, and immediately how to add interactivity to those objects using ScriptEase, rather than learning first about how to create all of the static objects with the Toolset and then learning how to make them interactive using ScriptEase.

Students worked under the supervision of their teacher and some of the ScriptEase researchers who were familiar with both the tools and tutorials so they could answer student questions. At the end of the workshop, the students returned to their high school classrooms to spend 4 more hours to complete their stories.

Although the educational goals and lessons of these case studies are not relevant to this paper, the fact that the high school students succeeded in using ScriptEase patterns is important since it illustrates that individuals without programming skills can use patterns to create an educational game adventure. Figure 7 shows the number of pattern instances used by students in two different case studies.

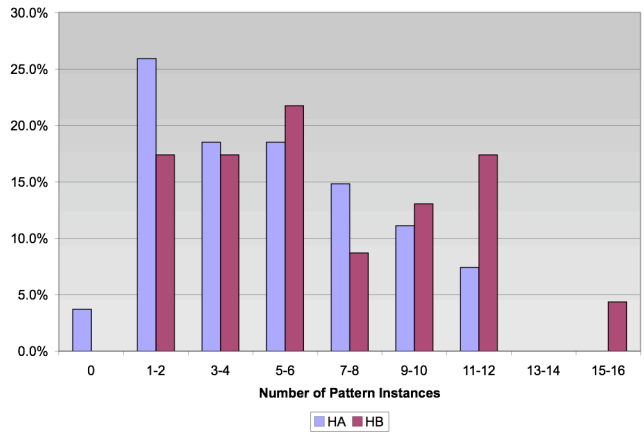

Figure 7 The Number of ScriptEase Pattern Instances Used by Students from Two High School Classes

There were 27 students in the class designated HA and 23 students in the class designated HB. For example, 26% (7/27) of the HA authors created 1 or 2 pattern instances and 7% (2/27) of HA authors created 11 or12 pattern instances. The major difference in the two classes is that HA was a regular high-school English class and class HB was an International Baccalaureate (IB) English class. Although the students from the IB class used more pattern instances, both classes succeeded.

CONCLUSION

We have shown how educators can create immersive educational games with high production values and engaging storylines by adapting commercial CRPGs. Specifically, we showed how educators can use ScriptEase to overcome the most difficult obstacle that stands in their way – the need for manual scripting. Although we are not the first researchers to suggest the adaptation of commercial games to educational games, we have shown how ScriptEase can provide a useful mechanism for quickly and practically developing games with specific educational goals, such as monetary models.

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