Narrative Threads: A Tool to Support Young People in Creating Their Own Narrative-Based Computer Games

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Abstract. This paper introduces Narrative Threads, a suite of tools designed to support 11-15 year olds in creating their own narrative-based computer games. Authoring interactive stories in game form has strong educational potential, but although there are tools which make game creation possible for young people, they have provided little to no interface support for the storytelling aspect of the task until now. Here we describe the design and implementation of Narrative Threads, which provides this support. After giving the background to the tool, we describe the extensive participatory design process which built on existing theory. Finally, an initial evaluation is presented, which indicates that games created using Narrative Threads are rated more highly than those created without the additional support provided by these tools.

Keywords: Multimodal game narratives, authoring tools for young people, participatory design, story representations.

1 Introduction

Many young people find computer game authoring to be motivating, and the challenging, yet appealing, nature of the task makes it promising as a learning activity [14, 21]. Researchers have explored game creation as a method of introducing children to computer science [31, 33], teaching mathematics skills [22, 32] and developing metacognitive skills [16, 21]. This research is motivated by work which suggests that game creation has the potential to support storytelling for young people aged 11-15 [14, 35].

Although some theorists argue that the relationship between games and narrative is problematic [8, 10], it is generally agreed that narrative elements are important to many games [9, 11, 20]. Creating an interactive narrative can involve the practice of traditional writing skills, when creating text-based conversations, as well as using other representational modes such as visual appearance, movement and sound to convey story elements.

Multimodal theory describes how meaning-making increasingly takes place through a variety of representational modes, with writing no longer holding the privileged position it once did [24]. In order to communicate effectively today, young people must make use of multiple representational modes, and additionally, understand and design for the interactivity of their readers. It is no longer sufficient for

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educators to teach children how to convey a message through linear text, they also need to know how to make effective use of modes such as video, image and audio, and to plan branching pathways through the content they create.

Computer and video games are a particularly prominent medium, embodying multiple modes and high levels of interactivity. Creating a narrative-based game involves conveying a complex interactive storyline through a range of representational modes, and the activity can be very motivating for young people [14]. For these reasons, game creation has a strong educational potential.

However, creating a narrative based game is a highly complex task: the narrative is composed of many different components which are woven together when the game is played to allow the story to unfold in one of a number of ways as the player explores the game world. A branching narrative can quickly get unwieldy as each choice point brings additional possible paths. Whilst working in a game creation toolset, the disparate elements of conversations, character appearances and behaviours, the design of locations and the placement of objects and characters are all represented separately.

External representations are crucial for writing [39], but there is little representational support currently available for creating and managing an interactive, multimodal narrative. Tools that do offer support along these lines are aimed at adults and are designed to support advanced tasks such as design and debugging in virtual reality environments [42] and creating interactive digital stories with emergent narratives and intelligent plot management [28, 41].

For young users, creating even a simple interactive narrative with relatively few branching points can be challenging. When creating a game-based story there is no equivalent of reading back over what has just been written. Instead it is necessary to exit the toolset, load up the game and play through it; a laborious process which can only be done intermittently. This can interrupt the flow of writing as the 'reading' of a game is necessarily detached from composing and revising.

With no integrated representational support in a game creation toolset it may be harder for our target users to create a compelling storyline for their games, and develop the associated skills which will be so potentially useful to them. Additional representational support for storytelling should allow designers to get a better sense of how their game narrative is developing while they are in the act of creating it, helping them to write a better story and to gain a deeper understanding and command of the multimodal and interactive writing skills they are using.

In contrast to work concerned with dynamic story generation based on narrative theories (e.g. [25, 26]) our focus is on assisting young game authors in weaving their own branching narrative from game elements such as characters, objects, conversations and area design by introducing software-based support for plot management as well as character and object creation.

In the next section we examine existing game creation tools in relation to our objectives. In Section 3 we describe the design of the tool, including the use of theory and previous work to devise broad requirements, and an extensive participatory design process. In Section 4 we describe the suite of tools, with notes on usage and relation to the design process. Section 5 outlines an initial evaluation of the tool and presents some key findings. Finally, in Section 6, conclusions are drawn and future work is outlined.

2 Existing Game Creation Tools

There are many tools available which make it possible for young people to create their own games. Some focus on support for programming and scripting [2, 3, 6], other tools focus on making 3D area design accessible [4, 7], and some include functionality designed specifically to support storytelling, such as Looking Glass [5] and Adventure Author [1].

Looking Glass (formally Storytelling Alice) offers support for storytelling by providing high level animations involving social interactions, as well as character and scene resources in keeping with the stories target users want to tell [23]. However, the tool is primarily designed for building linear animations rather than interactive stories. Additionally, storytelling is not the end goal of the tool; it is used as a means of encouraging middle school girls to engage in programming activities.

Adventure Author [38] makes use of a game making toolset (shown in Fig. 1) which is sold with a commercial role-playing game, Neverwinter Nights 2 (NWN2) [30]. This toolset allows users to create fully interactive games which have a similar look and feel to popular commercial games. The readymade art resources and an easy to use area editor allow young learners without 3D graphics skills to create games that are visually impressive. Another benefit of the toolset is that it allows young designers to quickly get to the stage of working on high-level narrative elements without concern for low level tasks such as implementing movement. Adventure Author scaffolds the creative process of game design through a suite of plugins which offer excellent support for ideas generation and evaluation, as well as an improved interface for creating interactive conversations. However, conversations are only one component in communicating a narrative in the form of a game. The Adventure Author project offered evidence that one of the most interesting elements of game-making is the way in which a story can be told through visual elements such as character appearance and behaviours, and landscaping of areas, as well as through textual means [37]. Narrative Threads aims to provide support for authors using the full range of representational modes available to convey a narrative.

A decision was made to design Narrative Threads as a plugin for the NWN2 toolset, in line with the approach taken by the Adventure Author project, because this software provides excellent support for 3D graphical design, has a good plugin architecture, and because tools to support other key aspects of game creation were either already available or being developed for this toolset [4, 29].

3 Design Process

The design was grounded in theory and developed using a learner-centred design (LCD) methodology, based on the CARSS framework [13, 36], which offers guidance on five key aspects of participatory design of technology enhanced learning with children; context, activities, roles, stakeholder and skills. In this section we explain how the overall aims of the tool were established, and describe the extensive participatory design process.

3.1 Design Model

A design model which focuses on directing learner attention to desired aspects of a task through foregrounding and backgrounding different tasks with representational choices was developed. The model synthesises theory on the use of external representations in educational tools, and is presented in full in [18]. The key recommendations of the model are that users should be able to carry out tasks unrelated to learning goals quickly and simply without need for reflective cognition [29], whilst tasks important to learning goals should be carried out thoughtfully and carefully, using reflective cognition. The model states that representational support for complex tasks should allow learners to avoid cognitive overload by storing intermediate results externally [27], should support re-use of learner created elements, and crucially that designers should avoid loss of motivation by aligning effort with learner goals where possible. Key aspects of the design model and the related theory are explained in detail below with reference to specific design decisions.

3.2 Evaluation of Existing Toolset Interface

As an initial design stage the existing toolset interface was evaluated against the design model, key underlying theories, and previous experience the authors had had using the toolset with young people [14, 19]. In keeping with most game authoring tools the NWN2 toolset interface centres on a 3D area view, as can be seen in Fig. 1. The built in mechanisms and representations in the NWN2 toolset encourage users to focus on 3D area design, whilst the storyline being developed is invisible. This is most evident in two key areas: in the creation of characters and other game objects, and in the overall visual representation of the game.

Character and Object Creation. The toolset contains a number of 'blueprints' or readymade versions of characters, objects and scenery items. The existing method of character creation involves users clicking on a name in the blueprints list and moving the mouse into the 3D area editor to see a 3D representation of their chosen character. They can then either place that character somewhere in the world or cancel the operation and choose another blueprint to preview. After the user creates a character they can open a properties window with over a hundred editable fields and customise the character. However, important fields like those which define traits, skills and the character's disposition towards the player are not salient in amongst a variety of obscure fields which users are unlikely to understand or want to change. The process is the same for creation of other in-game objects.

This drag-and-drop based interaction method encourages a habit of adding multiple readymade characters into a game under creation, with elements sometimes left in the game simply by default. Since characters and objects can be hugely important components of a game-story, this unreflective approach is not beneficial. It can also encourage young people to add purely functional characters which have a gameplay role (such as increasing challenge) but no relation to the plot.

Visual Representation of Game. In the existing toolset interface the only visual representation of the game under creation is a 3D area view, which shows the level the designer is currently working on. The objects added to the game are visible, but there is nothing to indicate whether a given object or character has a crucial role in the story, or is simply scenery. There are lists of conversations and scripts which the designer has written, but these are not connected to the visual representation. A quest creation tool integrated with an in-game journal is provided, but it does not give a visual representation of the game story, and additionally, is hard for young designers to use and could encourage a focus on a solely quest-driven plot. At present, attempting to consider the branching plot of a game involves a user keeping higher-level ideas about the storyline in their mind. This lack of representation of story elements can cause users to focus on the areas which are better supported by interface representations, as is reflected in the large amount of time given to area design according to participant estimates at previous workshops [35].

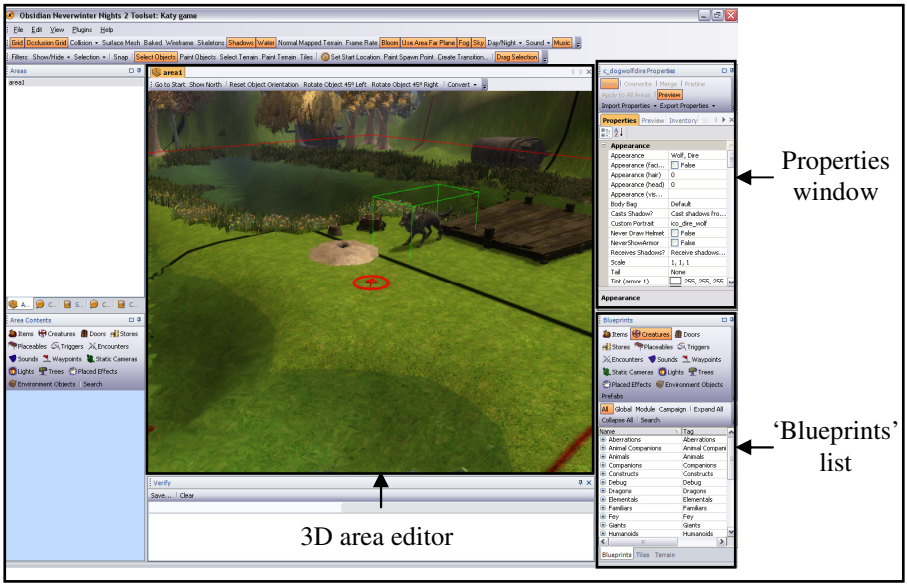


Fig. 1. Neverwinter Nights 2 Toolset Interface

3.3 Tools Summary

From the assessment of the existing interface provision, and helpful input from the Adventure Author project team, the key areas for improvement in storytelling support were identified. To prevent the creative process from being interrupted it was deemed important that the support should be an integral part of the game creation activity.

It was determined that addressing the two key areas required functionality across three separate tool categories:

1. Character and object wizards with associated visual representations: supports character and object creation by scaffolding the task.
2. Augmented 3D map view showing story event locations: improves visual representation of game by showing where important plot events are located on the map.
3. Branching narrative diagramming tool: improves visual representation of game by displaying the high level plot structure of the game to the user.

The tools are separate but connected, and aim to support young designers by providing representations of the narrative under creation. The overarching narrative model is that of the storyline being driven by a series of events or encounters, some of which involve a choice on the player's behalf, whilst the connections between these always involve choices. These events are based around characters, objects or scripted events.

Each tool was designed in an iterative way with input from theory and existing work, and participatory design activities involving various forms of lo-fidelity prototyping. Design activities are described in the following subsections, and final design decisions are explained in the system description in the next section.

3.4 Character and Object Wizards with Associated Visual Representations

Theoretical Background. Norman distinguishes between experiential and reflective cognition [29], where experiential cognition does not require deep thought and is reactive and event driven, with automatic reactions following from input. Reflective cognition tends to be slower and more laborious, and requires much deeper thought.

Choice of representation and means of interaction can completely alter the mode of cognition used in a task. Svendsen [40] concluded that whilst direct manipulation interfaces can be very user-friendly, they can hinder problem solving if they are supportive of unreflective action.

Adopted Approach. Being able to drag a generic character or object into the game world encourages a reactive approach to adding characters and objects, and is often used merely as a way of testing out what different readymade characters look like. To address this issue we decided to create a set of wizard tools which guide the user through the creation processes, uniting the previously separate activities of adding an object and editing its properties. In line with the design model and underlining theory, the new creator tools should encourage reflective cognition when users are creating characters and objects which are important to the story line.

Participatory Design. Two girls and two boys, aged 11-12, who had been using Adventure Author with their class as part of a creative writing project, were asked to build a paper prototype of a new tool which would help them to create more interesting characters for their stories. They were given an example paper prototype of a software tool they had previously used to help them understand what a paper prototype was, and shown some very simple examples of what a character creation tool might look like. Care was taken to provide a range of designs to avoid ideas simply being parroted back. The design sessions were audio recorded, observation notes were made and photographs were taken.

The prototypes (an example of which is shown in Fig. 2), along with transcripts of the activities and additional interviews with the children, were analysed. A number of key themes were identified, which gave suggestions for important design characteristics.

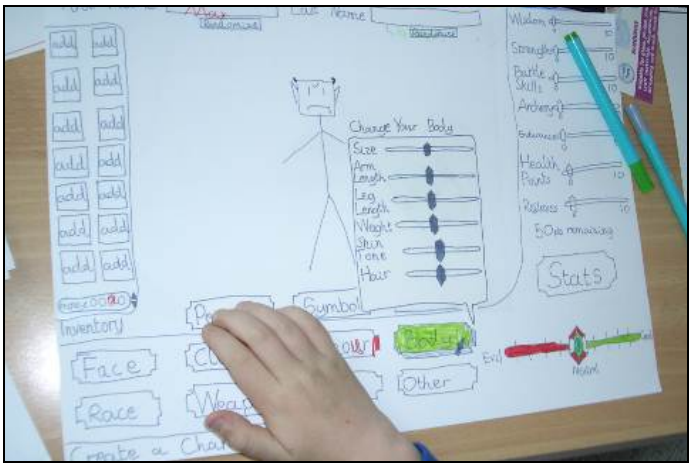


Fig. 2. A participant's paper prototype designs for a character creator tool

The designs created by the children were mainly based around physical appearances, with options for customising characters in fine detail. For the two girls, this involved numerous noses and other facial features to choose between, while for the two boys, this tended to revolve around combat settings such as strength, weapons carried, and for one boy, setting the amount of body hair and length of forearms!

Personality and the back story of characters were mentioned as important in interviews, but did not feature strongly in the designs created. It appeared that target users were not so interested in the personality of the characters, because typing a description of the character's personality did not have any effect on their game (visible or otherwise). When it was not obvious how an element would make a difference to the game, participants reported that they skipped straight past it, and both boys and girls comments on the importance of seeing the effects of their choices in a creator tool. The girls explained that they just picked 'any' for character settings which did not seem to make a difference. The boys also said that character-related settings should 'make a difference to how you play'.

Another aspect which caused confusion was the dungeons and dragons genre specific terminology used to describe some of the character traits; 'dexterity' was held up as a particular example of something which seemed meaningless to the participants.

The boys liked the idea of having the whole tool on a single view, and explained that it was hard to remember where options were if they had to switch between screens using 'next' and 'back' buttons.

3.5 Augmented 3D Map View

Theoretical Background. The match-mismatch hypothesis [12] states that where a representation highlights a certain type of information, tasks using that type of information will be easier to perform than those requiring other types of information. Where required information is implicit in a representation and needs to be inferred, the task will be harder than if the information were presented explicitly.

Adopted Approach. The task of creating an interactive digital story in the form of a game is not currently well supported because one aspect of the task, the design of the 3D areas, is fully represented while other aspects important to the story, such as how a character will behave towards the player, or whether an object can be interacted with meaningfully, are invisible. To tackle this problem, the decision was made to augment the existing 3D representation. This avoided adding an additional representation and had the further benefit of ensuring that users were more likely to use the story view map, as it would be integrated seamlessly into an existing essential display. The approach allows upfront debugging of story elements which could help to avoid the awkward feedback loop involved in testing the game under creation and making revisions

Participatory Design. Ten participants aged 12-14, nine boys and one girl, attended a half-term four-day game-making workshop where they learnt how to build their own simple games using the Adventure Author software. The study aim was to gather further information about the requirements for the augmented map view through targeted interviews and paper prototype activities with the participants.

A series of icons were designed to represent different game objects which were likely to have relevance to the plot of a game. There were icons for hostile characters, friendly characters, important items, conversations and transitions to other areas. These were used in conjunction with a sheet of acetate with a cardboard surround which allowed participants to place the icons on top of their 3D area views without risking damage to the laptop screens!

Participants were introduced to the paper prototype, asked to pick an area of their game and place the icons in the appropriate locations. Video recordings were made of the activity and photographs taken at key moments, and the videos were transcribed. The participants were able to place the icons on to their areas in the correct positions, as illustrated in Fig. 3, and found the representation reasonably easy to understand. In some cases they understood exactly what the icons represented and were able to interrupt and finish explanations as the researcher introduced them, but in other cases the icons did not seem to be intuitive.

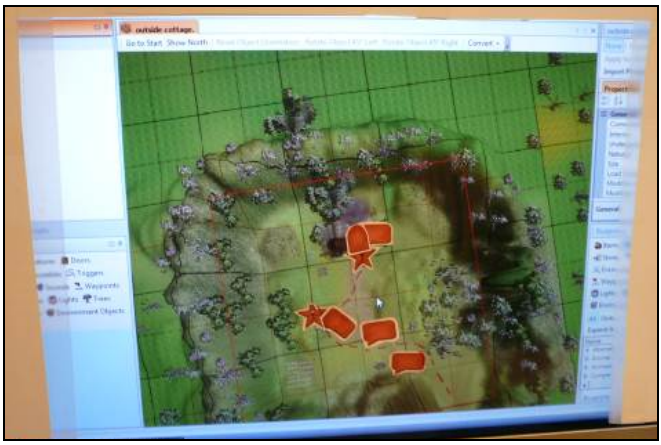


Fig. 3. Participant using paper prototype to show important story events in her game

In a second school study twelve children aged 11-12, six boys and six girls, selected from two classes who were undertaking a game making project, were asked to help with the design of icons for the augmented map view representation. Pupils individually designed icons which they thought best represented the key character and object types. They then took part in a group discussion about why particular icons were easy to understand, until a consensus was reached about the most appropriate icons for each category. A set of icon designs from this study is shown in Fig. 4.

Fig. 4. A participant's icon designs

3.6 Branching Narrative Diagram

Theoretical Background. Holding complex mental representations, such as a branching plot line, in working memory can be problematic as it can place a high cognitive

load on the user [27]. Reflective cognition requires the ability to store temporary results and use those results in further thought processes. For this reason external representations can facilitate reflective cognition by allowing more complex chains of reasoning to be built up [29].

Approach Adopted. Creating a branching interactive plot with multiple modes of expression is a hard task, and keeping this constantly in working memory is not feasible, necessitating a visual representation of the plot under creation. Previous work explored young people's ability to understand branching plot diagrams in the form of a simplified Augmented Transition Network (ATN) [15]. Here the researchers found that children aged 10 were able to follow an interactive story represented in the form of such a diagram and correctly answer questions about what would happen if different choices were made in the story. They were also able to use a hi-fidelity prototype storytelling tool and create some simple stories which included branching between scenes. We chose an ATN-like diagram style because of the evidence from this previous work that children can use diagrams of this type.

Participatory Design. As part of the second school study described above, the same twelve children were also asked to draw branching narrative diagrams, loosely based on an ATN model, to represent the story of their game. They were shown two examples of games mapped out in diagrams of different sorts. Design activities were audio recorded and photographs were taken of the designs. After checking that participants were able to understand the diagrams and felt able to draw their own diagrams, they were instructed to draw a similar diagram in any way they chose. They were told that they did not have to use the same style as any of the example diagrams, so long as it was possible to see what happened in their games if the player made different choices.

Fig. 5. A participant's branching narrative diagram

The children were able to create diagrams of their own which represented the plots they were in the process of creating; an example of this is shown in Fig. 5. Most participants reported that they found the task easy and created diagrams of some complexity, but some struggled with the task and created only basic diagrams. Participants

did not adopt a consistent approach to representing different elements, using a slightly different node design each time they referred to an element of a certain type. Most diagram nodes featured objects or characters around which significant story events revolved, but in some cases 'travelling nodes' were included, which described a movement the player would make, such as 'player walks to house'.

In this situation participants were asked to draw the diagrams as a one-off activity mid-way through the game creation project. However, the branching narrative diagram should serve not only as a planning tool, but also as a representation of the plot as it develops. In order to design a tool which could be used throughout the game-making process, it was necessary to explore the use of such diagrams over a longer period.

At a five-day summer holiday workshop 12 young people aged 11-15 took part in a game-making activity. Early in the week participants were introduced to branching narrative diagrams as outlined above and asked to work on their own diagrams on large public displays by each of their work stations. Fig. 6 shows a diagram drawn by a participant.

In line with the findings from the previous study all participants could understand and follow the ATN style diagrams. Additionally, in this setting all participants managed to create their own diagrams of reasonable complexity. This difference may be due to the increased interest and ability of the young people who had elected to attend a workshop with an educational element during their school holidays. Again, most diagram nodes were based around significant characters or objects, with a few 'travelling nodes' included.

Participants were encouraged to go back to their diagrams throughout the week and edit them as they made changes. Most participants did this at least once, but as the week progressed some of them found other representations more helpful, such as "to do" lists. Some participants updated their diagrams throughout the project but others left theirs at an early stage and did not return to them.

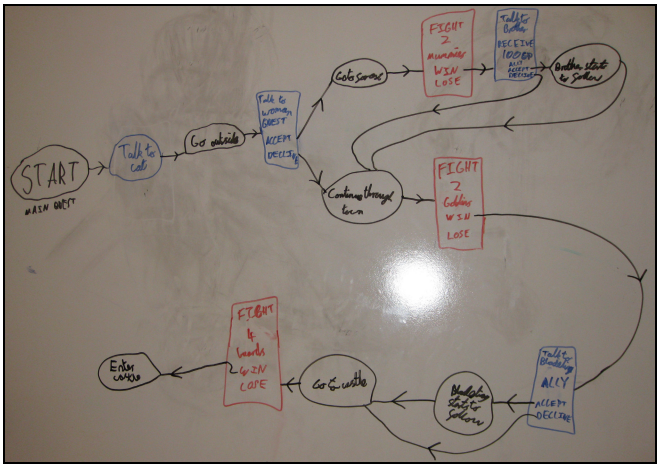


Fig. 6. A diagram drawn by a participant on a large whiteboard

4 System Description

In this section the completed system is described, and we explain how key features relate back to the design process findings.

4.1 Character and Object Creator Tools and Story Elements Panel

Main characters and plot relevant objects are now created using a wizard (less important characters/objects, or can still be added in the usual way). The wizards are loaded from the new Story Elements panel (shown in Fig. 7) which displays the characters and objects created using the wizards, and allows users to create new elements and add them to game-areas. Design activities indicated that target users like to configure characters in fine detail, but mainly focus on appearance-related properties. Evidence from interviews suggested that editing these properties is motivating because users can see a clear outcome from their effort when configuring appearance-related items; the visual feedback is strong and the impact on their game is obvious. Typing descriptions about a character's personality and back-story were seen as less appealing because there is no clear pay-off for such an activity.

Fig. 7. Story Elements panel

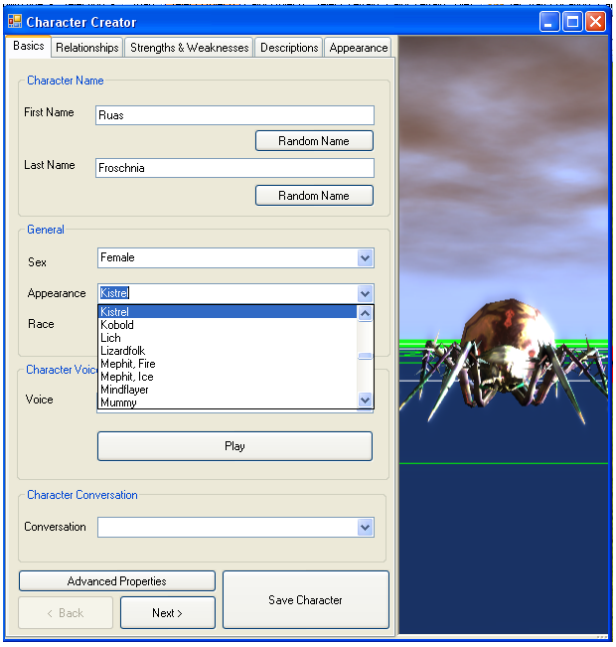


Fig. 8. Setting appearance on Basics Screen

To ensure that activities which are important to storytelling are seen as important by users, the Narrative Threads wizards give clear feedback for these activities and ensure that there are obvious outcomes for the game under creation. A persistent visual portrayal of the character was added alongside all screens so that users could see the effects of their changes and get immediate feedback as to the implications of those changes, effectively closing the loop. The character wizard is navigated using labelled buttons, in addition to 'next' and 'back' buttons to make it easier for users to find the option they want to change. The Basics screen is used to configure properties which are important for the in game mechanics, but not of great interest in the process of creating a character, including details such as name, gender and basic appearance, as shown in Fig. 8. The 3D window shows feedback from changes in appearance settings and an audio file can be played to support users' choice of the character voice.

The next screen is Relationships, which allows the user to choose whether the character they are creating will be the player, an enemy of the player or friendly/neutral towards the player. Because of feedback from users in design sessions about confusion due to the complexity of genre specific language, this screen translates the in-game terminology of 'commoner', 'hostile' and 'defender' into short sentences which describe the way such characters will behave towards the player. The 3D window gives visual feedback on the choices made by animating the character model in a way which reflects the chosen relationship type. Fig. 9 shows an example of the animation which results from choosing the friendly/ neutral relationship option.

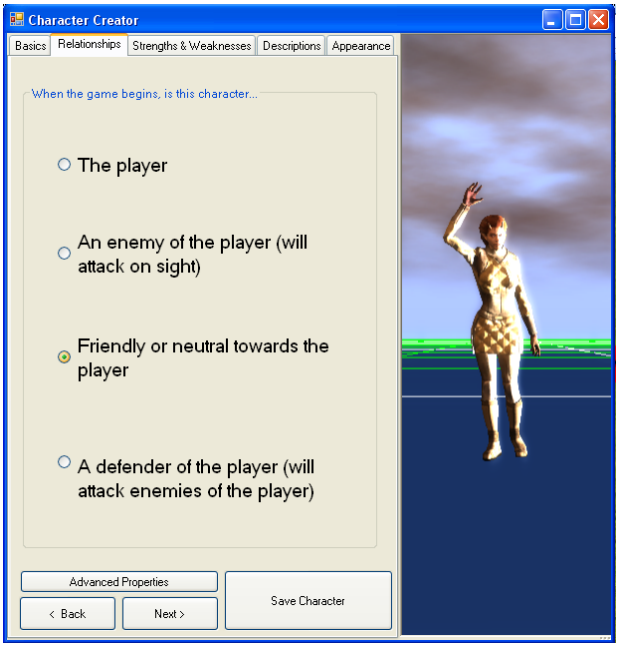


Fig. 9. Visual feedback from changing relationship setting to friendly

The third screen, Strengths and Weaknesses (Fig. 10), allows the user to set character traits by dragging and dropping descriptive phrases. This screen aims to encourage reflective thought about a character's significance in the story.

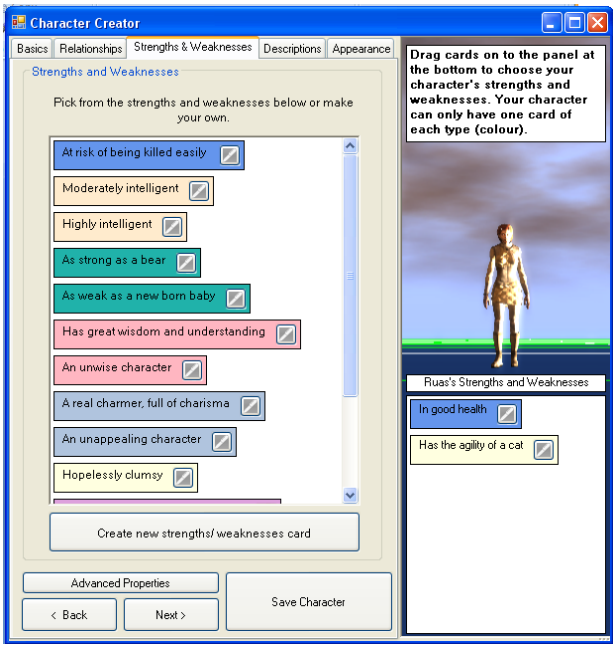


Fig. 10. Strengths and Weaknesses screen

Within the game characters have ability scores across five measures: Charisma, Constitution, Dexterity, Intelligence and Strength. On the Strengths and Weaknesses page users configure these score, as well as the health points the character will have, using descriptive phrases which explain these terms in everyday language. For example, a low charisma score is marked by the description 'An unappealing character'.

This design unites input from teachers about the potential for improving descriptive language through the activity and input from target users about confusion caused by the in-game terminology. Users can also define their own descriptive terms through a pop-up window which allows them to type in a new description and pick the associated trait and score. It was not possible to show feedback for character strengths and weakness, as appropriate animations were not available.

The next screen, Descriptions (shown in Fig. 11), invites users to enter two different character descriptions. Participatory design sessions suggested that boxes such as these would be skipped or completed with little thought if there was no clear in-game benefit to completing them. However, input from domain experts suggested that writing descriptive passages would help users think more deeply about the character under creation, as well as giving them more general practice in writing. As a result, descriptions were included, but the tool aims to show clear benefits for typing one of the descriptions.

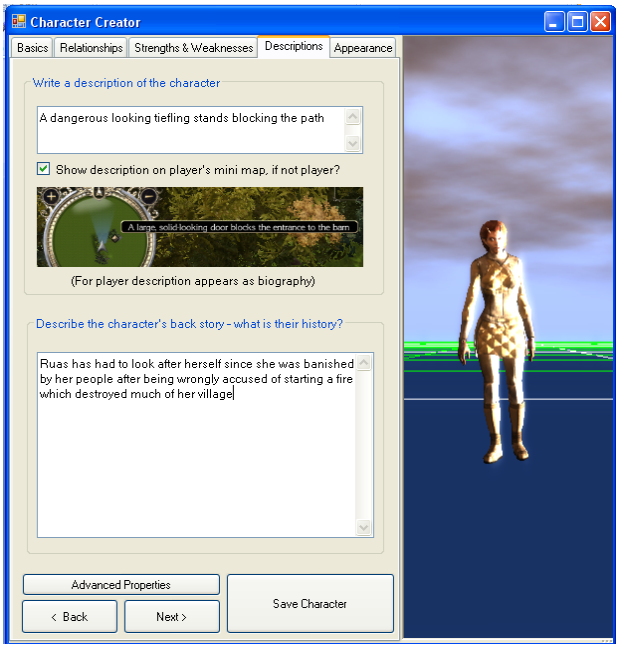


Fig. 11. Descriptions screen

The first description entered is tied to the in-game description of the character and can be made to show on the in-game map, and crucially, this is made clear to the users at the point of writing through the inclusion of an image showing where such a description will appear. The second description is deliberately left without a clear relevance to the in-game world to allow investigation of the extent to which this will affect what users type in to the different boxes.

The final screen allows the user to customise details of the characters' appearance using the existing functionality for changing things such as eye colour and skin tone. This page comes last in an attempt to ensure that the young users do not expend all of their time and energy on this part of the activity. However, users can navigate to screens in a different order to the one suggested by simply clicking on the button for the corresponding page.

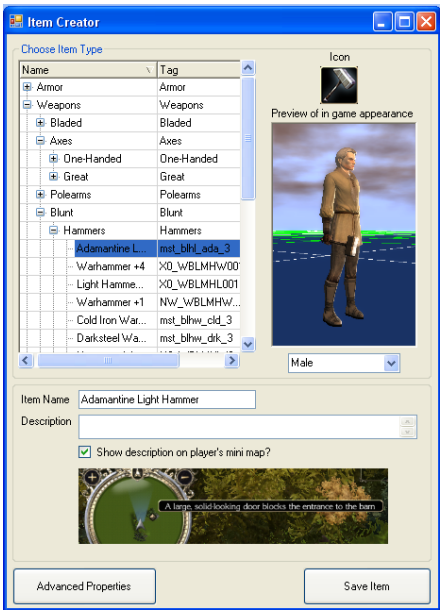


Fig. 12. Item creation wizard

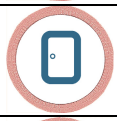
The character creation process now requires careful reflection and cannot be carried out thoughtlessly. Crucially however, the users are not asked to carry out activities which do not have a noticeable effect on the finished game. The same principles are applied to the design of wizards for creation of other in-game objects which have relevance to the plot. These make use of the same ideas, but in a greatly simplified form, as illustrated in Fig. 12, which shows the item creation wizard.

4.2 Augmented Map View

The augmented map view is a modified version of the existing toolset area view. It shows where key story objects are located, and indicates through different icons which type of story event can happen at that location.

Users can switch off the icons, which are turned on by default. Participatory design sessions indicated that target users can understand representations of this sort, and are even able to create their own correct representations when icons are provided,

Table 1. Rules for icon generation based on important objects

Object	Conditions		Icon created
Character	Hostile		
	Friendly	No conversation	
		Conversation	
Item	None		
Placeable Object	None		
Door	Without transition		
	With transition		

showing a reasonably deep level of comprehension. The icon appearances are based on designs by target users. Table 1 shows the icons and how they are automatically generated from the story elements in the game areas.

This spatially linked mode of representation cannot show all potential states or behaviours of a character or object, given that a single icon needs to be chosen. For example, it is possible to ascertain whether a friendly character has potential to turn hostile depending on the player's choices during the game, but the story icon will only represent the character's hostility or friendliness at the start of the game. One approach would be to attempt to represent all possible interactions within a single icon, but given the size of the icons this was not practical. The branching narrative diagram, as presented in the following subsection, is greatly superior in its representative power for interactivity.

Icons are turned on and off by a checkbox in the Story Elements panel, and update instantly when the corresponding object is moved. When the user clicks to turn on the icons, the area view is shifted to a zoomed-out, top-down camera angle, as shown in Fig. 13. This story icons view gives the user an overview of their area augmented with an indication of the location of key story events.

Fig. 13. Augmented 3D map view

4.3 Branching Narrative Diagram

The branching narrative diagram serves not only as a planning tool, but also as a representation of the plot as it develops. It is designed to provide visual feedback to the user within the toolset about how their interactive narrative will play out in the game.

A fully automated ATN diagram creation process was ruled out due to the computational complexity of such a task. It was also felt that an automatically created diagram would be less likely to encourage the user to reflect on the plot under creation. However, findings from the participatory design process suggested that it would be beneficial for some aspects of the diagramming task to be automated. The lack of consistency in node representations in diagrams created by target users suggested that automatically creating nodes to a standardised design would be beneficial. Additionally, findings from diagram use over a prolonged period showed that some target users were likely to forget or otherwise choose not to make updates to their diagrams as they made alterations in game, suggesting that it would be beneficial for nodes to update as changes were made. As a result of these design decisions the branching narrative diagram provides users with the building blocks to create the diagrams, but they compose the diagrams themselves. There is also a facility for custom blocks to be created to account for the 'travelling nodes' seen in participatory design sessions which cannot be automatically generated, and also to allow users to plan for future developments where characters or objects have not yet been implemented.

The diagram tool is launched from the story elements panel. On loading, the user is initially presented with a blank diagram space with only start and end nodes in place. At the bottom of the screen is a panel which contains all the plot events so far created by the user, presented as scenes. These include events generated from important objects, and scripted events. Table 2 shows the rules by which the scenes are automatically generated from important story elements.

Table 2. Rules for scene generation based on important objects

<table>
<tr><th>Object</th><th colspan="4">Conditions</th><th>Scene(s) created</th></tr>
<tr><td rowspan="5">Character</td><td colspan="4">Hostile</td><td>Fight Scene</td></tr>
<tr><td rowspan="4">Friendly</td><td colspan="3">No conversation</td><td>Meet Scene</td></tr>
<tr><td rowspan="3">Conversation</td><td rowspan="2">With script</td><td>Non-attack script</td><td>Branching Talk Scene</td></tr>
<tr><td>Attack script</td><td>Branching Talk Scene + Fight Scene</td></tr>
<tr><td colspan="2">Without script</td><td>Simple Talk Scene</td></tr>
<tr><td>Item</td><td colspan="4">None</td><td>Get Item Scene</td></tr>
<tr><td>Placeable Object</td><td colspan="4">None</td><td>Use Placeable Scene</td></tr>
<tr><td>Door</td><td colspan="4">None</td><td>User Door Scene</td></tr>
<tr><td>Flip script</td><td colspan="4">None</td><td>Script Scene (with description of script functionality)</td></tr>
</table>

This representation has much more power to show interactivity than the augmented map view, although it is much harder to understand in-game spatial relationships in this view. The majority of the interactivity in the diagram is represented through

diverging paths between scenes, but one category of scene has branch points within it. The item and object scenes have a single outcome; the picking up of an item or the using of an object. The alternative (not picking up and not using) are represented by the scene not being included in a given path through the diagram. There are more subtle encounters with items or placeable objects, such as seeing them but not interacting with them, but in the interest of keeping the diagrams to a manageable level of complexity, these scenes are not included by default. However, custom scenes allow events of this sort to be added to the diagram.

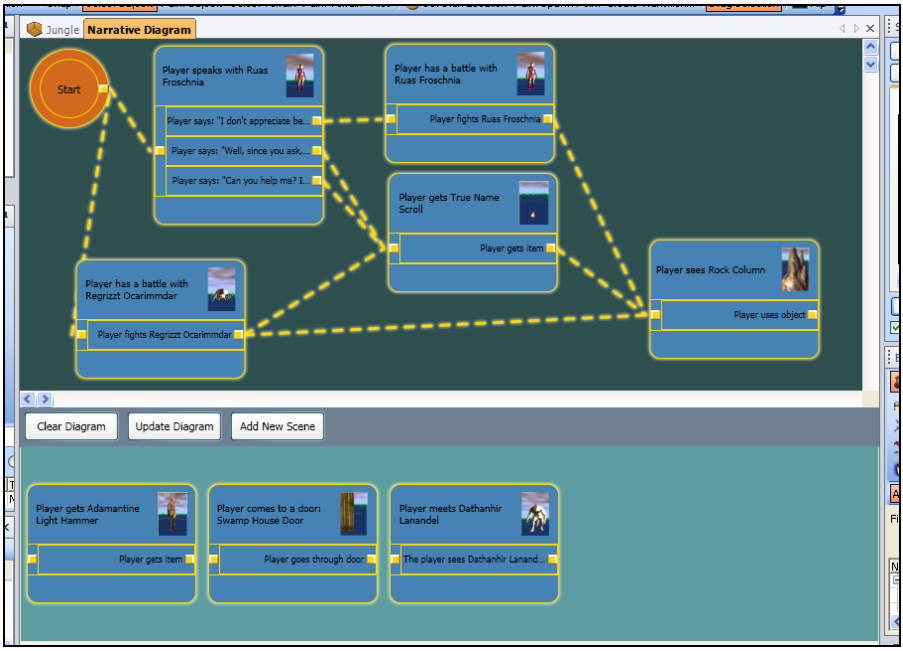


Fig. 14. Branching narrative diagram tool

Diagrams are built up by dragging scenes from the bottom panel on to the canvas, and drawing connections between scenes by clicking on the scene's connection point and dragging to draw a line to another scene's connection point. Start and end nodes are distinct, and connections can only go in one direction; from an end node of one scene to a start node of another scene. Once a user has started creating a diagram for their game, their progress is saved and when they return to the diagram tool later, they see the diagram they were previously working on. When a diagram is loaded, the tool checks for changes to elements involved in the diagram, and the corresponding scenes are updated with the alterations. In the case of an object being deleted, the related scene is removed from the diagram. This update process can also be carried out manually by the user clicking update within the tool (as the diagram can be left open whilst changes are made in other windows). Fig. 14 shows a diagram under creation.

Custom scenes are created by the user clicking 'Add New Scene'. This brings up an editor which allows the user to add a scene title as well as a list of potential branch points, as shown in Fig. 15.

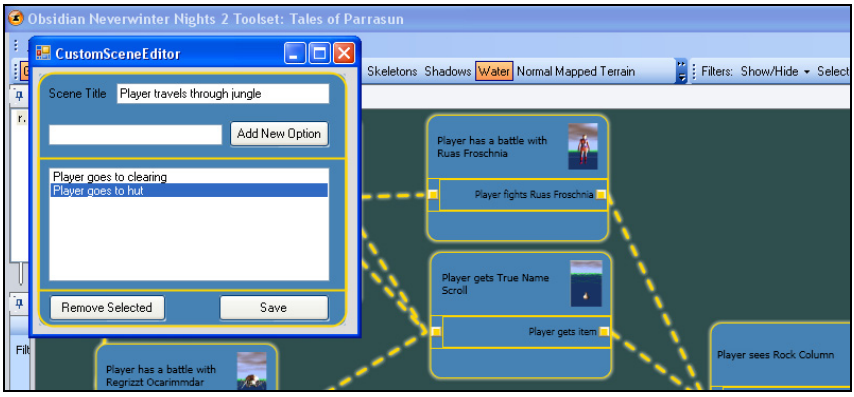


Fig. 15. Creating a custom scene for use in the Branching Narrative Diagram

5 Evaluation

An initial evaluation was carried out to explore the potential benefits of Narrative Threads. Data analysis is currently underway, but some early findings which indicate differences between games created with and without the tool are presented here.

5.1 Procedure

Fourteen young people aged 11-15 took part in a game creation project as part of a four day half-term holiday workshop. The participants were recruited through an advert on a university website and email list, and assigned to different groups before arriving at the workshop so that the groups were evenly matched according to age. One group (1 female, 6 male) used the NWN2 toolset with the Narrative Threads plugins (referred to as 'Toolset NT'). The other group (7 male) used the toolset without Narrative Threads (referred to as 'Toolset Basic').

Participants spent approximately 21 hours on the game creation project. Both groups were given video demonstrations of the basic toolset functionality, and the Toolset NT group received additional instruction in using these tools. The first and second authors each led a workshop group and provided guidance to participants, along with two additional workshop helpers.

The games created by the young people were blind-marked by a secondary school teacher with experience of running game creation projects using a rating scale which is described fully in [17]. The scale was developed in conjunction with an expert literacy educator and has subsequently been used by another researcher in a different context [34]. The scale guides a marker to assign a score for nine different factors:

storyline, visual interest of areas, player guidance, player purpose/ goals, player choice, characters, dialogues, imagination and challenge.

5.2 Results

The Toolset NT group received higher ratings on their games, as shown in Fig.17 (box plot shows minimum and maximum scores for each group through the whiskers, with the top and bottom of the boxes indicating the 75th and 25th percentile and the central line indicating the median).

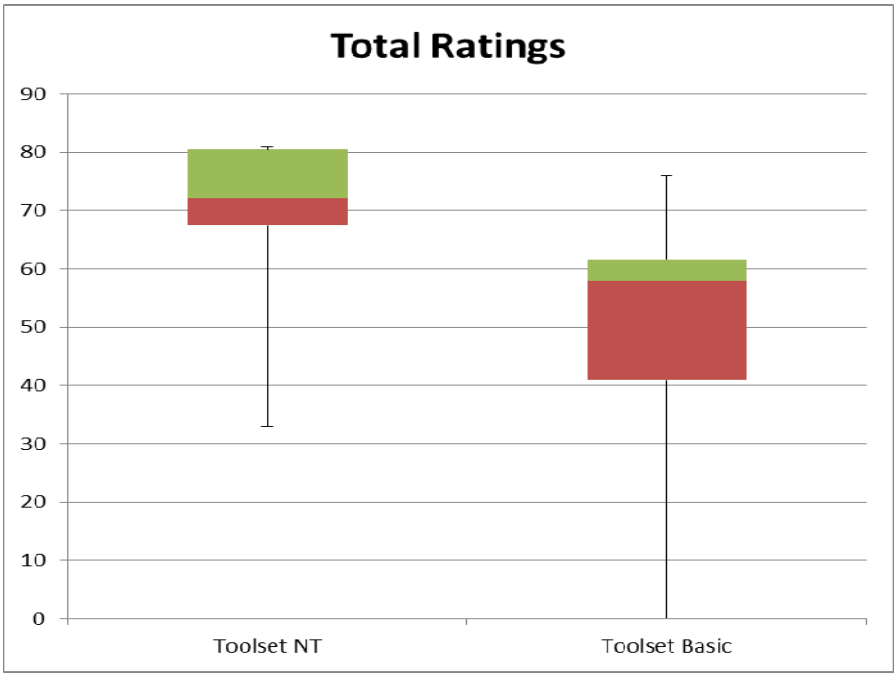


Fig. 16. Total Game Ratings by Group

As the data did not meet the requirements for a parametric test, a Mann-Whitney U test was used to examine the significance of the difference between the groups. The results indicated that there was a significance difference between the groups' ratings ($Z= -2.111$, $p < .05$).

5.3 Discussion

These preliminary result indicate that the additional support provided by Narrative Threads may make a positive difference to the quality of the games created as assessed by a teacher with reference to storyline and other factors of importance in a narrative-based game. Further data gathered from this workshop, including

transcriptions of interviews with participants, logs of tool usage and observation notes, are currently being analysed to allow closer examination of these findings. Additionally, a multimodal analysis of the games created is underway with a view to exploring their narrative features in more detail.

6 Conclusion

Narrative Threads is a suite of tools designed to encourage young people to approach game creation as a storytelling exercise. It was designed in accordance with the principles of an associated design model, with reference to established theory and with extensive input from users through a participatory design process. The participatory methods used gave invaluable input to the design process, from insight about the importance of all tasks having a clear impact on the game being created, to specific design decisions such as the choice of representational icons.

Data analysis is ongoing, but initial results suggest that the tools have a positive impact on the story elements of young people's games. Early findings from use in a workshop setting indicates that the tools have promise, and can help young designers to produce games which are rated more highly by a teacher without knowledge of the conditions under which they were created. Future work will explore in more detail the extent to which the tools help users to create games with stronger narratives, analyse the multimodal meaning-making taking place and examine the skills developed through the activity.

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