

# Narrative Threads: A Tool to Support Young People in Interactive Digital Storytelling

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**Abstract.** Computer game authoring offers young people the opportunity to create their own interactive digital stories. This activity has strong educational potential, but authoring tools have provided little to no interface representational support for the storytelling aspect of the task until now. Narrative Threads, a suite of tools which provides this support, is presented here, including a description of the extensive participatory design process which informed the design of the tools and a full explanation of the system.

**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 ideal as a learning activity [4, 14]. Researchers have explored game creation as a method of introducing children to computer science [16, 22, 25], teaching mathematics skills [15, 23], and encouraging more sophisticated thinking about learning [8, 14]. This research is motivated by work which suggests that game creation has the potential to support storytelling [4, 26], and the particular focus of our work is on designing software to support the development of multimodal, interactive writing skills.

Multimodal literacy [13] describes the extent to which meaning can be communicated through a variety of modes. In order to communicate effectively today, young people need to be able to make use of multiple modes of expression and additionally, to work with interactivity. It is no longer sufficient for educators to teach children how to convey a message through linear text, they also need to know how to make effective use of other modalities, such as video, images and audio, and to plan branching pathways through the content they create.

Although the relationship between stories and games is a controversial one [12], it is clear that narrative elements are integral to many games, and game creation can offer a motivating and engaging approach to learning multimodal and interactive writing skills. A series of interviews with English teachers and literacy specialists indicated that there was potential for a wide range of skills to be developed through

game authoring [10]. Of particular note was the consensus that game creation had good potential for teaching composition skills (including narrative structuring, using imaginative vocabulary, audience awareness and considering what the reader (player) needs to know), planning, drafting, reflection and understanding how meanings are changed when texts are adapted to different media. It was noted that, to aid learning, these aspects would need to be brought to the forefront of the game creation activity.

Creating an interactive digital story in the form of a game is a highly complex task. If young people are to engage with the activity successfully it is essential that support is provided, both through educators structuring the activity, and also through the software that makes the activity possible. This paper addresses the latter area, by introducing software-based support for plot management as well as character and object creation.

### **1.1 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, 5, 25], others tools focus on making 3D area design accessible [21, 24], and some include functionality designed specifically to support storytelling [16, 27].

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 [16]. There is little support for adding interactivity into the stories however, as the tool is primarily designed for building linear animations. 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 [27] makes use of a game making toolset (shown in Fig. 1) which is sold with a commercial role-playing game, *Neverwinter Nights 2* (NWN2) [21]. 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. 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 providing 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 gamemaking is the way in which a story can be told through a variety of modalities such as character and object appearance and behaviours, sculpting of areas and landscapes, as well as descriptions of objects [28].

### **1.2 Representational Support Required for Interactive Digital Storytelling**

Creating a multimodal interactive narrative is a 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 [29], but no representational support is currently available for creating and managing an interactive, multimodal narrative. 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 a commercial game, a team of writers will be involved and will use techniques similar to those used by filmmakers, such as storyboarding and scripting dialogue to support the storytelling activity [1, 7]. However, these are experts who have already developed the skills in question and are working specifically on a writing task. When a young learner is responsible for all elements of a game under creation there can be a tendency to focus on aspects which give immediate feedback and satisfaction, such as creating 3D areas, and it can be hard to convince them that paper-based planning work will be beneficial.

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. [17, 18]) 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.

### **1.3 Summary of Paper**

This paper describes Narrative Threads; a suite of tools to support multimodal interactive storytelling. In the following section 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 3 we describe the suite of tools, with notes on usage and relation to the design process. Finally, in Section 4, conclusions are drawn and future work is outlined.

## **2 Design Process**

The challenge of creating representational support for interactive digital storytelling was addressed in the context of designing an educational support tool for 11-15 year old children. The design was grounded in theory and developed using a

learner-centred design (LCD) methodology, based on the CARSS framework described in [2]. In this section we explain how the overall aims of the tool were established, and describe the extensive participatory design process.

## 2.1 Design Model

A design model which offers guidance on directing learner attention to desired aspects of a task through foregrounding and backgrounding specific elements with representational choices was developed. The model synthesises theory on the use of external representations in educational tools, and is presented in full in [11]. The key recommendations of the model are that interface representations should allow users to carry out subtasks unrelated to learning goals quickly and simply without need for reflective cognition [20], whilst subtasks 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 [19], should support re-use of learner created elements, and crucially that designers should avoid loss of motivation by aligning effort with learner goals.

Selected theories and aspects of the design model are applied and explained in greater detail in the following sections with reference to specific design decisions.

## 2.2 Choice of Toolset

A decision was made to design a suite of plugins 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 [5, 27].

## 2.3 Evaluation of Existing Toolset Interface

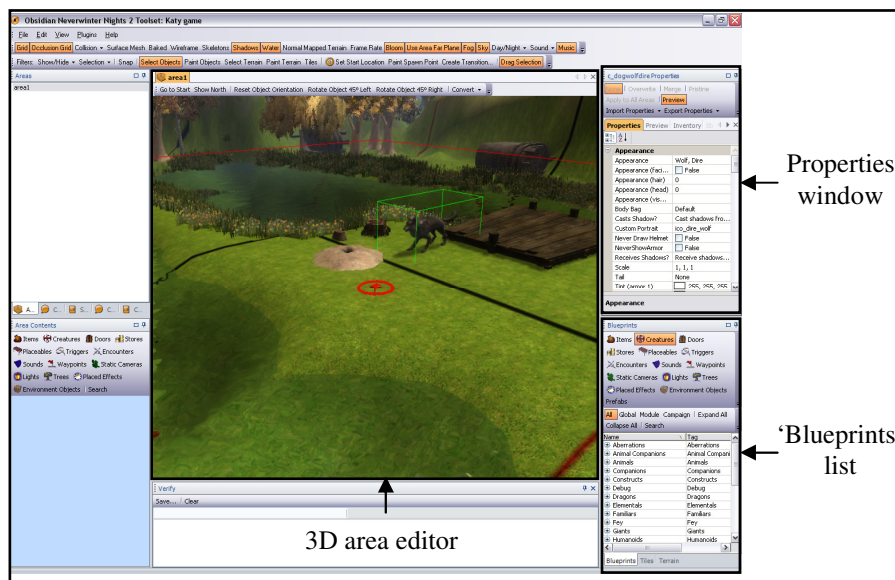
As an initial design stage the existing toolset interface was evaluated against the design model, key underlying theories, and previous experience the authors have had using the toolset with young people [4, 9]. In keeping with most game authoring tools the NWN2 toolset interface centres on a 3D area view, as can be seen in Fig. 1. The inbuilt 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 inbuilt 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 has simply been added as 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 [26].



**Fig. 1.** Neverwinter Nights 2 Toolset Interface

## 2.4 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 the required functionality could be divided into three separate tool categories:

1. **Character and object creation tools with associated visual representations:** Scaffolds character and object creation.
2. **Augmented 3D map view showing story event locations:** Shows where important plot events are located on the map.
3. **Branching narrative diagramming tool:** Represents the high level plot structure of the game to the user.

The tools are separate but interconnected, and are part of an integrated approach to supporting narrative development 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.

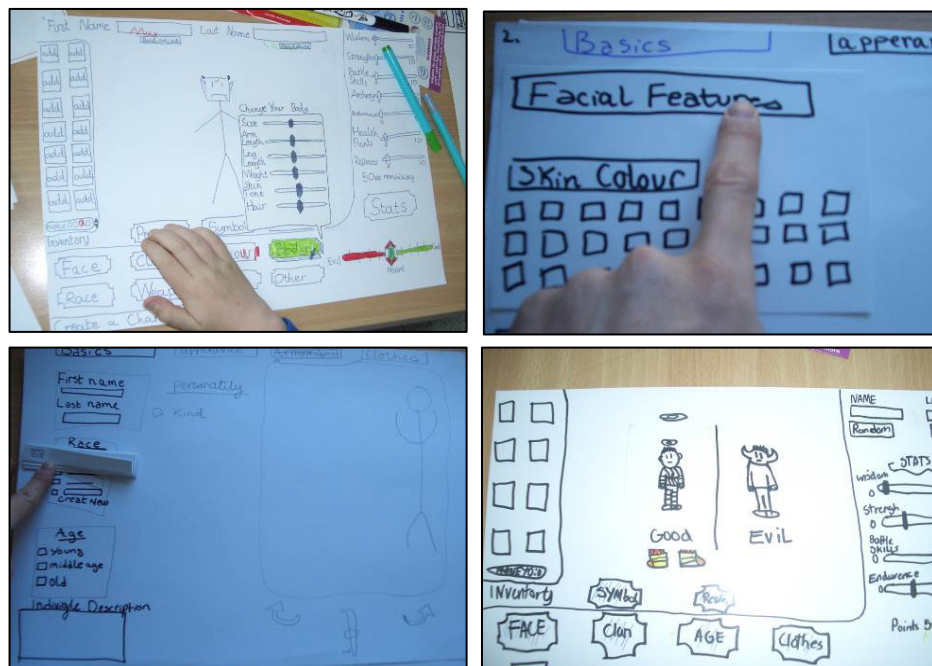
## 2.5 Character and object creation tools with associated visual representations

**Theoretical Background.** Norman distinguishes between experiential and reflective cognition [20]. 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 [30] 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 tool they had used in software form 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 the ideas simply being parroted back in their own designs. The design sessions were audio recorded, observation notes were made and photographs were taken.



**Fig. 2.** Participants' paper prototype designs for character creator tools

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

The designs created by the children were mainly based around physical appearances, with options given for customising characters in fine detail. For the girls, this involved having numerous noses and other facial features to choose between, while for the 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 there was no

clear outcome from typing a description of this sort. When it was not obvious how an element would make a difference in the game, participants reported that they skipped straight past it. When setting an appearance, users were having a clear effect and getting feedback based on their choice, but writing about a character's personality did not have any effect on their game (visible or otherwise). A number of comments made by both the boys and the girls reflected the importance of options in a creator tool making a difference in the game. 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'. This indicates that without feedback or an understanding of how certain options will have a noticeable effect on the character they are likely to skip through an item without giving it much thought.

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.

## 2.6 Augmented 3D map view showing story events

**Theoretical Background.** The match-mismatch hypothesis [3] 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.

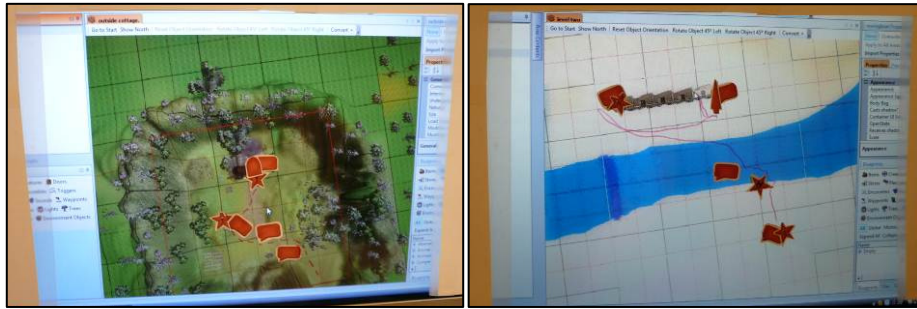
**Adopted Approach.** The task of creating an interactive digital story in the form of a game is not currently well supported because one aspect of the task, the design of the 3D areas, is fully represented while other aspects important to the story, such as how a character will behave towards the player, 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 additional 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 us to safely ask participants to place the icons on top of their 3D area views without risking damage to the laptop screens!



**Fig. 3.** Participants using paper prototype to show important story events in their areas

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 later 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.

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 type. 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. Two sets of icon designs from this study are shown in Fig 4.



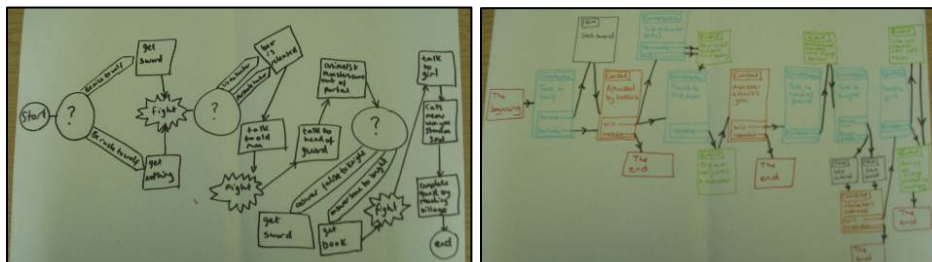
**Fig. 4.** Participants' icon designs

## 2.7 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 [19]. 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 assisting more complex chains of reasoning to be built up [20].

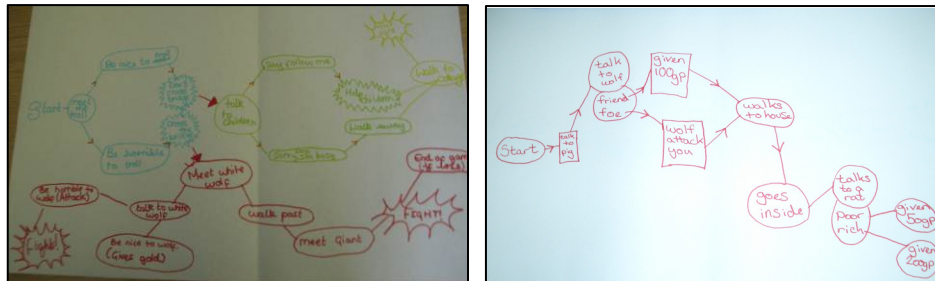
**Approach Adopted.** Creating a branching interactive plot with multiple modes of expression is a hard task, and keeping this constantly in working memory is not feasible, so a visual representation of the plot under creation is needed. Previous work explored young people’s ability to understand branching plot diagrams in the form of a simplified Augmented Transition Network (ATN) [6]. 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 able to 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, as shown in Fig. 5.



**Fig. 5.** Example branching narrative diagrams

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. 6.** Two diagrams drawn by participants

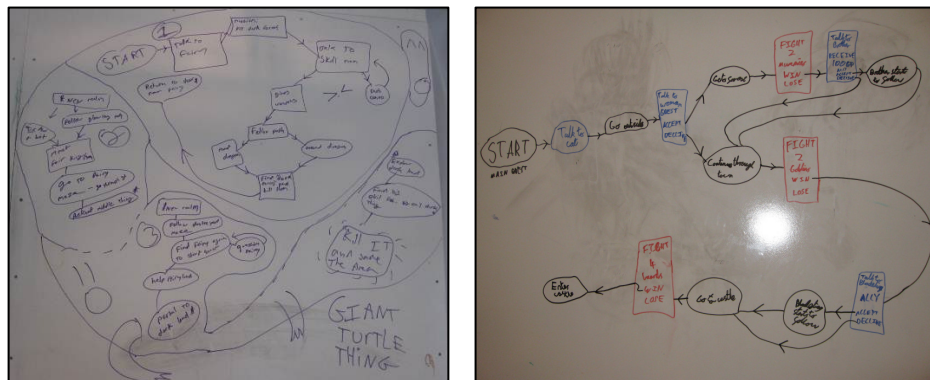
The children were able to create diagrams of their own which represented the plots they were in the process of creating; two examples of these are shown in Fig. 6. Most participants reported that they found the task easy and created diagrams of some complexity, but some struggled with the task and created only basic diagrams. Participants did not adopt a consistent approach to representing different elements, with a slightly different node design used each time an element of a certain type was referred to. Most diagram nodes featured objects or characters around which significant story events revolved, but in some cases ‘travelling nodes’ which described a movement the player would make were included, such as ‘player walks to house’.

In this situation participants were asked to draw the diagrams as a one-off activity at around the mid-point of the game creation project. However, the branching narrative diagram is not to serve 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 gamemaking 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. 7 shows two diagrams drawn by participants.

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 such as “to do” lists to be more helpful. Some participants kept their diagrams up to date throughout the project but others left theirs at an earlier stage and did not return to them.



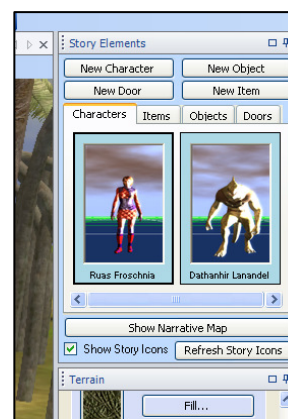
**Fig. 7.** Two diagrams drawn by participants on large whiteboards

### 3 System Description

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

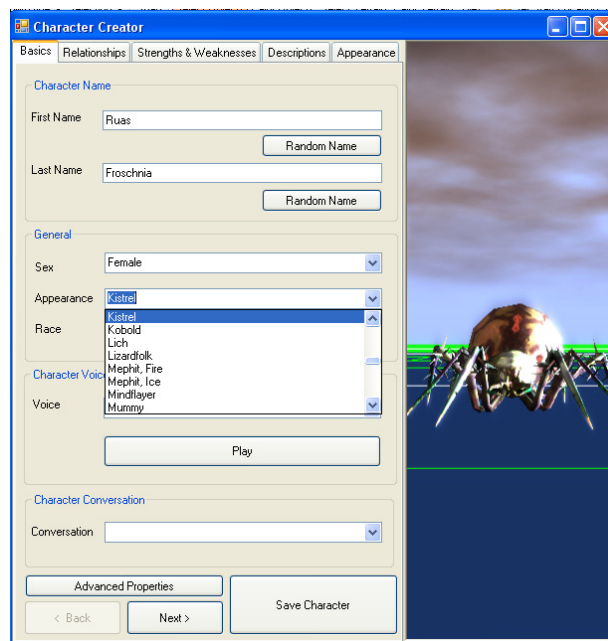
#### 3.1 Character and Object Creator tools and Story Elements Panel

The process for creating a main character or plot relevant item now takes place using a wizard (less important characters/objects, or ‘extras/scenery’ can still be added in the usual way). The wizards are loaded from the new Story Elements panel (shown in Fig. 8) which displays the characters and objects created using the wizards, allows elements to be added to areas, and includes buttons for creating new elements. Design activities indicated that target users are keen on configuring characters in fine detail, but this was largely limited to appearance-related properties. Evidence from interviews suggested that these elements were motivating because users can see a clear outcome from their effort when they are configuring appearance-related items; the visual feedback is strong and the impact on their game is obvious.



**Fig. 8.** Story Elements panel

Typing descriptions about a character's personality and back-story were not seen as appealing because there is no clear pay-off for such an activity. To counteract this problem and 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.

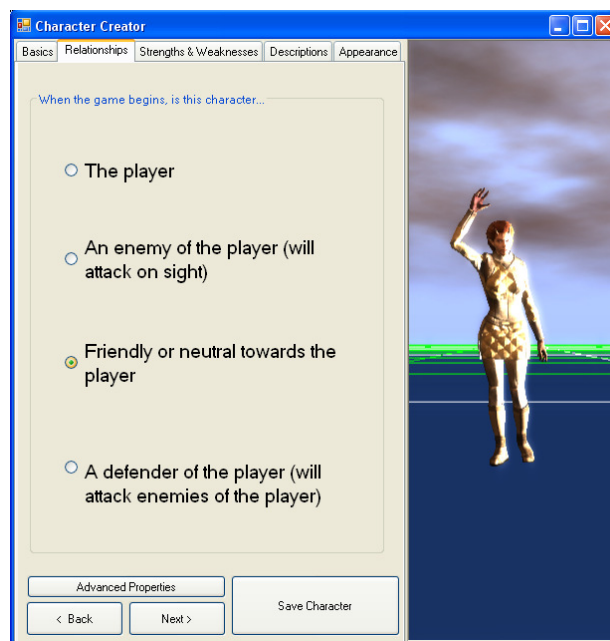


**Fig. 9.** Setting appearance on Basics Screen

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. 9. 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. 10 shows an example of the animation which results from choosing the friendly/ neutral relationship option.



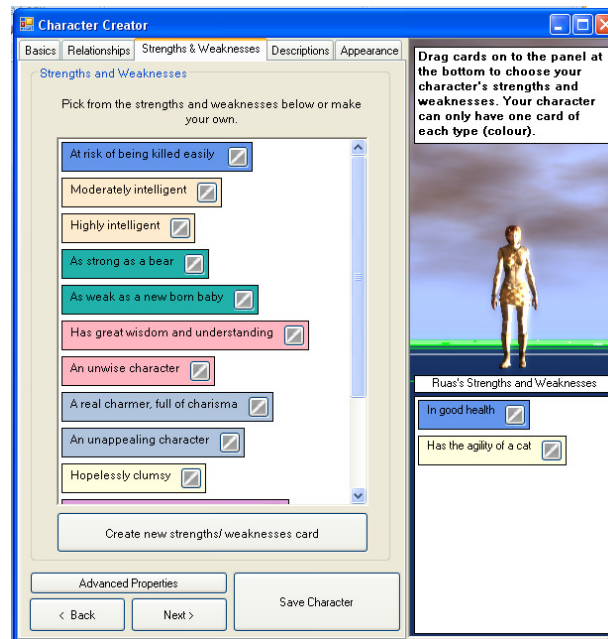
**Fig. 10.** Visual feedback from changing relationship setting to friendly

The third screen, Strengths and Weaknesses (Fig. 11), allows the user to set character traits by dragging and dropping descriptive phrases. This screen is key to the aim of encouraging reflective thought about a character’s significance in the story.

The game engine has a range of in-built parameters which affect the behaviours and abilities of characters. The parameters most important to the game are the characters’ ability scores across five measures: Charisma, Constitution, Dexterity, Intelligence and Strength. On the Strengths and Weaknesses page users configure these elements, 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’.

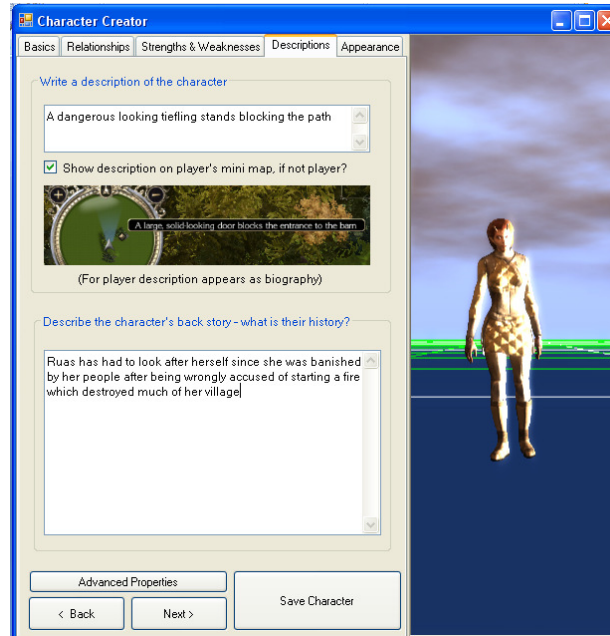


This design unites input from teachers about the potential for improving descriptive language through the activity and input from target users about confusion caused by the in-game terminology. Users are also able to define their own descriptive terms by loading a small pop-up window which allows them 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.



**Fig. 11.** Strengths and Weaknesses screen

The next screen, Descriptions, invites users to enter two different character descriptions, as shown in Fig. 12. The participatory design sessions gave insight that boxes such as these would be skipped or completed quickly with little thought if there was no clear in-game benefit to completing them. However, input from domain experts indicated that the process of writing descriptive passages would help users to 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. 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.

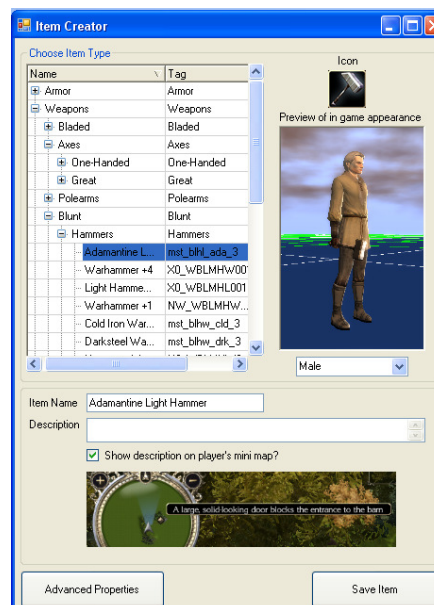


**Fig. 12.** Descriptions screen

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.

The character creation process has been transformed from one which can be done thoughtlessly to one which requires reflection carefully directed at certain activities. 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. 13 which shows the item creation wizard.



**Fig. 13.** Item creation wizard










### 3.2 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.

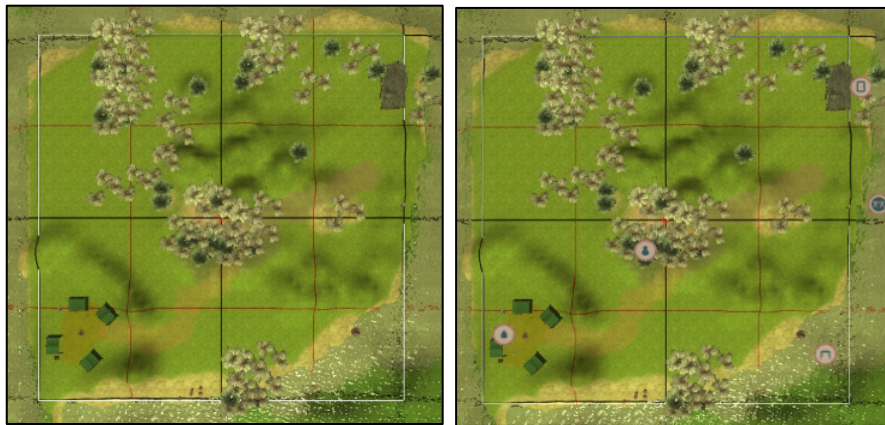
Users can switch off the icons, but by default they are turned on. Participatory design sessions indicated that target users can understand a representation of this sort, and are even able to create their own correct representations when icons are provided, showing a reasonably deep level of comprehension. The icon appearances are based on designs by target users at a participatory design session. Table 1 shows the icons and how they are automatically generated from the story elements in the game areas.

**Table 1.** Rules for icon generation based on important objects

Object	Conditions		Icon created
Character	Hostile		Battle 
	Friendly	No conversation	Character 
		Conversation	Speech Bubble 
Item	None		Important Item 
Placeable Object	None		Important Placeable 
Door	With transition		Door 
	Without transition		Transition Door 

It is important to note that this spatially related mode of representation is not well suited to showing interactivity, as a single icon needs to be picked to show all possible events for a character or object. For example, it would be possible to ascertain whether a character that is friendly when the game starts has potential to turn hostile based on the player's choices during the game. However, the story icon shown 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 they 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. 14. This story icons view gives the user an overview of their area augmented with an indication of the location of key story events.



**Fig. 14** (left) 3D map view without icons, (right) augmented 3D map view

### 3.3 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. The aim is to provide visual feedback to the user to contribute to their developing idea of how their story is progressing in between game testing sessions. A fully automated ATN diagram creation process was ruled out due to the computational complexity of such a task and the extent to which self-composing of such a diagram is likely to encourage reflection on the plot as it is created. 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 to aid the ease of comprehension of assembled diagrams. 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 them 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

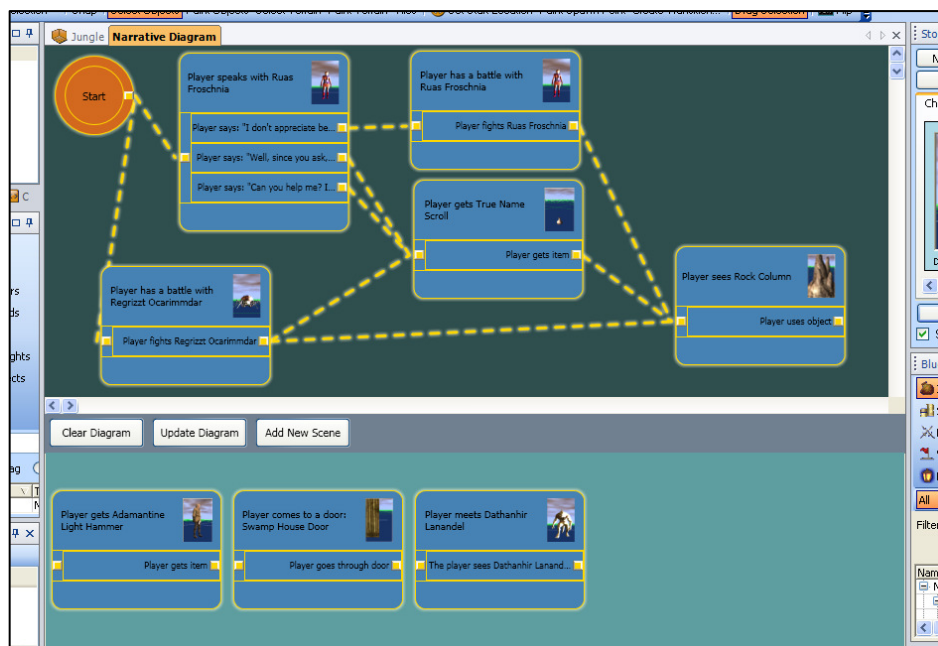
Object	Conditions				Scene(s) created
Character	Hostile				Fight Scene
	Friendly	No conversation			Meet Scene
		Conversati on	With script	Non-attack script	Branching Talk Scene
				Attack script	Branching Talk Scene + Fight Scene
			Without script		Simple Talk Scene
Item	None				Get Item Scene
Placeable Object	None				Use Placeable Scene
Door	None				User Door Scene
Flip script	None				Script Scene (with description of script functionality)

This diagrammatic 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 interests 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.

Diagrams are built up by users dragging scenes from the bottom panel on to the diagram, and once scenes are there users can draw connections by clicking on the connection point and dragging to draw a line to another 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. 15 shows a diagram under creation.



**Fig. 15.** Branching narrative diagram being edited

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. 16.

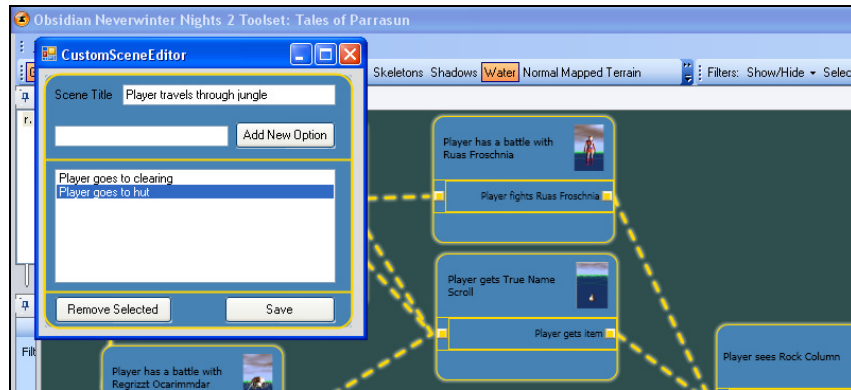


Fig. 16. Creating a custom scene for use in the Branching Narrative Diagram

## 4 Conclusion

Narrative Threads is a suite of tools designed to encourage young game designers to approach the game creation activity as a storytelling exercise, and by doing so to improve their multimodal, interactive writing skills. It was designed in accordance with the principles of an associated design model [11], 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.

Three interconnected tools make up Narrative Threads. The creature and object creation wizards encourage designers to consider and reflect on the important elements of their game as they are creating them. The augmented map view attempts to make invisible story-related elements visible in the 3D area view to support consideration of storytelling aspects in area design. Finally, the branching narrative diagram tool allows users to quickly and simply create a diagrammatic representation of the interactive plot of their game, providing feedback on the game being created and focusing attention on revising and improving the branching plot structure.

Early feedback from use in classroom and workshop settings indicates that target users find it easy to use Narrative Threads and are able to integrate the tools into their game design practice without any difficulties. Data analysis is ongoing, but initial results suggest that the tools have a positive impact on the story elements of young people's games. Future work will further explore the extent to which these tools help users to create more story-led games and examine the writing skills developed through usage.

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