A narrative centred Informant Design approach for interactive learning environments

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Abstract: This paper describes a narrative centred design approach, which has been developed to produce multimedia-based Interactive Learning Environments (ILEs) that incorporate a 'designed-in' narrative intended to provide users with a rich and engaging learning experience. The Narrative Centred Informant Design (NCID) approach is introduced and described. NCID has been developed from an analysis of narrative theory and computer games development, and incorporates dramatic and narrative devices that are meaningful to the target learner group. One of the major issues addressed is how to ensure that the ILE will appeal to students who find the domain knowledge difficult. The development of a prototype ILE that utilises the NCID approach is described and the design process is outlined. The paper concludes by identifying how the design framework can be further developed and refined.

Keywords: design; games; interactive; learning; motivation; narrative.

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1 Introduction: why do we need narrative centred design?

The more principled design methods used to develop Interactive Learning Environments (ILEs) tend to use variants of user centred design – often known as learner centred design (Soloway, Guzdial and Hay, 1994). Methods for developing such systems have increasingly involved developing an approach to design the interactions – i.e. interaction design (Dourish, 2001; Preece, Rogers and Sharpe, 2002). The work reported in this paper is aimed at adding an element into the design process, which seeks to develop the notion of interaction design to include 'designed-in' narrative. We term this approach narrative centred design.

In terms of extending interaction design, it might be argued that the role of narrative is in tension with the unpredictable ways in which interaction might develop. Yet, narrative has several distinctive advantages if used effectively – including that it can motivate, engage, and also aid learning. In terms of learner centred design, it might be argued that there is a tension between seeing things from the learner's point of view and the designer's point of view – these could easily be in significant tension. Narrative Centred Informant Design seeks to provide the benefits of narrative for interaction design and combine the notion of learner centred design with narrative centred design. By working with informants, we can develop their understanding of narrative such that they can 'design in' a narrative that has some chance of being understood by their peers.

For example, Quinn (1994) has suggested a cognitive engineering methodology that incorporates elements of user centred design; specifically to address the design of learning environments that utilise both narrative and game like elements as motivational and pedagogic devices. Quinn suggests that a user-centred design approach that makes use of cognitive engineering is most appropriate and that the principles used in these methodologies can be applied to the design of educational systems.

Quinn also asserts that games can provide a situated context for learning that can enhance motivation but that a meaningful game (providing an appropriate context) must be chosen or developed if this is to be effective. From this perspective games are considered constructivist in nature as they can allow the user to explore the game environment and discover the actions/knowledge required for success. He suggests that reflection is not always specifically supplied in games and that some games only allow this when they have concluded.

We agree with Quinn that the users must be involved in the design process of educational games, but we argue that the narrative must be the central focus of the design if the system is to have meaning for the users rather than the designers. In addition, though Quinn's model is useful in identifying the importance of user centred design it neither considers the design techniques or approach used by commercial games developers nor does it outline specifically what games techniques, in practical terms, may be of use to the developer of educational games.

We adapted the Informant Design framework (Scaife et al., 1997) so that it incorporates narrative techniques, which can then be used to address these issues (see below).

Here, the narrative developed through this process is in the form of an educational game. Amory et al. (1999) have suggested a model that focuses on the interface of an educational game, the Game Object Model. The elements of the game environment such as graphics, sound and technology are related to the categories of problems that can be addressed such as memory, mathematics, reflexes, and so on. The model does not directly

address theories of drama or narrative which we consider important for the development of adventure games as the narrative is an important component of the ILE. Amory and Govender (2000) claim that an evaluation of the use of this model showed that it was 'useful in the creation of an interactive story' though the users who evaluated the system felt that the 'story line should be more complex'.

1.1 Computer games narrative and learning

It is well established that computer games are able to hold the attention of the player for long periods of time; that is, they motivate them to continue to play (Provenzo, 1991; Herz, 1997; Johnson, 1997; Prensky, 2001). Computer and video games are attractive to players because they allow risk taking in a predefined and controlled 'world' with few negative consequences and provide users with opportunities to prove their skill in addition to being both entertaining and challenging.

Malone (1981) has identified a number of reasons for the success of computer games in this respect such as, the use of clearly articulated goals, variable levels of difficulty, an appealing fantasy context (through a simple narrative) and both cognitively challenging and non-predictable elements. Prensky (2001) has also analysed computer games to determine why they are engaging, his findings largely concur with those of Malone. He suggests that the narrative used in game environments is linked to the 'representation' that the game uses and can be a powerful motivational tool that can engender strong emotions in the player. Prensky argues that the main reason that games are successful is because they are fun to play and that this aspect of computer games must be incorporated into educational games if they are to be successful.

There is a long-standing debate over the value of computer games for education; some authors suggest that learning is enhanced through increased student interest and involvement. Other workers regard games as a 'cheap fix' with possibly distracting and irrelevant features; it is argued that games motivate children to win but that they learn little as they progress through them (Lepper and Cordova, 1992). Others report that educational games when appropriately designed and constructed are intrinsically motivating because they stimulate user's curiosity (Thomas and Macredie, 1994).

1.2 Designing narrative centred interactive learning environments

Although adventure based games have been developed for use in schools their use in higher education has been relatively limited. Amory et al. (1998) describe the development of an educational game 'Zadarh' that is designed to teach learners about aspects of human evolution. They do not indicate whether the target learner group were involved in the design of the game.

The design of educational game based ILEs often uses computer game design principles to inform the design, but they do not directly involve users in their design.

Quinn (1996) has described the development of an educational adventure game 'Quest for Independence'. An important design parameter was the need to entertain the learner – this is not given a high priority in traditional computer based learning software, but we argue that it is potentially a very important issue as both children and adults are exposed to increasingly sophisticated computer games, software, and other media. The Quest for Independence illustrates that computationally (and financially expensive to produce) graphics are not necessarily essential for an engaging game. The design and

development of an appropriate, simple narrative can be used to engage the learner instead; addressing the needs and abilities of the potential users is important if this strategy is to work.

1.3 Narrative and learning

Constructivist educational theorists (such as Piaget, 1973) have argued that the interpretation and assimilation of knowledge occurs within a specific social and cultural context. Several theorists (for example, Bruner, 1991; Berger, 1997) have suggested that stories are the primary way that we assimilate knowledge of the world and make sense of it.

Other workers have shown that narrative is important in the recall and comprehension of material (for example, Mandler and Johnson, 1977; Mandler and DeForest, 1979; Stein and Glenn, 1979; Trabasso, Secco and van den Broek, 1984). Narrative then can be viewed as a mechanism to make sense of the material that we are presented with or as a fundamental property of meaning making. In addition, it has been shown that narrative can act as useful structural mechanism to help guide students through a learning environment if it is appropriately designed and used (Plowman, 1996).

When our aim is to design a motivationally engaging learning environment it is clear that narrative could have a very important role.

1.4 Narrative motivation and engagement

Lepper, Woolverton and Mumme (1993) report the results of studies on educational activities with identical instructional content but differing motivational appeal. These studies have shown that gains in learning can occur when the learning activities take place in a motivationally embellished setting. The embellishments used were the provision of a number of fantasy contexts for simple educational games providing a basic narrative.

Students exposed to the motivationally enhanced programmes showed significantly increased motivation for learning target domain knowledge, even when the motivational factors were removed. Lepper et al. (1992) also distinguish between intrinsic and extrinsic rewards for learning. Intrinsic rewards are based on a high congruence between the material being taught and the motivational techniques used. Lepper notes that extrinsic rewards can have a detrimental effect on learning (Lepper, 1985; Lepper et al., 1992).

For any learning task to be meaningful to the learner they must have both a sufficient context for the learning and motivation to perform the tasks that will help them to learn (Bielenberg and Carpenter-Smith, 1996). We believe that game based learning environments that incorporate a strong narrative can meet these requirements as the learning tasks if appropriately designed can be tightly coupled with the narrative.

We have used an approach that is based on designing a meaningful and engaging narrative for the users of the system so that they will be motivated to continue using the system rather than explicitly trying to determine their motivational state. Employing this approach the learner does not have to disengage from the narrative at all.

The narrative elements that have been used as the basis of Narrative Centred Informant Design (NCID) are based on Propp's (1968) model of a universal narrative. Propp's identification of a common narrative structure and characters provides a useful

basis to identify major plot events and characters with informants (Waraich, 2002). A simplified version of the Proppian model was used directly with the informants in this work.

2 What is narrative centred Informant Design?

The development approach we describe here is an adaptation of Informant Design (Scaife et al., 1997) known as NCID (Waraich, 2002). Conventional approaches to user centred design revolve around the evaluation of prototype designs and careful requirements gathering to ensure that the needs of the user are met.

Informant Design is designed to involve a range of experts in the development of software and considers the potential users of the system as partners in the design process. NCID adapts the Informant Design model to use narrative centred techniques. There are four phases to the design process as per Informant Design, but the first two phases use narrative centred techniques to help to design and develop the macro and micro narratives that will form the basis of the ILE.

NCID uses a number of informants in the design process, as does Informant Design. In the work at Manchester Metropolitan University (MMU), the roles were adapted as some experts (such as psychologists) were not available. Others filled such roles where possible. The adapted version of NCID used is shown in Table 1.

Table 1 NCID as used at MMU

Design Phase	*Methods*	*Contributors*	*Outcomes/techniques*
1. Define domain and problems and identify basic narrative elements	Interviews Analysis of existing materials and software Talk about nature of narrative	Lecturers Domain expert Students Designer Narrative facilitator	User requirements document Learning objectives/goals Preliminary documentation produced Group discussions with focus group of students from years 2 and 3
2. Translation of specification and plot/character definition	Storyboarding and sketching, scenario creation	HCI expert Software designer Narrative facilitator Students	Storyboards; index card based narrative description; Paper based narrative scenarios; Student's stories/group work Story analysis
3. Design low-tech materials and test	Storyboarding Scenario creation Design through scenarios plot definition; character matrices	Lecturers Domain expert Software designer Students Narrative facilitator	Storyboards; index card based narrative description; Paper based narrative scenario (cut outs)
4. Design and test high-tech materials	Prototype (high-tech) Multimedia Pre- and post-tests Cognitive analysis	Psychologist Software designer Students HCI analyst Narrative facilitator	Prototype system (BAT) functional; Pre- and post-tests Questionnaires Observation Interviews

3 Using NCID: developing an ILE for a 'demotivating' topic

Computer architecture courses at first year undergraduate level, involve the teaching of a domain that contains both abstract concepts and procedural knowledge. One problem that is often faced by tutors is devising suitable practical activities for the students that would help them to comprehend the abstract concepts and knowledge that underpin computer systems (Lees, 1986, 1987; Waraich 1998). Additionally, some students consider the material to be 'dry' and have difficulty in understanding why it is relevant. Some appear to be poorly motivated to study the subject (Waraich, 2002).

One of the authors has been involved in the teaching of computer systems to students who often have little experience or understanding of the architecture or operation of a computer. Often they appear to have difficulty in visualising the interrelationship between the concepts they study and the operation of a computer. This includes conceptual areas such as binary arithmetic and logic gates.

It is often reported that ILEs can provide a rich learning environment (for example, Berg, 2000), but they require careful design and integration into the curriculum, which in turn requires the use of design, and development methodologies that incorporate both the needs of the learners and provide the learning experiences required by tutors. If we are to produce an ILE that will help to motivate learners to engage with their learning we must consider what features of the ILE must be developed to appeal to the users of the system.

3.1 Teaching computer systems

Consultation with first and second year undergraduate students at MMU who had studied/were studying the unit Computer Systems Organisation (CSO) confirmed the authors' view (from similar discussions with students at two other Higher Education institutions studying a comparable unit) that although many considered that the CSO unit was well taught, they found the material 'dry' and 'not very interesting'. Many students who had completed the unit stated that they 'could not remember the details' of what they had studied (Waraich, 2002).

The CSO unit was identified as a domain that could benefit from an ILE designed to motivate the students to learn and to increase their enjoyment of learning by providing a situated context for the material and using clearly articulated goals. The target audience for this study was first year undergraduate students at MMU who were taking the unit 'Computer Systems Organisation' in the Department of Computing and Mathematics.

At the time of the study CSO was a compulsory unit for students studying on the Modular degree scheme (single honours) and an optional module for those studying under the Combined Honours scheme. The unit was taught with the assumption that the students had no prior knowledge of computer systems and their architecture, though in practice few of the students had not been exposed to some of the material before.

Discussions with the CSO tutors indicated that the Combined Honours (CH) students were traditionally considered to be weaker than the Modular Scheme (MS) students. This is largely because they are studying two main subjects as opposed to a single honours degree and often have very limited previous experience of computing as an academic discipline. Both tutors also expressed the opinion that these students were often poorly motivated to study and the previous years results and attendance for CSO (and other compulsory units) seemed to indicate this though there was no other formal evidence to support the statement (MMU, 2000).

The CH students were therefore chosen as the main target group for the design of the ILE. Although the CH and MS students were taught in separate tutorial groups and attended separate lectures both groups were taught exactly the same material. Discussions with the tutors indicated that efforts were also made to keep the two sets of students synchronised in terms of when they were taught the material.

After detailed discussion with the tutors, it was agreed that the software should address the areas of binary arithmetic and logic gates. One lab-based tutorial session would be set aside to field the software.

4 Design and development of the ILE

The design of the Binary Arithmetic Tutor (BAT) prototype ILE was based on the use of the learner centred Informant Design methodology (Scaife et al., 1997) which considers users (children) as 'informants' to the design process. A design framework that addresses narrative was derived from this, which we have named as NCID. A detailed discussion of the framework is beyond the scope of this paper but a summary table is provided in Table 1 which shows the main phases and the participants involved (see Waraich (2002) for a detailed discussion of NCID). The approach relies on close cooperation between designers and informants to ensure that the system that is developed meets the needs of the users; in this case a major objective was to ensure that any narrative and related plot/characterisation appealed to the target learners. This required a series of meetings with a focus group of learners and the use of a variety of techniques. The focus group were involved in developing the narrative, assessing prototype interfaces and the domain material as well as a number of other tasks.

4.1 The design process

The main focus group was composed of five final year students who were willing to act as design participants. The design process involved a series of meetings with both the focus group and the other informants. The students in the focus group were in the 21–25 age range (all were male; there was a concerted effort to secure female volunteers for the design work but we were unable to recruit any. This reflects the strong male bias in the study of computing within the Computing and Mathematics Department at MMU). All participants had studied the CSO unit at MMU in their first year and so were aware of the content of the unit and its mode of study. Regular meetings were scheduled with the group to facilitate the design process. All the participants were aware that they were helping to design material that would be meaningful to first year students of both genders rather than themselves.

Design Phase 1: Definition of domain and identification of narrative elements

The first meeting with the students was used to establish their prior knowledge of narrative and of computer based learning systems. None of the students in the focus group had a humanities background and all stated that they had traditional science/technology based educations. They had no formal knowledge of narratology and though all professed to an interest in film none had a background in any aspect of media studies. However, there was a common interest that linked them and this was an interest in computer games; the entire group described themselves as keen players of such games.

In addition, three of the group also expressed an interest in popular science fiction. These influences were to prove significant in their interpretation of narrative and in their use of shared examples and experience.

The students were asked to recall their own experience of the CSO unit and described it as 'dry' and 'uninteresting' though it was acknowledged that the unit was 'well organised'. All stated that they had difficulty remembering what they had studied in detail, though they could recall general topics such as logic gates and computer architecture. The group were presented with the current teaching materials and notes and confirmed that this was similar to the unit.

After this the students were asked to suggest how the areas of binary numbers and logic gates could be taught using CBL. It was noticeable that the students struggled initially to generate any suggestions at all. Further discussion led to the suggestion of the use of puzzles 'that might involve solving problems with logic gates'.

At the end of this session, the students were asked to describe a narrative that they could recall well and consider why the narrative was important. The students clearly found this difficult and were very reticent about discussing this at all. The researcher provided an example of a narrative from advertising that the researcher had found engaging and described this. A discussion of narratives including computer game ensued.

Towards the end of this phase of the design process the students were provided with material to read that explained how it was hoped the narrative would be incorporated into the prototype ILE.

Design Phase 2: Translation of specification and plot/character definition

In the meetings for this phase, the group were asked to contribute to 'brain storming' sessions to gather ideas for potential narrative elements. The sessions started with brief discussions of the nature of narrative and an outline of the elements of narrative as derived from Propp's (1968) work on universal narratives. The group appeared to grasp the concepts quickly and in particular the idea of 'opposition', for example, good vs. evil in defining characters.

It was noted that initially, the focus group could not easily identify how an ILE could be used to teach binary arithmetic that would incorporate narrative. They were presented with examples the designers had considered for incorporating narrative into the teaching of the target domain.

Each of these three potential storylines is outlined below. It should be noted that the students were not presented with any details only a 'rough sketch'.

1 the learner is 'placed inside' a computer that is not working and must help to fix it by interacting with various characters

2 the learner is a trainee computer technician and must complete a set of tasks to obtain a full time job.

3 the learner is an astronaut and must fix their malfunctioning spaceship to return to earth.

These scenarios acted as a useful focal point for the discussions and the group were able to discuss each of them in turn and suggest embellishments and other alternative scenarios.

The group very quickly decided that these scenarios were 'games' and that the most interesting were the first and third. They were less convinced by the second alternative as they felt it was too much like a simulation and would therefore not engage the intended user group as well as the others. They were very positive about the idea of using a fantasy environment as opposed to a simulation style system, as they believed the majority of students were games players and were comfortable with the idea of as they put it, 'other realities or virtual worlds'. They suggested that computer games were a strong social and cultural referent for young people in the target age range and that even students who did not play games regularly had some knowledge of computer games because of references to them in the wider media.

The focus group believed the systems they were designing would appeal to female students as long as the characters were not all male and the system used humour as a method to engage the users. In fact, they considered humour to be a very important factor. They emphasised that they would not consider the use of violent actions within the ILE as they suggested this might 'alienate certain people'.

Following these discussions, they were instructed to outline a basic narrative and identify any characters that might be encountered the story. The character definition guidelines often used by scriptwriter were presented to facilitate this process (see Table 2). The narrative was outlined using index cards and storyboarding.

Table 2 Basic character definition (after Garrand, 1997)

Basic character definition
Who is the character?
Where is the character from?
What does the character need/want?
Why does the character need to do this?

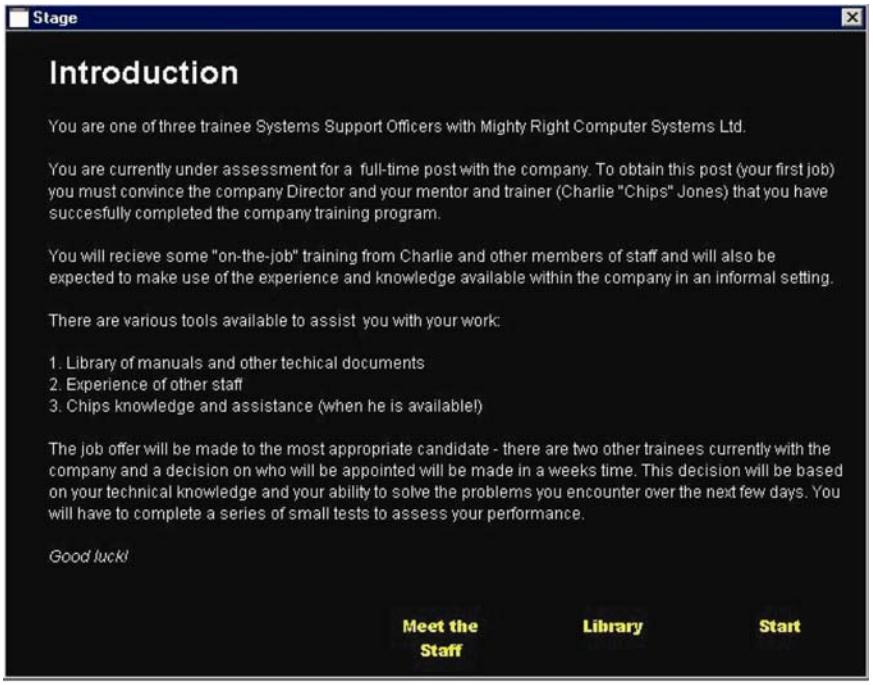
It was noted that the (adult) students in this study, found the narrative tasks much harder to complete than children who acted as informants in a previous project which used NCID (Waraich, Mitchell and Sharman, 2004). There are many possible explanations for this but two are suggested. The first is that children have little difficulty in using their imaginations and are often encouraged to do so whereas with adults the reverse is true (Papert, 1980). A member of the focus group suggested the second possibility, and this, was that the computing students 'were not used to thinking about these topics'. It is difficult to assess which of these two are the most likely but the initial reticence of the undergraduate students was noticeable.

Design Phase 3: Low tech materials

In the third phase of design, the group were shown non-functional interfaces that had been developed for feedback on interface issues. It was noticeable that the students were the most animated in discussing these than the more abstract and imaginative ideas of the narrative. This would also be expected of students whose area of study is computing.

The interface shown in Figure 1 is based on the idea of an office style simulation were the user would be a trainee computer technician looking to secure a permanent post – they would be in competition with other trainees.

Figure 1 Screen shot of early non-functional interface (simulation, introduction; scenario 2)



The group made numerous comments on each scenario. A sample for the office example is listed below:

- It's not very interesting using an office environment
- too much like real life
- The idea of a library will turn people off
- I like the cartoon-like look.

The group were of the opinion that the opportunity to use narrative in developing the ILE should lead to a more 'off-beat' and fantasy environment rather than an attempt to replicate real life.

The designer then used a cooperative evaluation based approach, explaining how the interface might work to obtain comments on specific issues.

Design Phase 4: Design and test high technology materials

Having gained an insight into the narratives and interface elements that the focus group found interesting the designer produced a simple prototype storyline based on the comments of the group.

The storyline was built around the idea of time travel. The user would play them and would accidentally travel back in time and crash land on earth in the distant past. This basic story was based on the designer's original concept of space travel but the idea of using time travel was suggested by the focus group.

It is interesting to note that the designer had independently considered a storyline that incorporated the need to repair a malfunctioning computer and it may be that this narrative has some 'fundamental' appeal.

Using this basic concept the group were encouraged to make further suggestions for the narrative in consultation with the designer.

A summary of the main suggestions is presented below:

- the user could play a janitor or 'handyman' who accidentally presses a button on the time travel machine and sends it back in time
- the user could meet a tribe of cavemen who could help to repair the damaged ship
- introduce humour into the language used in the system
- use references the user group are likely to be familiar with such as 'Dr. Who' for example
- provide a simple mechanism to allow the user to communicate with the characters in the environment.

The group were now much more willing to discuss the narrative aspects of the interface and stated that they had become so involved in the process that they had met as a group in their own time to discuss the material. These 'unofficial' meetings had an impact on the more formalised meeting as the group had clearly previously reached a consensus on some aspects of the design.

From the previous discussion of a possible narrative for the system a refined version of the story was produced. The students were actively involved in this process describing how characters might appear and some of their basic characteristics; an outline of the basic storyline was agreed.

The basic narrative had now been identified and agreed. The story would revolve around a cleaner who accidentally operates a time travel machine and gets transported back in time and must help the ships computer to repair the craft and thereby return to the present day.

The designer introduced the students to the concept of character matrices (Garrand, 1997) these are often used by screenwriters to develop characterisations and to show how the characters will interact. This was used as a device to elicit further information on the characters and how they might interact. The designer acted as facilitator and observer – the group were left to make their own suggestions and resolve any problems they encountered as much as was feasible.

4.2 Binary Arithmetic Tutor ILE

The BAT ILE uses a fantasy narrative to provide a context for learning the domain knowledge (binary arithmetic and logic gates).

The students play the role of a janitor who accidentally finds himself or herself in an experimental time travel machine that has malfunctioned and transported them back in time. The ships computer character acts as tutor to the learner providing them with basic domain knowledge and testing their understanding through a series of tasks that are incorporated into the narrative. These tasks provide a series of goals for the learner and a basic structure for the narrative and are designed to increase their motivation to learn the

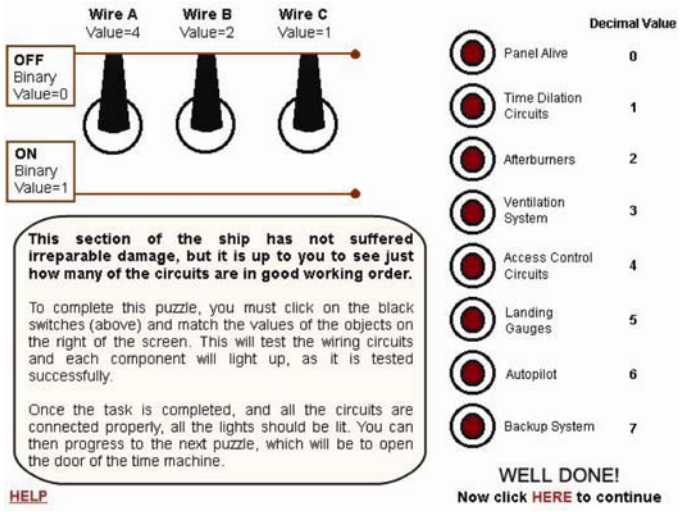
material. The janitor must use their knowledge of computer architecture, logic gates and binary arithmetic to repair the ship.

4.2.1 The interface

The ILE was developed using Macromedia Director 7.01. The system is split into three sections. The first section provides information on the background knowledge required to understand the principles of binary arithmetic. The second section covers binary arithmetic and binary-to-decimal as well as decimal-to-binary conversion. The final section introduces Boolean algebra and logic gates and briefly considers simple logic circuits. See Figures 2 and 3 for sample screenshots.

Figure 2 BAT interface showing communication between spaceship and janitor

Figure 3 BAT screenshot showing training mode for binary arithmetic



Progression from one section to the next is dependent upon the learner correctly completing a series of tasks which are embedded into the overall narrative of the environment and which relate to the domain areas; the tasks are often presented as puzzles or problems or in some cases questions. The narrative and the subject knowledge are thus tightly coupled to create an intrinsically motivating experience for the learners (Lepper and Cordova, 1992).

4.3 Evaluating BAT

A detailed discussion of the evaluation of the BAT system is beyond the scope of this paper, however, an overview of the procedure used is presented. The evaluation strategy that was adopted included the collection of both qualitative and quantitative data. Students' learning was assessed by pre- (prior to use of the ILE) and post-testing (after use of the ILE) of the target CH group; a comparison group who were not exposed to the software were also assessed. Engagement with the environment was assessed in four ways, by direct observation of the learners using the system, by the use of a questionnaire, by interviewing a sample of students based on test results and through informal comments from students and tutors.

The results show that the students who were exposed to the software did improve their test scores, though the results must be interpreted in the light of a ceiling effect on the test score. The comparison group showed no change in their test scores after exposure to identical pre- and post-tests. See Tables 3 and 4.

Table 3 Mean scores for pre- and post-test for combined honours students

	Mean score	*Sample size (N)*	*SD*	*SEM*
Pre-test CH	10.64	22	3.39	0.72
Post-test CH	12.73	22	2.11	0.45

Table 4 Mean scores for pre- and post-test for single honours Computing students

	Mean score	*Sample size (N)*	*SD*	*SEM*
Pre-test MS	13.13	15	1.13	0.29
Post-test MS	12.87	15	1.41	0.36

All students who used the software reported enjoying using it and the majority rated the story as a highly important component of this. Informal comments from the students were generally very positive. The most consistent comment regarding improvements that could be made to the software related to the level of challenge. A few students reported that the domain knowledge addressed should have been more advanced, but they were generally positive about the context provided by the story and its 'offbeat' approach.

It is clear from the interviews with students, questionnaires and the observations of them using the BAT environment that students who used the ILE did engage with the system and that they were absorbed with it whilst they were using it (see Table 5).

Table 5 Student ratings of the BAT software from pre-defined categories, $N = 22$, NR = no response

BAT rating	*Unsatisfactory*	*Satisfactory*	*Good*	*Excellent*	*NR*	*Total*
Frequency	0	2	13	6	1	22
Percentage	0	9.1	59.0	27.2	4.5	100

5 Discussion

The techniques that underpin NCID are based on a careful analysis of existing narrative theory and included the use of interactive narratives in computer games design. It is clear that involving users in the design of a narrative centred interactive learning environment has a number of potential advantages. The strong emphasis on the need for humour in the ILE would not have been considered appropriate by the tutors for example. Firstly, the material produced should appeal to the target learner group as opposed to the designers. Secondly, an appropriately designed environment appears to have a positive motivational affect on those learners who struggle with the domain material; this needs further investigation but is potentially a very interesting finding as poor motivation is often reported by students who under perform at Higher Education level.

Use of the NCID has shown that a strong pre-defined narrative, based on principles of computer game design can motivate students at higher education level. Although we do not claim, this is the only method to produce engaging and interesting learning software, this is a promising and somewhat neglected approach. We believe that there are parallels between the worlds of entertainment and education. A teacher needs to motivate his/her students to learn material and must create experiences that will change their world-view in some way. Entertainers have a similar aim, they must communicate their theme or message to the audience and need to understand how to engage and motivate them. We suggest that computer games can act as a bridge between these two worlds and provide engaging environments that can teach and entertain at the same time; in higher education in particular, there is a reluctance to view education as an enjoyable experience, computer game based learning systems could help to redress that balance particularly for those students whose motivation to learn the material is poor.

6 Conclusion

The results of the BAT evaluation suggest that the use of game like learning environments that incorporate simple narratives and goal directed activities can help to motivate students to learn abstract domains. It is clear that it is valuable to include the target audience in the design of such systems and that though the use in higher education of adventure style games is limited they may be used to help students to engage with abstract material particularly for those students who find the domain difficult. The evaluation indicated that the students who were most enthusiastic about the ILE were those who were struggling with the material. Further work needs to be done to develop the NCID design process. In particular with adult learners, it may be necessary to incorporate exercises that inform them about narrative structures. Initial results indicate that narrative based design techniques maybe useful for gathering requirements and

incorporating them into an ILE. It is noticeable that once the informants in this study had overcome their initial problems with developing a narrative they became very enthusiastic about the process and exercises. The techniques to help students identify narrative structures should be refined however; perhaps through the development of a narrative toolkit of elements. These could then be used to provide a context for student discussions and requirements gathering. The simplified Proppian structure we have used could also be further developed; it is likely that other plot based theories may also be useful as a basis for narrative centred design and this area needs further investigation.

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