

FEARNOT! INVOLVING CHILDREN IN THE DESIGN OF A VIRTUAL LEARNING ENVIRONMENT

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Abstract. This paper presents FearNot, a virtual learning environment populated by synthetic characters interacting in bullying scenarios, aimed at 8-12 year old children. FearNot was designed within the VICTEC project where a key aim was to ensure that children participated in the design process. A range of techniques were used to gain children's input. This paper discusses the various techniques used within VICTEC and highlights some key examples of the results gained by using such techniques, challenges encountered, and the design implications.

INTRODUCTION

This paper provides a case study of the learner-centred method used within the European Framework V project Virtual ICT with Empathic Characters (VICTEC). This project applied synthetic characters and emergent narrative to Personal and Health Social Education (PHSE) for children aged 8-12, in the UK, Portugal and Germany, through using 3D self-animating characters to create improvised dramas (Aylett, Paiva, Woods, Hall, & Zoll, 2005). Our goal in VICTEC was to create synthetic characters that evoked user empathy (Marsella, Johnson, & LaBore, 2003), creating a synthetic character that by its appearance, behaviours and features allowed the user to build an empathic relation with it.

Developing FearNot!

In VICTEC we developed FearNot (Fun with Empathic Agents to Reach Novel Outcomes in Teaching), a school-based Virtual Learning Environment (VLE) populated by synthetic characters representing the various characters in a bullying scenario, see figure 1. FearNot depicts bullying incidents in the form of an episodic virtual drama. The child user views the bullying incidents that take place between autonomous agents in a virtual school and acts as the 'invisible friend' of the victimised character in between episodes, providing help and advice. Each episode is framed by an introduction segment at the start of the episode, and a reflective interactive segment at the end.

FearNot aimed to enable children to explore physical and relational bullying issues, and coping strategies, through empathic interaction with the synthetic characters who populated the virtual school. This was achieved through providing scenarios in which the main purpose of the communication was to engage in social interaction as opposed to accomplishing a task as efficiently as possible.



Figure 1: Screenshots from FearNot

Intelligent autonomous agents were developed for these scenarios, each representing one of the characters (Paiva et al., 2004). Each is equipped with an independent mechanism for selecting its next action, depending on its emotional state, which is generated as a response to events within the environment using the cognitive appraisal rules of Ortony, Clore and Collins (1988), often described as the OCC model (Ortony, Clore, & Collins, 1988). Personality-dependant variables relating to the thresholds at which emotions are triggered and the rate at which they decay are also set. This emotional state is then used to drive both reactive behaviour and a non-linear planning system (Aylett, Dias, & Paiva, 2006) by using the coping model of Lazarus (Lazarus & Folkman, 1984) and the prospective event emotions of hope and fear from the OCC model.

The result of this approach is that characters do not have to be scripted, since once their initial situation and goals have been defined the action-selection mechanisms will determine what they next do, and the actions of one agent will form the input to the actions of the next. For this reason, the story seen in episodes emerges from interaction between characters rather than being pre-specified, though of course the initial conditions will have a substantial influence on the type of story generated: establishing what these should be was an important reason for the collection of scenarios from children. The investigation of emergent narrative is one of the technical objectives of the project, discussed elsewhere (Aylett, Louchart et al., 2006).

The use of AI technology to produce autonomous characters was motivated by the need to maintain the believability of characters so that children would feel that the outcome of episodes mattered, and to allow child users to influence the emotional state of the victim character by acting as an *invisible friend*, and advising them between episodes. In the nature of the agent architecture, changes in emotional state produced by interaction with a child will impact the actions a character selects in the next episode, allowing the child to explore coping choices at a safe emotional distance.

Gaining input from children

There is a lack of methods and approaches that support the design and development of Virtual Learning Environments populated by synthetic characters. However, to ensure that children engaged and socially interacted with FearNot, a key requirement for the VICTEC project was the incorporation of learner ideas, views and perspectives into the design of FearNot's innovative learning experience. To meet this requirement, we developed the learner-centred approach presented here. This aims to support the development process, from inception to the creation of a robust prototype incorporating design and technical innovations.

As VICTEC was a multidisciplinary project, with aims that were both technical and psychological, a mixture of different methodologies and data collection techniques were essential to ensure that all of the project aims were met, and that children could provide input in an appropriate and effective way. The approach taken reflects the impact of several disciplines including computer science, psychology and education and resulted in the development and use of a number of complementary methods to enable the design and development of FearNot.

This paper discusses this learner-centred approach. Section 2 briefly outlines the basis of our approach, placing this in the context of earlier work. Section 3 briefly outlines the various

techniques developed for the approach and explores their use and impact on the design of FearNot. Section 4 provides a discussion on the approach used in VICTEC. Section 5 presents conclusions and future directions.

OBTAINING CHILDREN'S INPUT FOR FEARNOT

Druin and her colleagues have classified children's contribution to the design process in terms of varying levels of involvement (Druin, 2002), from end user to design partner. In VICTEC, the children were informants, that is children who "*play a part in the design process at various stages, based on when researchers believe children can inform the design process*" (Scaife & Rogers, 1999). In this sense the children were "*involved at any time the design team believes it needs direction or support.*" Earlier findings have highlighted the significant contributions that a child informant can have for educational software design (Scaife & Rogers, 2001). This informant approach helps to ensure that the application is designed from a child- and learner-centred perspective rather than relying on adult aspirations and goals.

Obtaining children's views requires participatory design approaches that reflect not only the child's competences and perspective, but additionally their context of use (e.g. the classroom (Guha et al., 2004; Read et al., 2002)) and the cultural effect of the child's expectations of the adult-child dynamic. Current methods, for example (Druin, 2002; Guha et al., 2004; Hoysniemi, Hamalainen, & Turkki, 2003) for involving teachers and pupils are typically extra-curricula in approach and context. An informant approach is far more suitable for incorporation into the classroom and curricula, requiring only limited and bounded interaction with children and permitting teachers to embed curricular issues into the informant sessions.

There are considerable benefits in having a learner-centred method that can be applied within the classroom. Social desirability and other confounding variables are likely to be minimal as children are not removed from the environment that they are comfortable with (Lyons & Chrysochoou, 2000). Working within the classroom setting also ensures that developers design a package that is suitable and practical for classroom environments, i.e. lesson length, size of classroom, classroom equipment, number of children, timetable of lessons, the product is compatible with curriculum activities and can be used in parallel with other teaching aids. The limitations of conducting design trials and evaluation work in the classroom setting includes time restraints, space, adequate equipment (Rode, Stringer, Toye, Simpson, & Blackwell, 2003), and lack of experimental control in some instances (Winn, 2003) although if a flexible research approach is adhered to these can be overcome.

In VICTEC we took the pragmatic approach seen in many studies, to support child input at specific stages of the design process through using a number of approaches mainly based on the modification of adult-oriented usability techniques and making them age appropriate (Brna, Martins, & Cooper, 1999; Cooper & Brna, 2000; Lieberman, 1999). The application of different design methods and techniques, such as low-fidelity techniques (Nielsen, 1993), wizard-of-oz (Maulsby, Greenberg, & Mander, 1993), paper prototypes (Snyder, 2003) and high fidelity prototypes (Rudd, Stern, & Isensee, 1996) have all been successfully used with children in the design of virtual environments (Alborzi et al., 2000; Höysniemi, Hämäläinen, Turkki, & Rouvi, 2005; Machado, Paiva, & Prada, 2001; Montemayor et al., 2002).

INFORMING THE DESIGN AND DEVELOPMENT PROCESS

The learner-centred method developed for the VICTEC project aimed to support the development process of FearNot. During this process, we had extensive input in both design and evaluation from children, teachers, educational staff, researchers in bullying education and designers of virtual learning environments, see figure 2.

We gathered extensive data using prototypes and questionnaires with a wide range of adult stakeholder groups. This experimentation and the results from stakeholder input are further detailed in (Hall, Woods, Sobral et al., 2004; Paiva et al., 2004; Woods, Hall, Sobral,

Dautenhahn, & Wolke, 2003), with the results identifying that an innovative approach to bullying interventions was viewed positively. However, teachers had high expectations and rated FearNot more negatively than any other stakeholder group.

In addition to gathering quantitative data to evaluate FearNot we obtained extensive input through involving teachers, researchers in bullying education and designers in two 2-day international workshops. These workshops allowed us to explore teachers' experiences, needs, requirements and expectations for educational software aimed at bullying. The workshops involved questionnaires, focus groups, working sessions and exposure to mid and high fidelity prototypes of FearNot. The main results can be summarized as:

- Bullying is a widespread problem in European schools and there is a need for interesting, stimulating and enjoyable interventions for children to develop strategies to cope with bullying.
- There is a need for educational software products, such as FearNot, to be easy to install, learn and incorporate within typical classroom activities. However, for successful introduction, FearNot would need to be supported with teaching materials and appear professional.
- Teachers had high expectations of what FearNot should be like and rated the appearance, movement and speech of the synthetic characters poorly. However, they approved of the scenarios content and character conversations.
- German teachers were least impressed by FearNot and consistently rated it lower than UK or Portuguese participants.

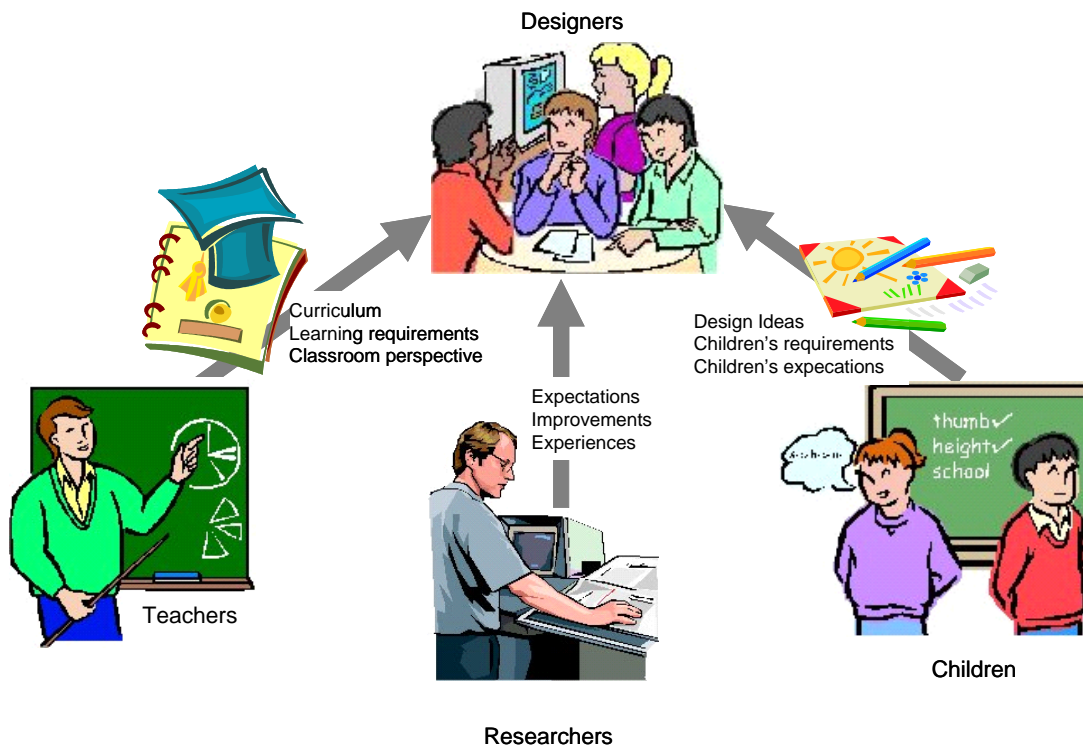


Figure 2: Gaining Stakeholder and User Input

With the child operating as informant we identified a number of key areas where we needed children's input:

1. To design comprehensive and meaningful bullying scenarios that children from the UK, Germany and Portugal found engaging, interesting and enjoyable to interact with, within a VLE.
2. To evaluate and refine the technical design of visual and audio features of the VLEs including, the appearance of the school environments to be modelled, the appearance of the characters to depict different bullying roles for the scenarios, character movement, and the conversation content and styles of the characters.
3. To evaluate and enhance the interaction styles within the VLEs – i.e. could children easily navigate through the bullying scenarios, and identify, and type in suitable coping mechanisms to deal with bullying behaviour.

Achieving input for each of these required a learner-centred approach that offered a diverse range of data collection methods and techniques. This diversity aims to provide children with multiple channels for input, including verbal expression, interaction data, qualitative and quantitative measures of experiences, views and attitudes to support and match the different techniques used at various stages of the development process. These methods are briefly summarized in table 1 and the following sections further discuss their development, refinement and a brief example of the results obtained from using this learner-centred approach.

Supporting the informant in verbal discussions: Classroom Discussion Forums (CDF)	
Aim	To assist children in verbalizing opinions
Method	Refined form of focus groups modified to reflect classroom culture. Used throughout development process to complement other techniques.
Data	Verbal, in the form of answers to researcher led group discussion
Informing the design of scenarios: Storyboard Generation & Evaluation	
Aim	To obtain children's perspectives and views to create the events, characters and context in FearNot
Method	Electronic storyboarding software, questionnaires, CDFs
Data	Content analysis of storyboards, questionnaire responses, verbal
Informing character speech and storyline: Character Utterance Generation	
Aim	To indicate utterance content for the mid- and high- tech prototype
Method	Electronic Storyboards, CDFs, Wizard of Oz, Questionnaire
Data	Storyboards, verbal, qualitative questionnaires, Interaction data
Informing the look, feel and interaction approach: The Trailer Approach	
Aim	To provide an early evaluation of the proposed character and VLE design
Method	Trailer of final product, Questionnaires, CDFs
Data	Quantitative, verbal
Evaluating User Interaction with FearNot: Large scale evaluation	
Aim	To evaluate interaction with a preliminary version of FearNot
Method	Scripted version of FearNot, Character Evaluation Questionnaire, CDF
Data	Interaction data, quantitative questionnaire responses, verbal
Evaluating Pedagogical Impact: Classroom-based evaluation	
Aim	To investigate the pedagogical impact of the use of FearNot in the classroom
Method	Pre- post- tests, Scripted version of FearNot, Character Evaluation Questionnaire, CDF
Data	Quantitative, Qualitative, Verbal, Interaction data
Evaluating emergent characters: Small Scale Final Study	
Aim	To investigate the impact of emergence on user views and experiences of FearNot
Method	Emergent FearNot, Character Evaluation Questionnaire, CDF
Data	Quantitative, Qualitative, Verbal, Interaction Data

Table 1: Methods used in VICTEC

Supporting the informant in verbal discussions: Classroom Discussion Forums (CDF)

Discussion groups are a key part of classroom activity. Our aim in VICTEC was to assist children in verbalising opinions about novel, innovative software and to achieve this we developed Classroom Discussion Forums (CDFs), a method for exploring children's perspectives, and of gaining qualitative data from children.

Our initial intention had been to use focus groups (Gorman & Clayton, 1997) to elicit verbal views, expectations and needs from children. This approach has been successfully used with children (de Vries, 1997), however, classroom logistics made it difficult to implement, as teachers expressed a preference for discussion to follow the normal classroom approach of "Table Time" (small group discussion) followed by "Circle Time" or "on the carpet" (whole class discussion).

Classroom culture impacts on the discussion activity, requiring it to be structured with clear goals and steps. As well as verbal discussion, CDFs involve tangible inputs (e.g. FearNot trailer, see below) and outputs (e.g. FearNot interface designs) that are used to focus and structure the discussion. However, where CDFs differ most strongly from focus groups is in their staccato pace, something that strongly reflects the classroom situation.

Rather than a facilitated discussion, a CDF involves a question and answer session, involving many small, related questions from the researchers and rapidly raised hands and responses from the children. Even when a child responds to another child, our fieldwork has identified that rather than a free-flowing discussion, children in this age group typically turn-take via the researcher who nominates whoever has a raised hand to respond. This was seen in all VICTEC partner countries: Germany, Portugal and U.K.

The CDF typically involves "Table Time" where small group discussions (typically 6-8 children), led by an adult (researcher, teacher) are structured with a set of previously provided themes and topics. CDFs also occur at the whole class level, with discussions directed through the CDF leader. Typical topics covered within CDFs include:

- Levels of interest and enjoyment that the children experienced from interacting with FearNot
- Interacting with FearNot and the synthetic characters - design, information provision, navigation approaches, and interaction style.
- Design of characters, focusing particularly on emotions and children's emotional responses to the events in the episode.
- Changes to improve FearNot particularly related to types of advice, endings and educational goals.

Informant Design - Implications from CDFs

CDFs have been extensively used in VICTEC both in the classroom and laboratory. CDFs have been extremely informative and have had a significant impact on the design of FearNot. CDFs and their results are discussed in more detail in (Hall, Woods, & Dautenhahn, 2004).

Where CDFs have been particularly useful is in capturing qualitative information that would have been missed had we relied entirely on interaction data and questionnaires. For example, suggestions provided by the children to help the victims cope with bullying generally supported those considered by the design and psychology team. However, an important suggestion made by the children was that all scenario endings should be positive. This view was supported by discussions with teachers and resulted in significant changes for the scenario design. Whilst the intention had been to have some scenarios with negative endings (e.g. the bullying issue does not get resolved, thus reflecting the real world – and a clearly adult perspective!), now all scenarios end with a positive outcome and a resolution of the bullying situation.

Informing the design of scenarios: Storyboard Generation & Evaluation

Initially, we attempted to gain input to scenario design using low fidelity techniques and attempted to gather children's ideas through asking them to design paper prototypes with pencil and paper. We attempted this approach with several classes in both the UK and Germany. After a brief introduction to FearNot the children were asked to help us design the scenario and the interface by drawing pictures. However, children were unsure as to what they should draw, asking the researchers for suggestions. When they understood that we effectively wanted was a picture of the screen, most directed us to look at their favourite games and websites, and explained their preferences typically in terms of discussing interaction approaches that they liked (primarily point and click). Thus, we rejected paper-based techniques supporting the view that these have only limited use for the design of virtual environments (Scaife & Rogers, 2001), as they tend not to give the user the operational sequences clearly, and the look and feel of the interface is not apparent. This is especially important for a virtual environment as the interaction of sound, graphics and animations is intrinsically impossible to represent on paper.

In designing the scenarios we chose to use storyboarding (Rudd et al., 1996), a technique involving the creation of comic-strip like representations borrowed from the film and television industry. This has been successfully used for design with children (Druin, Stewart, Proft, Bederson, & Hollan, 1997) and is particularly suited to informant-based (Druin, 2002); (Scaife & Rogers, 1999) development serving as a common language and communications vehicle between developers and users. Although storyboarding is typically paper-based, in VICTEC we used electronic storyboarding to generate and evaluate scenarios providing us with a mid-tech approach that is particularly useful for visualising and determining agent activity.

The electronic storyboarding technique takes advantage of the use of case modelling and screen captures to create a single product allowing the user to more readily gain a clear unambiguous understanding of the system to be developed (Gregor & Oretsky, 2002). Such storyboards are most appropriate for supporting the activity of agent systems as they can represent processes such as animation mapping time into space, so that a number of different moments of time may be seen together and compared visually. The stories deal with characters and goals, attempts to achieve those goals, and degrees of success or failure, an ideal format for agent based systems.

We have used storyboards in two distinct ways: 1) for scenario generation, 2) evaluation within a classroom setting. Kar2ouche (Immersive Education, 2001), an electronic storyboarding software package aimed at children aged 8-12 years was used.

Storyboard Generation

Our storyboard generation approach mirrored other similar classroom activities using software packages, with a whole class introduction and goal setting, followed by paired working and then a whole class discussion. This approach had been developed through discussing storyboard generation with media designers and teachers and provided a structured approach that generated information whilst replicating typical classroom activity.

Initially, the whole class were told that they would be asked to write a story about bullying and friendship behaviour using a software tool and were provided with a work sheet outlining the storyboard task. It was ensured that each child could read the work sheet competently, that they each understood the nature of bullying behaviour, available coping strategies to deal with bullying behaviour, and what the consequences of being bullied, and being a bully are.

Children were divided into same and mixed gender pairs based on the teacher's decision in terms of abilities and suitability to work well in a pair (i.e. ensure equal contribution from a pair). The decision to allow children to work in pairs rather than individually was based on the fact that we wanted children to share ideas and experiences and provide a balance of skills necessary for the development of bullying scenarios.

The storyboarding software package was demonstrated to the whole group by the researcher followed by children interacting with the software for five minutes to familiarise themselves with the package. Each pair were instructed to write down the ideas that they had for

their story before being given 40 minutes to design their stories using the software. The sessions ended with a whole class CDF.

Informant Design - Implications from Storyboard Generation

The generated storyboards, (see figure 3 for some examples) were analysed using a content analysis scheme and were of considerable benefit in the design of the final scenarios (Woods et al., 2003). Storyboard generation was more successful than we anticipated, with children providing detailed storyboards that provided both their views and awareness of bullying behaviour. The storyboards were useful in aiding us to identify the key factors and events in a bullying scenario aiding with the structuring of episodes. The results have had significant design implications for the design of the FearNot scenarios. Storyboard generation was used:

- To elicit the cognitive and social understanding of bullying behaviour among children (Wolke, Woods, Schulz, & Stanford, 2001), thereby providing information about the social behaviour of children, i.e. who children socialise with, same gender groups or mixed gender groups.
- To demonstrate and understand the language capabilities of children for this age group for future scenario development (Aylett & Louchart, 2003 (in press)).
- To provide up to date information about what children typically talk about both in and out of school, and what types of activities children participate in. This information was obtained through analysing the types of speech acts, thought bubbles and introductory text boxes used by the children. This has led to the development of both bullying and non-bullying speech acts for the VLE (Aylett & Louchart, 2003).

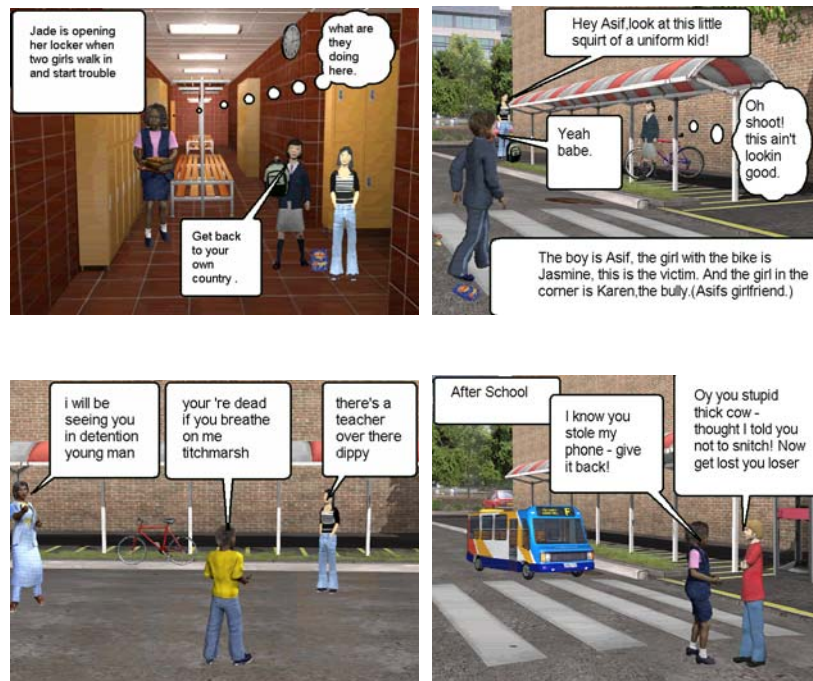


Figure 3: Examples of storyboards developed by children

Storyboards for scenario evaluation

The scenarios used for the evaluation were developed by research psychologists with the assistance of a drama department. The children who took part in this study were different to those who had participated in the storyboard generation. This study was also carried out in Germany and Portugal. The aims of this study were to ensure that the storyboards that we had developed were appropriate, interesting and relevant from the children's perspective.

In each classroom-based session, a trained researcher led the class, with the researcher operating as the teacher. The scenarios were presented to the whole class as part of "Circle Time" (whole class involvement), projected onto a wall / screen. The researcher ensured that children had understood the contents of the scenario and the character's names through a question and answer session. Children then went back to their seats and were distributed the storyboard questionnaire to complete. The questionnaire comprised of both structured and semi-structured questions enquiring about: 1) The bullying scenarios children had watched and whether this was realistic compared to their previous experiences. Questions also enquired about the realism of the speech used in the scenario, 2) Coping strategies that children believed were successful or unsuccessful for dealing with bullying situations, 3) Which characters children liked and disliked in the scenario and which character they would choose to be if they could be one of the characters

- **Characters in the Scenarios**

Children were asked which character they liked most, and the reasons why. Children then stated their least preferred character with justifications for a particular selection. Next, children were asked about 'prime characters' in terms of if they could choose to be one of the characters, which one would they choose to be and why.

- **Emotions and Empathy**

Children were asked whether they felt sorry for any of the characters, and if so which character(s) and why, whether any of the character(s) made them feel angry and why, and finally, how they felt overall after watching the scenarios (very happy, quite happy, neither happy nor sad, quite sad and very sad).

After completing the questionnaire, the children took part in a whole class CDF. The scenarios were extensively evaluated in the UK, Portugal and Germany in rural and urban schools of a range of sizes and socio-economic status.

Informant Design - Implications from Storyboard Evaluation

Using this approach has revealed important design implications for developing believable, interesting and engaging scenarios to be implemented into a VLE (FearNot) for VICTEC. Of most importance for the design of FearNot has been the impact of gender. Examples of key results are briefly summarized here, and discussed in more detail in (Hall, Woods, Dautenhahn, & Wolke, in print).

- Gender is an important consideration for the target age group particularly in the UK. To ensure high interest and engagement in scenarios with educational impetus for boys may mean that same gendered scenarios are necessary, although it is important that boys are aware of the relational nature of bullying. This has had a significant impact on designing scenarios, and UK scenarios are now generated for boys and girls, with agents being predominantly same gender as the child.
- The comprehension of the direct/physical bullying scenario may be higher for children compared to relational bullying and this is particularly the case for German children. Developmentally, this may be explained by the lack of competent social skills at this age although relational bullying will most certainly become more prevalent in early adolescence. Differences in the education systems in the UK and Germany may

contribute to this finding as there is more exposure and media coverage about relational bullying in the UK.

- Girls, and particularly girls in the UK sample appeared to have a greater understanding of relational bullying than boys. This had design implications concerning whether girls interacted with more relational bullying scenarios and boys interacted more with physical scenarios, although from an educational perspective it is important that children understand the nature of both types of bullying.

Informing character speech and storyline: Character Utterance Generation

A key issue for the development of FearNot was the utterances of the characters, an issue that was further complicated as FearNot was produced in three different languages. Children's language is strongly influenced by television, media and fashion, and it was essential that the language used in VICTEC was familiar and appropriate.

We had relatively little experience of generating utterances from children and tried a number of different approaches. This included the use of storyboards where children entered the utterances into speech and thought bubbles. We also held a number of small group CDFs which focused on generating likely utterances in a group situation, asking children to suggest what the characters would say in certain situations.

We also went into the classroom to talk about bullying and to ask children to complete a simple written questionnaire that asked for the likely utterances that characters would make. We asked children what bullies might say, and how bullies insulted and manipulated others. We also asked children what could be said to stop a bullying situation, how you might help a victim and how a victim might be able to respond to a bully.

We used a Wizard of Oz approach to investigate the utterances the children provided when they were talking to the victim. This involved children interacting individually or in self-selecting pairs with a prototype of FearNot. A number of Wizard of Oz studies were carried out in Portugal, Germany and the UK in a non-classroom situation, either in a laboratory setting (with children who were visiting the Universities) or within the schools in a library or computer suite rather than the child's classroom. It was logistically impossible to perform a Wizard of Oz study within the classroom, as we did not have enough *wizards* available during testing, and the technical infrastructure within the classroom was rarely sufficient to support this activity. Typically, 4 children or pairs of children interacted in 10 minute sessions. After the session, children took part in a CDF, where further information about utterances was elicited.

Informant Design - Implications from Utterance Generation

The storyboard generation method revealed that the UK children, aged 8-12 years, used explicit language such as swear words, references to rape, racial insults and slurs about immigrants, to accompany their storyboard designs. This however, was not evident from the German and Portuguese storyboards developed by children. This result was surprising as we had not expected children of this age group to be aware of some of the issues raised at such a young age. The implication from this result was that some of the language raised by children in the scenarios would have to be addressed in the final FearNot scenarios in order for children to have an engaging and believable experience that was age-appropriate. However, swear words and other insults were not ethically possible to incorporate, and teachers were consulted to provide feedback on what was appropriate.

The other important implication from using the Wizard of Oz method for speech utterances was that it took children a great deal longer to type in their responses and there were frequent spelling and grammatical mistakes that the final FearNot system would have to take into account.

Informing the look, feel and interaction approach: The Trailer Approach

It was essential for the VICTEC team to gain early feedback from children relating to the look, feel and interaction approach to be used with FearNot. Attempting to get this feedback prior to the existence of a stable version of the final product prompted the modification of an approach we had developed to gain stakeholder feedback, the trailer approach. The Trailer is a snapshot vision of the final product, similar to the trailers seen for movies, where the major themes of a film are revealed. Similar to a movie trailer using real movie clips, our trailer used a technology closely resembling the final application, see figure 4.

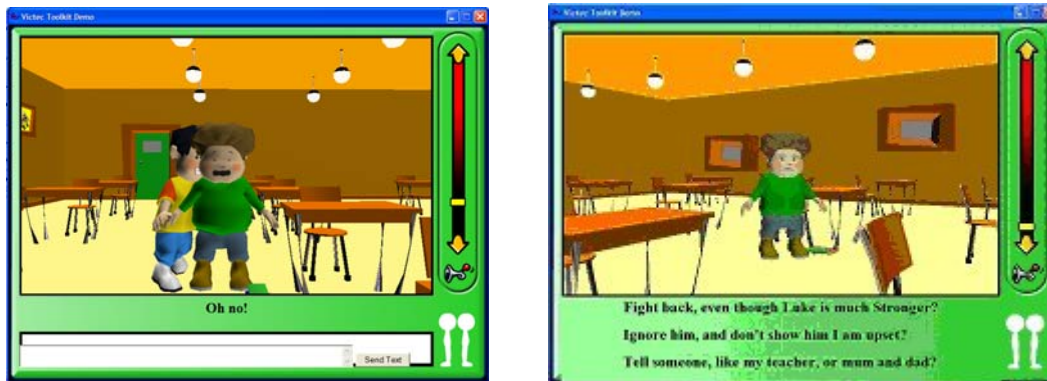


Figure 4: Trailer Clips

The trailer depicts one physical bullying episode involving 3 characters, Luke the bully, John the victim, and Martina the narrator. The trailer begins with an introduction to the main characters, Luke and John and subsequently shows Luke knocking John's pencil case off the table and then kicking him to the floor. John then asks the user what he should do to try and stop Luke bullying him and arrives at 3 possible choices: 1) Ignore Luke, 2) Fight back, 3) Tell someone that he trusts such as his teacher or parents.

The Trailer approach had been initially developed for stakeholder research at the UK Childline Conference (Woods et al., 2003) this was modified for use within the classroom situation and has been used extensively in all three countries. Within the classroom situation, each session began with an introduction to bullying and our aims and goals in the development of FearNot. The FearNot trailer was shown to the whole class and then a questionnaire about the trailer was distributed to all children. The questionnaire enquired about character attributes (e.g. voice believability), character movement (e.g. smooth or jerky movement), appearance of the school environment (e.g. attractive or unattractive environment), bullying storyline (believability of the storyline), character preference, and empathy felt towards the characters. The questions were rated according to a 5-point likert scale (The Character Evaluation Questionnaire shown in Table 2 was similar to the Trailer Questionnaire). After the children had completed the questionnaire CDFs were held.

The trailer was also used as the basis for the Wizard of Oz tests mentioned above, with a dialogue phase between the bullying situation and the final message. Use of the Wizard of Oz technique allowed us to iterate on our dialogue system and adjust the user interaction during this stage.

Informant Design - Implications from use of the VICTEC Trailer

The results from the trailer questionnaire provided the team with valuable input for the further development of a variety of aspects: quality of graphics, animation and sound, believability of the characters and the story content, the amount and nature of the interaction, feelings evoked by the single episode in the user and for the characters. Results revealed that

children empathised with the victim character in the trailer and felt sorry for him. They expressed anger towards the bully character.

Technical experts and teachers did not have strong reactions towards the characters, but did prefer the female character. There was also a strong tendency for teachers to prefer the bully character to the victim character, and some teachers felt that the victim's appearance was too stereotypical, whereas this was not conveyed by children. The interesting result from children's responses was that they were critical of the graphics, animation, lack of voices, and character movement. However, this did not appear to impact on levels of story engagement and believability.

Evaluating User Interaction with FearNot: Large scale evaluation

A preliminary version of FearNot with scripted rather than emergent scenarios was developed for evaluation purposes. Although this scripted version did not feature autonomous agents, emergent narrative or a language system, it permitted a high-fidelity mock-up that enabled user testing.

With this Scripted FearNot our intentions were to investigate whether FearNot provided a positive, stimulating and effective user experience. That is, did FearNot enable children to explore and experience learning about bullying and coping strategies and were children empathically engaged in the interaction. The technical goal of whether the synthetic characters in FearNot appeared to react and behave appropriately could only be partially assessed as whilst the characters behaved in a similar manner as they would in the final FearNot, their behaviour was pre-scripted and not a result of the character's autonomous reactions to each other or the child.

In Scripted FearNot, the child user views one physical bullying scenario and one relational scenario. Each child user initially provides their personal information (name, gender and age) and a unique personal code. After the introduction of the characters, school and situation, users view the first bullying episode, followed by the victimised character seeking rescue in the school library, where it starts to communicate with the user. Within the initiated dialogue the user selects an advice from a list of coping strategies (shown as a drop down menu). The user also explains his/her selection and what he/she thinks will happen after having implemented the selected strategy, by typing it in (see figure 5).



Figure 5 Interaction with victim

The next episode then starts. The content of the final episode depends on the choices made by the user concerning the coping strategies: Paul, the bystander in the physical bullying scenario, might act as a defender for John (the victim), in case the user has selected a successful strategy, i.e. "telling someone"; or Martina (the bystander) might offer Frances (the victim) help. However, if the user has selected an unsuccessful strategy, i.e. "run away", the victim rejects the

help in the final episode. At the end of the scenario, a universal educational message is displayed pointing out that “telling someone” is always a good choice. This universal message had to be incorporated as all teachers had strong preferences for children to finish the interaction with a positive feedback message.

Figure 6 shows a flow chart of one scenario (physical or relational) for the evaluation version of FearNot. The symbols indicate the following:

- Introduction (I): Type in of code, name, age and gender, introduction of characters and school
- Bullying episode (1-3)
- In between episodes: interaction with victim character in resource room (cope)
- Educational message (F): after end of episode 3.

Phases I to F appear twice, once for the physical scenario and once for the relational bullying scenario.

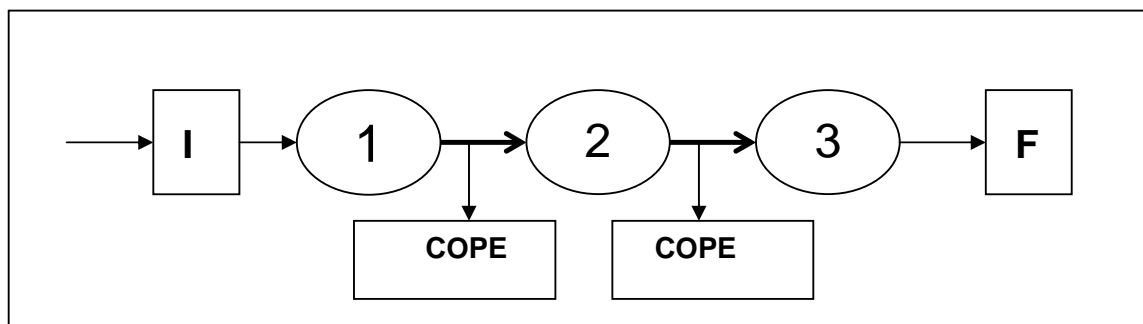


Figure 6 Flow chart of FearNot evaluation version

The evaluation of the Scripted FearNot was achieved through a large scale study, further discussed in (Aylett et al., 2005; Hall & Woods, 2005). This large scale evaluation event called “Virtually Friends” was held at the University of Hertfordshire, UK, in June 2004, and involved 345 children aged 9-11 years.

Two classes from different schools participated each day in the evaluation event. All children individually interacted with FearNot on standard PCs. FearNot began with a physical bullying scenario comprised of three episodes and children had the role of an advisor to help provide the victim character with coping strategies to try and stop the bullying behaviour. After the physical scenario, children had the opportunity to interact with the relational scenario showing the drama of bullying among four girls. After the interaction children completed the Character Evaluation Questionnaire (CEQ). This was designed in order to evaluate children’s perceptions and views of FearNot, see table 2 and extends the Trailer Questionnaire already discussed. Posters of the characters were displayed with both a graphic and the name as an aide memoir to help children in identifying preferred character, etc. Children’s views were predominantly measured according to a 5 point Likert scale.

Aspect	Nature of Questions
Character preference	Character liked most and least, most like to be friends with Prime character - who child would choose to be
Character Attributes	Realism and smoothness of movement Clothes appreciation and similarity to own Age
Character conversations	Content believability, interest, similarity to own conversations
Interaction impact	Victims acceptance of advice and how much child had helped

Bullying Storyline	Storyline believability and length
Similarity	Character that looks and behaves most and least like you
Empathy towards characters	Feeling sorry for characters and if yes which character Feeling angry towards the characters and if yes which character Ideomotoric empathy based on expected behaviour

Table 2: Content of the Character Evaluation Questionnaire

Informant Design - Implications from use of Scripted FearNot in the large scale evaluation

The large scale evaluation provided us with an opportunity to gather extensive data. The children and teachers who participated in our study were extremely positive about their participation and most children enthusiastically completed all of the activities at the Virtually Friends event. The results we gained from this event were largely successful, and suggested that FearNot did provide a stimulating learning experience for most of the children. In addition, a number of results emerged that had particular resonance for the design of FearNot and other synthetic character environments, relating primarily to gender and perceived similarity.

Similar to the results gained from the Trailer studies, children emotionally reacted to the characters, feeling sorry for the victim and angry with the bully. However, in the results gained from the Virtually Friends event, we gained considerable additional data relating to this empathic engagement. Results indicated that greater levels of empathy were evoked in children if they perceived that they were similar to the characters in the scenarios. This is strongly gender related, with children preferring same gender characters and exhibiting greater understanding and empathy of same gender characters. This identifies the need to take a gendered approach to scenarios and to create synthetic characters that are similar in appearance and behaviour to the intended users.

Evaluating Pedagogical Impact: Classroom-based evaluation

The large scale evaluation event held at the University of Hertfordshire highlighted that children found interacting with FearNot to be a positive and stimulating experience and that they empathically engaged with the characters. Our next step was to evaluate FearNot in the classroom situation and extensive evaluation work, involving over 300 children in Portugal, the UK and Germany, was carried out in schools involving experimental groups which interacted with FearNot, and control groups who did not. The main aims of this evaluation were to assess cognitive, behavioural and affective effects of children’s interactions with FearNot, however, it also provided us with an opportunity for a large-scale evaluation within the classroom situation.

Unlike the Virtually Friends event, which occurred on a single day, for the classroom evaluation we used a pre- post- test design. Questionnaires were used to assess empathy (Enz, Zoll, & Shaub, 2004) and bullying behaviour (Wolke, Schulz, & Woods, 2004). The pre-test occurred 4 weeks before the interaction with FearNot and the post-test 4 weeks after the interaction. In addition we conducted short interviews with all educational staff involved.

The approach taken for the interaction with FearNot replicated that used for the Virtually Friends event, with children interacting with a scripted version of FearNot, before completing the Character Evaluation Questionnaire and taking part in a CDF.

Informant Design – Evaluating FearNot in the Classroom

The results achieved from the interactions with FearNot, the Character Evaluation Questionnaire and the CDF were similar to those achieved at the Virtually Friends event. This suggests that our learner-centred approach to evaluation was also viable within the classroom environment. In addition, this approach supported teachers’ involvement in the developmental process, and provided the developers with information on its feasibility in the natural environment. The

results were extremely positive, with FearNot appearing to be highly usable within a classroom situation.

However, the pre- post- test was inconclusive and it is clear from our evaluation of FearNot in the classroom that this type of study was insufficient to determine whether use of FearNot had any impact on children's long term learning and behaviour. No increases in affective or cognitive empathy were observed between the experimental and control groups, indicating that FearNot had not had any noticeable effects on children's attitudes and behaviour change.

Large differences between the experimental groups and control groups were not expected due to the fact that a field study design was used where it was difficult to control for confounding variables, and children's experiences in between the pre- and post-test design phases. Disappointing results for the psychologists and educationalists have highlighted the need for a different approach involving longitudinal design with repeated exposures to FearNot to be used in the future to determine the long-term educational implications of FearNot.

Evaluating emergent characters: Small Scale Final Study

Emergent FearNot enabled the characters to act autonomously and for their behaviour to emerge in response to their experiences. Following the underlying perspective of the VICTEC project, our expectations were that an emergent system would be more interesting and stimulating than a scripted one. As the emergent version was produced at the very end of the project, time constraints only permitted a small-scale evaluation in Portugal. This small study involved 11 children and took place in a Portuguese school. Children were given a brief introduction to FearNot and then asked to interact with FearNot. The children then completed the Character Evaluation Questionnaire and took part in a CDF.

To create the Emergent FearNot the scripted scenarios were structured into speech and behaviour acts (Louchart & Aylett, 2004) to enable the synthetic characters to interact using emergent narrative. Thus, Emergent FearNot has no scripting of the action within an episode – the character action-selection systems allow the characters to select from their repertoire of actions on the fly. A certain amount of physical indeterminacy is also built in to this version. This means for example that if the victim is advised by the child to hit the bully back, and if the character's state of confidence is high enough to do this, sometimes the bully falls over and sometimes he does not. If he does, this impacts his level of confidence so that he desists from any further bullying in that episode. But if the bully is not seriously affected by the victim's blow then he becomes angry and is likely to hit the victim back even harder. This makes the exact sequence of events in the episode and the eventual outcome hard to predict, and the fact that this outcome has an effect on the emotional state of the characters involved means that differences propagate through the episodes.

Figure 7 shows a scene of the emergent version of FearNot in the corridor in which the victim is about to try and hit the bully back. This version of FearNot is similar to that used for the scripted version, with a somewhat improved interface and some slight modification to the character appearance.



Figure 7 The victim is deciding whether to hit the bully back – and the outcome is uncertain

Emergent FearNot also incorporated the free-text input language system to allow the child user to interact in a more natural way with the victim in order to give him or her advice. This new interface is shown in figure 8 below.

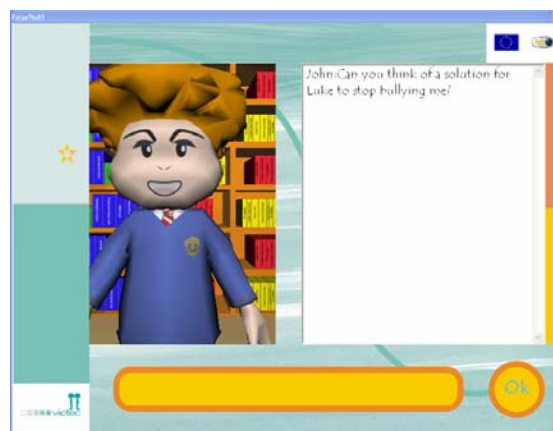


Figure 8 Emergent FearNot also incorporated an improved free-text interaction system

Our evaluation of Emergent FearNot aimed to determine if children found the character's emerging behaviours and emotional status believable and engaging, and if there were any differences in response to the emergent rather than the scripted version. Ideally, we would have liked to extensively test this system, but were unable to do this within the timeframe of the VICTEC project. Thus, our results are from a very small sample in only one European country.

Informant Design – Evaluating Emergent FearNot

This small-scale evaluation of emergent FearNot replicated many of the results found in the scripted study. Children stated empathic reactions to the character, feeling sorry for the victim and angry towards the bully. Again, there was a same gender preference for characters. However, results from the Character Evaluation Questionnaire showed a clear trend that children found the characters in this version of FearNot to be more responsive and that this increased their believability in the characters.

The CDF highlighted that children appreciated the fact that their interaction had been different to that of other children in their class, with each child having had a slightly, or even

completely different experience. These different experiences provided the basis for children to discuss the results of different strategies and behaviours. In the emergent version of FearNot children were more convinced that the characters “listened to them” and “took their advice.”

The children found the free-text input language system easy to use, however, as found in the large scale evaluation, children type very slowly and this tends to result in only short text inputs. However, children did not identify this as a limitation.

The main design implication for FearNot from this small evaluation is that we are following an appropriate approach to the design of synthetic characters and empathic interaction. Children appear to be empathically interacting with the characters in FearNot and find the scenarios realistic and appropriate. This study highlighted the need for further evaluation of the pedagogical impact of the emergent version of FearNot and we have recently begun additional work in the European CIRCUS project that began in March 2006.

DISCUSSION

The VICTEC team had previous extensive experience of obtaining quantitative and qualitative data, under experimental conditions and in context, both for pedagogical and psychological empirical research, software design, development and evaluation. This experience aided significantly in the development and validation of instruments and the protocols for their interpretation. Practitioner experience was of considerable benefit in determining an approach both sensitive to the user group and informative to the design process. However, organizing and conducting such a variety of design and evaluation activities and their coordination in 3 countries provided a significant challenge.

Table 3 briefly summarises the main implications of the results achieved through the learner-centred approach adopted in the development of FearNot and this is discussed below.

Method	Implications of results
CDFs	Unstructured, answers complement questionnaire responses and assisted in design of FearNot interface
Storyboard Generation	Useful info about speech acts, content scenarios etc, daily life for children, types of bullying used cross-culturally
Storyboard Evaluation	Info about coping strategies children use to deal with bullying, character impressions, emotions and empathy
Wizard of Oz	Info about speech acts, spelling, grammar of children aged 8-12 yrs
Trailer Approach	Differences in views between children, teachers, experts about characters, storyline, empathy etc. Acceptability of look and feel of interface. Introduction and acceptance issues
Large Scale Evaluation	Children’s views of scenarios captured, believability, engagement, empathy. As scripted and standardised also able to assess psychological phenomena such as bullying roles and differences in interaction styles, theory of mind abilities and interaction styles.
Pedagogical Impact	Assessed pre-post-test ability of FearNot to result in attitude and behaviour change for children about bullying behaviour, but inconclusive results. Need for longitudinal assessment of long-term educational impact.
Small-scale study	Assessed children’s views of an emergent version of synthetic characters and the satisfaction and engagement achieved with FearNot. Further studies needed to further explore the impact of emergent behaviour on the learner’s experience.

Table 3: Summary of the main implications of the learner-centred approach

Classroom Discussion Forums (CDFs) enabled the team to gather more detailed information about children’s attitudes towards bullying behaviour, views of FearNot, perspectives on interaction and opinions about the stories, characters and environment. CDFs are based on focus

groups, refined for use by children in the classroom. The use of a standard classroom approach of questions and selected respondents was highly effective. Both children and teachers benefited from CDF as they could provide their ideas and views in a non-threatening environment that they are familiar with, learn listening skills, verbalisation skills, and how to form ideas and opinions on particular subjects. CDFs were used in conjunction with almost all of the other methods and provided a natural closure for sessions, allowing children a chance for questions, discussion and thoughts.

The storyboarding generating and evaluation technique have been extremely useful research tools for VICTEC. The use of a mid-tech approach using electronic storyboards was highly stimulating for children, and is an appropriate and effective tool that provided children with sufficiently more scope than our earlier low-tech, paper and pencil attempts. Storyboarding has contributed to the correct language configuration for the bullying scenarios, the development of detailed bullying character profiles that children will comprehend, and storyline design and progression. A consideration of the impact of culture and gender differences surrounding bullying behaviour has enhanced the design of scenarios and marketability of FearNot as a product for teachers and children in different countries. The storyboard technique also allowed an exploration of the importance of empathy in creating believable and engaging VLEs.

The Wizard of Oz was used to supplement the storyboards through focusing on the child's utterances and interactions. Useful data was obtained that extended the language system of FearNot. However, due to the constraints of the number of available wizards, it is logistically difficult to support many individual children at the same time.

Initially, our expectations for the trailer had been fairly limited, aiming only to get the stakeholder's perspective on the suitable appearance of the characters and the virtual school in FearNot. However, our decision to use this approach in the classroom was a highly useful approach to gaining feedback from children. The Trailer Approach has been used in a range of venues (e.g. conferences, classrooms, workshops) and for a range of audiences (e.g. teachers, stakeholders, researchers). The use of the Trailer Approach outside of the classroom is discussed in (Hall, Woods, Sobral et al., 2004; Woods et al., 2003). Of all of the instruments and methods developed, the Trailer Approach is the most innovative and has proven to be the most useful in terms of guiding design and development, particularly at the mid stages of development.

The trailer approach, using a snapshot vision of the final product, enabled us to obtain a range of viewpoints and perspectives from children using a mid-tech prototype. The Trailer was particularly useful as it allowed children to experience and gain an overview of FearNot. It allowed the design team to verify that the interaction approach and the look and feel of FearNot was appropriate for children and viewed positively by them. We also used the trailer approach to investigate the opinions of other stakeholders and these results highlighted that the child's view is different to that of both adult experts (researchers) and teachers (Hall, Woods, Sobral et al., 2004). We have sought to design for the child's view, whilst taking into account stakeholder issues in terms of the pedagogical goals of FearNot.

VICTEC aimed to provide an environment that enabled children to explore bullying and coping strategies through evoking empathic interactions with the child. To evaluate this we performed a number of studies on different versions of FearNot, each of which fed back into the design process of the subsequent prototype. The evaluation was achieved through logging interaction data, the Character Evaluation Questionnaire and CDFs. FearNot does provide an environment for exploring bullying and coping issues, however, further research incorporating a longitudinal design with repeated exposures to FearNot is necessary to assess the pedagogical impact of FearNot as a bullying intervention.

The instruments and methods used for the large scale evaluation, pedagogical studies and emergent FearNot study were developed over several years and show the impact of numerous earlier studies on a smaller scale. Further, the multidisciplinary input can also be clearly seen with a diverse set of evaluation approaches merged into a coherent, structured activity, sufficiently flexible for both the lab and the classroom.

The use of a methodically developed learner-centred approach has generated results (Hall & Woods, 2005) that have highlighted that FearNot provides an enjoyable and engaging experience for children. A number of key design issues also emerged from the evaluations that have relevance both for FearNot and other applications aimed at providing virtual learning environments populated with synthetic characters. Gender was a key issue for the 8-12 age group and that if children perceive that they are similar to a synthetic character in appearance and/or behaviour, that they are more likely to like and empathise with the character. Future research is needed to gain greater understanding of the level and nature of similarity required to evoke an empathic interaction.

Incorporating the child as informant has been highly useful within VICTEC. Gaining input from children in response to specific design decisions has enabled us to tailor the design of FearNot to children. The children have been enthusiastic and feedback from schools highlights that participating in the VICTEC activities described here is viewed as an enjoyable experience by the children. Teachers are also very positive about the technique, noting that it stimulates children not only in relation to discussing the content of the application, but also about computing and technology.

Whilst research discusses the satisfaction level of teachers and children in taking part in software design and development activities (Hall et al., in print; Read et al., 2002), there is no focus on the contribution of this involvement to the curricula activities of the school. However, there is growing recognition of the need for a classroom-based approach that takes the curricula needs of teachers and pupils into account (Rode et al., 2003). The approach that we have taken in VICTEC has highlighted the potential of using learner-centred methods within the classroom context and the potential of creating a classroom-based, curricula-focused participatory design approach. Future research focuses on the mapping between curricula objectives and learning outcomes to classroom-based informant activities to support the educational software development lifecycle.

CONCLUSIONS

Our approach of child as informant involved obtaining children's opinions and views, their responses to FearNot at various stages of the design process, prototype evaluations and the collection of empirical data that can be quantified and analysed. Incorporating the child into the design process as informant and using a diverse set of instruments has proved to be an effective approach to gathering information.

Classroom Discussion Forums provided a useful modification to focus groups with refinements ensuring that this approach was appropriate for the target group and context. CDFs are a suitable tool for other designers and researchers aiming to support a novel learning experience in the classroom situation.

Electronic storyboards for generation and evaluation proved to be considerably more informative and useful in eliciting children's ideas, views and perspectives than low-tech approaches. The use of electronic storyboards provided children with an engaging and stimulating approach to the creation of scenarios.

We tried several approaches to gathering content for the characters' utterances. Whilst storyboards provided some input, we further supported this with Wizard of Oz studies. Although our results did provide some content this was often of poor quality and of limited use within the design process. This issue needs further consideration and study to ensure that the final dialogue does replicate children's language and create believable characters and storylines.

The Trailer Approach provides an innovative technique that enables users to get a clear view of the final product in the early stages of the design process and achieved useful results that have had a clear impact on the design of FearNot. This approach is useful for the design of any application that experiences a long lead time from inception to robust prototype. We can conclude that the Trailer Approach provides a useful and effective technique for designing virtual environments populated by synthetic characters, however, future studies investigating

the applicability of this technique in other domains is necessary to determine its suitability as a generic approach.

The large-scale studies were facilitated through the use of techniques that we had already tried and tested, such as questionnaires and CDFs. Extensive pre-study experience in smaller design studies significantly contributed to the successful planning, organisation and execution of these studies. The questionnaires were developed, piloted and refined during a long iterative process and this ensured that they were learner-centred and age appropriate. However, whilst the large-scale studies were useful and gave us a snapshot view of FearNot, it is clear that an educational impact for issues as complex as those studied in Personal and Social Education, cannot be determined through interaction in a single session. Future work will further explore this issue and we are conducting a longitudinal study in the classroom with children and teachers using FearNot as part of everyday school activity to assess pedagogical impact.

The learner-centred informant approach that we have taken in VICTEC has been effective and through its application we have created an engaging application that children enjoy using and that they view positively. Whilst the pedagogical impact of empathic interaction requires further study, FearNot does meet VICTEC's aims in that it provides an innovative approach for children to explore bullying and coping issues. The learner-centred design approach and associated methodologies were either adapted or developed specifically for the current study with young children in schools, therefore increasing the ecological validity. The approach used provides significant contributions to the research community as we are not aware of any previous studies having used such innovative and extensive testing throughout the design process of a software application. The approach that we have developed, refined and applied is relevant for other applications for use in the classroom and we encourage other researchers to modify this approach for their own learner-centred developments.

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