Pulling together: keeping track of pedagogy, design and evaluation through the development of scenarios: a case study

Pulling Together:
keeping track of pedagogy, design and evaluation through the development of scenarios

A case study

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Abstract:

This case study describes the multipurpose use of scenarios in a large multinational research project (MOBIlearn) whose aims are to design and develop a pedagogically sound mobile learning environment. Maintaining effective communication and design focus in large consortia is a well-known problem (e.g. Carroll 2000), and we describe the role of scenarios in addressing this. Scenarios were initially used to simply envision the future system in order to inform design, but as the project progressed, the role of the scenarios grew to encompass (i) relating system design and implementation to pedagogy by providing a common frame of reference for developers and pedagogic experts; (ii) through a process of refinement, defining the evaluation strategy for the user trials; and (iii) allowing us to keep the user at the heart of the development project. Thus, scenarios helped to resolve the difficulty identified by Taylor (2004) of how to bring together the relatively high level issues of pedagogic evaluation and the more technical user-centred system evaluation. The development of a first-aid training scenario is used as an illustrative example.

Keywords: scenarios, mobile learning architecture, user trials, evaluation planning; communication in design teams.

Introduction

MOBIlearn (IST-2001-37440) is a large, multinational, European-funded research project involving more than 15 organizations from seven European countries , and one Middle Eastern country. The consortium comprises both industrial partners and universities, and brings together areas of expertise in technical design and implementation; and pedagogy and evaluation. Taking a user-centred approach, the aim of the project is to define an architecture for a pedagogically sound mobile learning environment, and to evaluate an instantiation of that architecture using currently available mobile technologies. There are several problems which need to be addressed in this situation.

Firstly, this is specifying a novel design, and no such systems yet exist. In addition, there are few in-depth studies of the use of mobile technologies for learning where the focus is on the pedagogy, rather than the tools. The design team would, therefore, have to envision a system and specify its design with very little previous work, or existing requirements, to build from.

Secondly, collecting user requirements for the use of systems and learning situations which don't yet exist is problematic, since users have little idea of what they would want or need. Asking them to imagine what they might want is generally

unsatisfactory because either they generate ideas which are so far into the future that the requirement is useless for driving design now:

> I'd like a thing like Mr Spock has - a scanner you wave over a person that gives me readings of all bodily functions and diagnoses what's wrong…
>
> *A first-aider in conversation*

Or they may have little insight into their own performance (Sharples et al 2002):

> They may idealise their methods, describing the ways in which they would like to or have been told to work, rather than their actual practices. Although users may be able to describe their own styles and strategies, they may not be aware of how other people can perform the task differently and possibly more effectively. Furthermore, basing design on a survey of user preferences can result in new technology that is simply an accumulation of features, rather than an integrated system.

Thirdly, as Taylor (2004) points out, there is potential gulf of understanding between the technical partners comprising the team responsible for design and implementation of a system, and the partners comprising the team responsible for pedagogic validity and evaluation, mainly because they may not understand each others' expertise. This can lead to a vicious circle where the technical experts are keen to know the requirements for a pedagogically effective system, so they can begin design – 'that's pretty straightforward isn't it?' The pedagogy experts, on the other hand, want to know the range functionalities that the system could offer in principle so they can develop some appropriate pedagogical strategies – 'pedagogy doesn't work in a vacuum, it needs a context'. This situation can be compounded by the use of different discourses, where (a) specialised terms are used which are not understood by non-experts (e.g. 'pedagogy') and (b) where seemingly common terms are used, but in one field of expertise they have specialised meanings not found in other domains (e.g. 'system').

Finally, given these different discourses, there is also the problem of keeping the communication between partners flowing, and maintaining focus on the design aims of the project. Carroll (2000) discusses these problems of supporting design teams, and suggests that scenarios are an effective way to manage them. Scenario-based design entails using concretisation – a concrete story of use. This story typically specifies a setting; objects; agents or actors and their goals or objectives. They also have a plot. Scenarios may be very short, focusing on a small piece of interaction with a system, or they may be quite elaborate. Scenario-based design

- evokes a task-oriented reflection in design work
- makes human activity the starting point for design work
- helps identify and develop requirements
- helps designers analyse the various possibilities of use afforded by the design
- produces a rubric of task-oriented abstractions

The main point about scenarios is that they provide a coherent and concrete vision, and 'not an abstract goal, not a set of requirements, not a list of features and functions' (p.50).

Carroll also notes:

> ‘The problems of managing novelty and complexity in design are no doubt exacerbated in cases [where] the technological issues [are] quite novel and tangled and the team large, diverse and distributed.’ (p. 8).

This exactly describes the situation of the MOBIlearn consortium. In this case study we describe our use of scenarios, and discuss the advantages and disadvantages we encountered.

Scenario Development

We began to use scenarios in the project to fulfil a dual function.

- The first was to assist in the process of ‘envisionment’ (Carroll, 1995) of the mobile learning environment.

- The second was to begin considering basic requirements to enable us to progress towards the field studies that will provide us with user requirements in the user-centred context.

We tried to find ways of harnessing all the available expertise in the project to feed into this vision of the future, and scenarios for envisionment were potentially an effective means to achieve this.

The project had identified three target domains for study and development. These were Museums (including Art galleries), First Aid, and MBA students attending a university business course on a part-time basis. These domains are representative of a range of applications related to mobile learning, with particular reference to learning outside the classroom.

Livingstone (2002) makes a useful distinction between internal and external initiation and structure of learning, shown in Figure 1.

	External structure	*Internal structure*
External initiation	Formal teaching	Resource-based learning
Internal initiation	Voluntary learning	Informal learning

Figure 1: Internal and external initiation of learning (Livingstone, 2002)

Traditional teaching is initiated by demands external to the learner, including the curriculum and examination system, and structured by a classroom teacher. Learning may be externally initiated, but structured by the learner, as in resource-based learning where learners are encouraged to manage their own study, but within the constraints of a curriculum. It may also be initiated by the learner, but externally structured, for example in professional or personal development, where the learner opts to study in an evening class or coaching session. Lastly, learning may be both initiated and structured by the learner.

The use of mobile devices in traditional classroom settings is not within the scope of the MOBIlearn project, so the three scenario strands can be located in Livingstone's schema as shown in Figure 2.

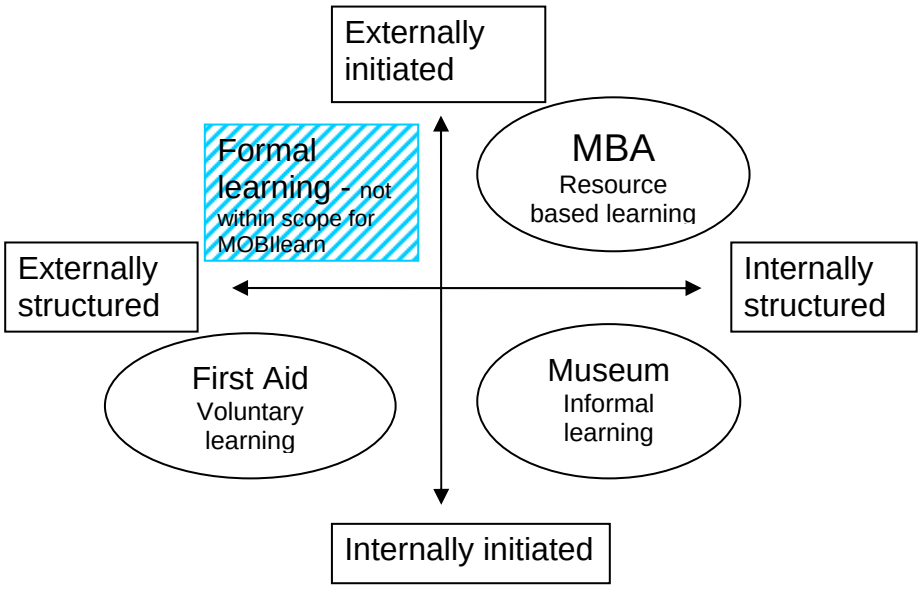

Figure 2: Three scenario strands in Livingstone's schema

The first phase of our activity was to invite all members of the consortium to contribute scenarios, primarily for the purposes of envisionment, but we also wanted to scrutinise the scenarios to see which might be suitable for development towards the user trials. Twenty-seven scenarios were submitted, 3 within the Health strand, 9 within the MBA strand, 11 within the Museum strand and 4 outside of these categories.

We next examined these scenarios to identify the basic requirements for mobile learning, and to pull out the common elements across all three strands. This gave us a general top-down view of the essential elements of a future mobile learning environment, as identified by informed experts. An example is shown in Figure 3.

First aid for burns in isolated location

A group of summer visitors are located in a small island. During cooking, some boiled water spills on the hand of one of the holidaymakers (Helen). The group has some medical supplies with them, but nobody knows how to use them, or how to treat burns. Moreover they have no idea of how to get access to medical help immediately if the situation becomes critical. However, at the moment, Helen seems OK and the pain is not too much.

John, a member of the group, uses his personal assistant (PA)* to chat with 166 (the authority for emergency health care). 166 just upgraded the call centre to allow enhanced chat

operations with people needing help and for emergency situations. There are also several specialized doctors located at various hospitals that could be involved.

John communicates with 166 and exchanges some textual messages with an agent of the call centre to explain the situation. The agent identifies a doctor specialized on burns available on line and involves him in the chat session. The doctor needs more **visual** information. Fortunately John has a PA equipped with a camera and immediately takes a snapshot of Helen's hand. Then he transmits the picture to the enhanced chat session. The doctor suggests that it is not a critical situation and provides some directions of how to use the available medical supplies to take care of Helen's hand.

Finally the doctor suggests that the next day a doctor should have a look at Helen's hand, and disconnects from the session.

**The personal assistant is a small handheld device that allows retrieval, viewing and information processing and also communications with other people.*

Figure 3: An envisionment First Aid scenario

Whilst giving us insight into a possible use of mobile technologies, this scenario raises important social issues – for example, the ethical question as to whether diagnosis should be made at a distance like this on an unknown patient. Ascertaining the level of shock, for instance, might be hard, or establishing whether there are any possible confounding factors for the diagnosis which wouldn't be evident from a transmitted picture of a hand.

Whilst this is an interesting scenario, it deals with an emergency situation (not easily replicable) and involves a range of services which do not currently exist, and it has some ethical issues associated with it. Furthermore, no learning takes place within the scenario, and since we were building a pedagogically sound mobile learning environment, this was a drawback. These limitations applied to all the potential first-aid scenarios. Another suggestion was a scenario in which first aid advice is provided on a personal digital assistant (PDA), which raised worrying visions of a first-aider trying to perform CPR whilst fiddling with the PDA to access the next screen of information.

So, we filed the scenarios for envisionment, and decided we would need to create the scenario to take forward towards the trials, and that it might involve supporting first-aid training.

The method of successive refinement we used for these scenarios has much in common with the approach to scenario development described by Cugini et al (1999). We would, in effect, move from the *high-level descriptions* through to fully *specified scenarios*, and eventually arrive at a level of description close to a *scripted scenario*. As the level of detail became more specified, the technical team would be able to comment on the technical feasibility. However, we defined our own terminology as follows:

- *Agreed scenarios* are a set of scenarios which project members agree to work with intensively. These capture the expertise of partners with experience of teaching and learning. Because the scenarios provide a context, pedagogic considerations can be developed, and are embedded into the envisaged user activities of the scenarios from an early stage.

- *Test scenarios* developed from the agreed scenarios go into more detail, specifying even more details of context, content and tasks.

- *Instantiated scenarios* locate the activities in a real place (e.g. the Uffizi Museum in Florence, Italy). These scenarios provide the structure of the user trials.

It is important to recognise that the scenario development process takes place collaboratively between the relevant teams. In this case, between system developers; pedagogic and domain experts; and requirements and evaluation leaders (see Figure 4).

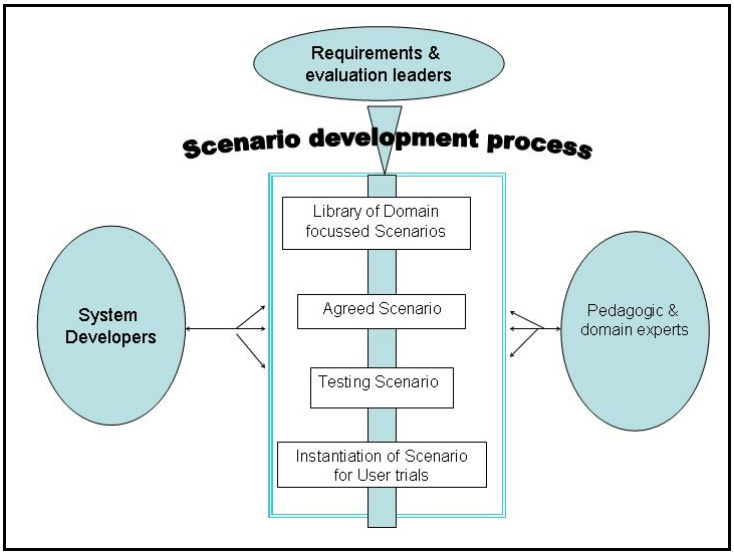

Figure 4 - The scenario development process

This allows work to progress in parallel – whilst the pedagogic and evaluation teams could discuss what tasks the learners would be engaged in, the system developers were able to identify some system requirements, and begin organising their approach to implementation of the system. This breaks the deadlock of no-one being able to move because they are awaiting output from other teams.

Scenario calibration

Although we had now identified the area of first-aid that we wanted to work with, we also wanted to gather requirements from actual first-aiders through analysis of their existing activities. We also wanted to engage them in scenario development to help calibrate, and validate the scenarios – i.e. ensure that the scenario represented a feasible first aid situation with actors performing valid actions.

One such technique for engaging in activity analysis is the Future Technology Workshop (Vavoula et al., 2002). In these workshops, participants are encouraged to consider the range of their existing activities before being supported in thinking about how those activities could be more effective when supported by new technologies and services. This allows participants to approach the concept of a new activity in a way which has their goals at the forefront of the discussion, rather than have their aims and objectives subsumed beneath the glamour and glitz of new technology for

its own sake. A series of these workshops was held with First Aid workers and their training officer.

Figure 5 illustrates the overall process, with the experts creating the first set of scenarios which in turn generated the first early requirements for the system. The calibration exercise with domain users not only validated these requirements and added new ones, but also helped to define acceptance criteria for potential user satisfaction.

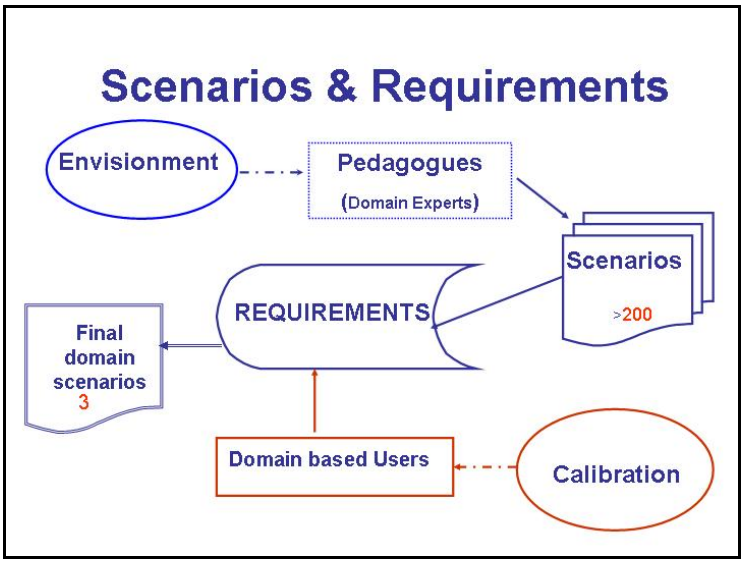

Figure 5: the relationship between Scenarios and requirements

The evolution of these scenarios, remaining grounded in first-aiders and their requirements, has become increasingly important to the evolution of the developing system. We now consider the development of the agreed final scenarios and explain how the preparation of specific instantiation of the scenario assisted the preparation of the evaluation plan for the user trials.

Developing the First Aid Scenario

Our first-aiders were employees of the Open University (OU) who have the role of 'Designated First Aider' for their department. This means that in addition to their normal job role they deal with first aid incidents in their department or around the OU. Training for these First Aiders follows a fixed process of instruction, practice and testing, with refresher courses and further testing at prescribed intervals. This training is provided by organizations such as St. John's Ambulance.

These first aiders were invited to attend future technology workshops (Vavoula et al, op cit) as part of the calibration exercise. Through discussion and workshop activity we identified ways in which their training might be supported through the use of mobile technology in the context of their authentic work activity. Discussions revealed that many of the First Aiders felt insecure in their diagnosis and treatment of casualties.

Part of the problem they identified was that, whilst their training needs to be up-date, and annually refreshed and tested, there was little opportunity to practise their skills in the normal run of things at work. This was particularly the case for more dramatic incidents, such as heart attack, when being able to leap into appropriate action

immediately would be of critical importance. They met on a regular basis to refresh their training, but felt they wanted to have some in situ training in the workplace to get a better feel for what it might be like in reality. We felt that mobile technology could offer some possibilities for providing stimulating training exercises, conducted in situ (rather than in an assembly hall, or other meeting place).

Other issues which came out of the FTW were:

- First aiders are usually not trained medical practitioners like doctors and nurses, there is therefore a need for consultation and reassurance on the nature of the problem being experienced by the victim so as to make appropriate diagnosis and report correct symptoms

- The so-called 'ABC procedure' is fundamental at any incident – this is when the First Aider check airways, breathing and whether the patient is conscious. The system should provide the first aider with step by step reminders in following ABC procedure

- There are recognised procedures and standards within first aid training. Conformance to these is a requirement for continuing qualification - the system should enable the first aider to abide by first aid standards and procedures.

- The system should include video /image capturing and transmitting facilities

- The system should support communication to consult with/get information from others e.g. emergency services and Occupational Health Practitioners (OHP)

- The communication support system should be able to detect the location where the first-aider is calling from or where the incident is being reported from, i.e. location awareness. The position of the first aider or incident is needed to coordinate responses.

Some of these issues straddle the boundary between training and practising first aid. For example, the workshop had identified the need not only for support with procedures and treatments but for mutual personal support in the case of a real incident. Similarly, the ability to be able to capture and transmit images was seen as a very useful capability in first aid situations. The resulting scenario focuses on these needs, and supports the development of the skills needed to undertake image capture and transmission as part of a training exercise.

The scenario is designed to supplement the required formal training activities provided by St Johns Ambulance and was planned as the potential basis of the User Trials. The First Aid trainer was engaged in the scenario development process through discussions, and she ratified the tasks, specific skills and topics worthy of inclusion in the scenario

The scenario adopts a socio-constructivist pedagogy and involves learner interaction focussed around defined activities or learning episodes. There is a clear collaborative focus to the activities. The activities identified as the basis for the scenario were:

1. Quiz – based on First Aid procedures and processes.

2. Picture / Video Based Activity – based on incident assessment given a picture or short video clip.

3. Enactment – a role play activity based on a simulated incident.

4. A further episode of individual activity lasting throughout the week enables the use of self-assessment content, access to external links and the opportunity to view other related content.

These four distinct episodes support different learner activity and collaborative activity over a period of a week. The activities cover procedures laid down for Action at an Emergency; CPR (cardiopulmonary resuscitation) and the Recovery position.

These activities support a variety of interactions with others. For example, in the **Quiz** the users work independently, competing with each other to provide correct answers in the shortest time. In the **picture based activity**, users initially work independently, but then collaborate in pairs and /or small groups, in a situation where they are not face to face, to achieve an agreed group response. This will involve reading and commenting each others work, and achieving a consensus.

The **enactment** involves participants in different ways. One person will be chosen as the active first aider, another will have a supporting role using peer to peer communication. The remainder of the group will be in a position to observe what happens and comment on the procedures and processes carried out. There will be an opportunity for feedback and debriefing after the enactment. Figure 6 presents the scenario.

A training programme for first-aid workers

At the Open University, Gill is a member of the first-aid team. She, and others in her group, have recently complained to their team leader that although they have regular skills updating classes and assessments, in between times, they have little or no opportunity to practise their skills if no first-aid emergencies arise. They therefore often forget what they know due to lack of opportunity to embed their skills. The team leader decides to run a 'First Aid Skills Week'. During this week, Gill is asked at all times to carry her mobile device (phone or PDA) which connects via the wireless local area network to the leader's office, which can receive and transmit text, photos, video and audio.

Throughout the week, the team leader runs a competitive quiz – first aiders are sent quick questions related to their first-aid manual. Who can reply most accurately in the shortest time? This is just a bit of fun, but gets everyone into the mood for other more substantial activities.

One day, Gill receives a picture of a first aid event (e.g. a person is lying on the ground, face down, in a kitchen area, with some split fluids on the floor around the body – the person appears to be unconscious). The picture is accompanied by a text message asking her to scrutinise the picture, and file an initial assessment with the leader as to what needs to be attended to in the environment, using her mobile device. Gill looks carefully at the picture – she notes that (apart from the obvious body on the floor) there is a gas cooker in the room – is it switched on but not lit, she wonders? is the person holding any electrical equipment? what are the fluids on the floor – water? blood? chemicals? vomit?

Gill notes that there are no electrical cables or equipment near the body, so she make the preliminary assessment that it is not a case of electric shock. The kettle, the toaster and the microwave are on the worktop, are plugged in and are upright. There is an upturned mug on the floor beside the body, so Gill decides that the split fluid is coffee or tea. However, she is not sure about the cooker. She texts for further information from the leader – is the gas switched on but not lit? Yes, it is, replies the leader. So Gill files her assessment with the leader, adding that the gas should be switched off, no electrical equipment must be switched on (not even lights); she must open windows wide, and then she can proceed to attend to the person on the floor who has inhaled too much gas. She would follow standard ABC procedures with that person.

The leader is pleased with Gill's initial assessment, but notes that it differs from Peter's, another first aider participating in the exercise. She suggests that Peter and Gill communicate with one another about their interpretations of the scene. They need to agree on a procedure. Peter had noted that the coffee or tea may have been hot when spilt, so was expecting some scalding, which he surmised had caused the casualty to faint. He had not noticed the gas cooker.

He and Gill communicate with each other about the scenario, and reach an agreement that incorporates Gill's observation about the gas, but also that they must take care in moving the patient because there may be scalding.

The team leader decides to open the scenario and Gill and Peter's assessment to the wider team. All members of the team are requested to join a group discussion where they comment on the assessment and offer further advice.

The team leader notes that neither Gill nor Peter had indicated that they needed to liaise with anyone else in dealing with the scenario emergency. The group signs off.

Shortly afterwards, Gill receives a message asking her to continue with the scenario – a first aid dummy is to be found in Room GC 220 - but to activate the relevant support that would be needed. Gill starts running to the 'emergency' using her mobile device's context awareness system as she goes to see who else is around in the building near to GC220 to give her a hand – Ann is on the next floor, so she communicates with her using an emergency protocol. Ann's mobile device bleeps, and provides her with information as to where Gill is. She runs to the room too, and observes Gill undertaking CPR on the dummy. She quickly ascertains from Gill what the situation is, and, staying outside the room, activates the emergency services number on her mobile device which connects her to the team leader who is acting as the emergency service. The team leader behaves as the real emergency services would, asking Ann for the necessary information an ambulance service would need to arrive quickly at the scene with the correct equipment.

The exercise is complete, and the team leader congratulates Gill, Ann and Peter on their assessment and actions, and invites the whole team to sign back on to the group discussion to debrief themselves on the handling of the scenario. Gill makes notes of her experiences with the scenario, noting that she wasn't really very quick at using the context awareness system – she needs more practice at that – she notes that its difficult to use your mobile device when running. She also finds information about the treatment of scalds which she shares with the group. Peter realises he needs to be more careful in scrutinising scenes before acting, as he could have suffered ill effects from the escaping gas, or turned the light on, which might have caused an explosion. Several other first-aiders confess that they hadn't noticed this aspect of the scene either. Gill, Peter and Ann are requested to submit a report of their experience to the group as the final part of the exercise.

Figure 6: The first aid scenario

As the instantiation of the test scenario became more defined, the requirements for content became more specific, not only in terms of the information it should provide, but also the media type which was needed to support the activity.

This meant that rationales were needed to justify one medium rather than another. For example the requirement to provide first aiders with step by step instructions by audio to assist them in producing a diagnosis / administering first aid has, as its rationale:

> 'When under pressure it is possible that procedures to aid diagnosis or treatment may be (partially) forgotten'. Within the scenario context this diagnosis may involve examining the casualty and/or carrying out procedures. Textual instructions will have limitations, detracting the eye from the casualty, using hands to navigate the content etc. Audio content that can be delivered and controlled 'hands free' would be more appropriate.'

The scenario instantiation for the User trials

Whilst the scenario was satisfactory from the point of view of the pedagogic experts, it was still not sufficiently detailed for either the technical team or the evaluation team – it was too high level, and there was a great deal of room for conjecture as to what the actual system might be to support the activities described. This produced a slight impasse in the design process because the pedagogic experts and evaluation experts felt they couldn't be much more specific, whilst the technical teams felt that they didn't have enough information to proceed. The piece of the jigsaw that was missing, however, was the relationship between activities of the participants and the expected activity of the system.

It was important, therefore, that the links between services and requirements, and between requirements and testing / evaluation were identified by the decomposition activities carried out as part of the final test instantiation, and in this process, further documentation was required which mapped from scenario activity, through sub-activities to system services and the expected system response (see Figure 7).

Scenario Activity	**Sub-activities**	**System Service**	**Expected system response**
… Notification of quiz TL sends message to all the TPs informing of the imminent quiz and the procedure they should follow.	… 1.Log on to system 2.Select group of users 3.Enter text message 4.“send” message	... MD_PDA-25 MD_PDA-26 MD_PDA-16	… Login page displayed. Correct login displays main menu List of users / groups of users is displayed Allows selection of target group Place to enter text is displayed Option to send text

Figure 7 Extract from scenario description matching participant activities with system services

This document could be used by both teams to check progress and development. Developers were able to use the agreed scenarios to identify, plan and develop a range of services. Testing and evaluation of the developing prototypes could be planned against the needed functionality of the scenarios creating a link back to the services.

Using this level of representation of the scenario, we are able to plan the user trials because there is little ambiguity, and we know what we are expecting the system to do at any given point.

The role of scenarios in evaluation

Usability often attracts a great deal of attention from evaluators. Clearly usability is an important aspect of any evaluation study, but when considering devices and software for educational purposes there is a need to move beyond this and consider pedagogic requirements and usefulness.

The MOBILearn system could be described as a toolset containing a set of integrated tools which are not in themselves tied to a specific context or pedagogy. Thus an important question concerns the extent to which the system supports the types of activities, methods and characteristics of different pedagogical approaches. This would enable the evaluation of a much wider aspect of usefulness.

A decision was made to extend the instantiation document to satisfy the needs of the evaluation process by including details of the context of use, possible questions that could be answered during the evaluation and the activity or task which would be used to gather responses. Generating this content provided an opportunity for partners who were focussing on pedagogic validity and socio-pedagogic usability to maintain their input into the process of design, development and evaluation.

Furthermore using three different scenarios, each focussed on a set of tasks or activities, grounded in a pedagogic approach, and designed to satisfy a defined set of objectives, not only supports evaluation targeted at each specific context but has the potential to provide a basis for higher order evaluation of the system across a range of pedagogical approaches.

Question: *'Is the use of mobile devices suitable to support activity based group collaboration?'*

- The Health scenario addresses this using the Picture / Video Based Activity

Pedagogical Strategy:
Constructivist – collaborative activity, sharing knowledge, agreeing outcome.

Activity:
The learner is presented with the opportunity to work either in pairs and in small groups in a situation which is not face to face. The activity requires them to collaborate on production of a final document and to discuss the process and value of the task.

Evaluation Method:
Observation study; video taped protocol; questionnaire and interview.
Data focuses on ease of use; success of collaboration as perceived by both parties; production of a satisfactory outcome;

Evaluation Outcomes: <to be ascertained>

Figure 8 Focussing on higher level questions for evaluation

Conclusions

Scenarios support multiple purposes and can be used as boundary objects between teams of varying background and expertise. They support mutually informing dialogue between the technical partners in the project and the evaluators and pedagogues, thus bridging the gap identified by Taylor (2004).

However, our experience shows that projects cannot expect this to happen spontaneously. Documentation needs to be created to make explicit the expectations of the high-level perspectives, and the level of detail required at that point can be overwhelming for non-technical partners. Nevertheless, because such documentation is translatable back to scenario activities, which are expressed in simple language, important links between implementation, design and high level aspects such as

pedagogic validity and usefulness can be maintained. Used in this way, scenarios can also support verification of system functionality against user requirements.

Scenarios also help to keep the user in sharp focus during implementation. If all collaborating partners keep referring to what envisaged users are actually supposed to be doing, it helps ensure that users don't get lost in the process. There is also the added benefit that users themselves can read and contribute to scenarios, which can make considerable difference to their motivation to stay engaged with the project (see Danielsson et al 2004) and participate in studies.

There are some potential pitfalls in using scenarios which future users need to be aware of

- Specifying a single scenario only
  - Too limited a system
- Scenario based in restricted set of requirements
  - Too limited a system
- Scenario based on too many requirements
  - Too broad a system, can't complete on time
- Left too late
  - not possible to perform high-level evaluation

We have found that the use of scenarios in the way described in this paper has many beneficial features.

Referring back to the socio-cognitive engineering design process, we found that the development of our scenarios contributed to the general requirements (abstracting out common requirements from scenarios generated by experts); the theory of use (from the contributions from the pedagogy experts); and the field studies (by identifying what would be needed to run user trials in terms of content and context, and by helping specify issues and methods for evaluation). The calibration element of the process also contributed to the field study component. All of these, in turn, have fed into the activity model, which is currently being developed. The socio-cognitive engineering method is specifically neutral in respect to what methods could or should be used to provide data, so similar effects could have been achieved through a variety of different means.

But the additional benefits of the scenario development process, in terms of scaffolding the mutually informing discourse, and keeping users involved in the design process, made this a particularly useful technique, especially in the context of a large project with many partners.

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