Development of a cross-platform ubiquitous language learning service via mobile phone and interactive television*

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Abstract
This paper describes the development processes for a cross-platform ubiquitous language learning service via interactive television (iTV) and mobile phone. Adapting a learner-centred design methodology, a number of requirements were gathered from multiple sources that were subsequently used in TAMALLE (television and mobile phone assisted language learning environment) development. A number of issues that arise in the context of cross-platform user interface design and architecture for ubiquitous language learning were tackled. Finally, we discuss a multi-method evaluation regime to gauge usability, perceived usefulness and desirability of TAMALLE system. The result broadly revealed an overall positive response from language learners. Although, there were some reported difficulties in reading text and on-screen display mainly on the iTV side of the interface, TAMALLE was perceived to be a usable, useful and desirable tool to support informal language learning and also for gaining new contextual and cultural knowledge.

Keywords
cross-platform development, interactive television (iTV), learner-centred design, mobile phone, ubiquitous language learning.

Introduction
The possibility of using ‘non-desktop’ technologies for supporting learning opens up a wide variety of activities and interactions for learners. The potential for technologies such as mobile devices (m-learning) and interactive television (t-learning) for learning has provided a new direction for research in the field of educational technology. In particular, designing for these new technologies has thrown up a number of design challenges associated not only with the physical and functional limitations of these devices, but also with the effective implementation of new learning paradigms – situated, collaborative, lifelong, personalized and contextual (Fallahkhair et al. 2004b; Pemberton et al. 2004; Naismith et al. 2005).

‘Beyond the desktop’ technologies are currently being harnessed to support these learning paradigms. However, each technology has distinct characteristics that facilitate some types of use and hamper others. For example, while mobile devices afford a wide variety of personal activities and learning on-the-move, they are less powerful for enabling learning from authentic and immersive content. In contrast, television provides rich multimedia presentation of authentic and immersive content that is constantly renewed. Programmes such as news, soap operas and documentaries have the potential to enhance language learners’ experience by showing the target language, culture and context of use. However, interactive television (iTV) does not naturally provide...
facilities for personalized learning or learning on-the-move in the way that mobile devices do. Designing facilities that take advantage of what each device does best is the primary focus of the TAMALLE (television and mobile phone assisted language learning environment) project.

Despite Robertson et al.’s (2006) pioneering CHI paper discussing coordinated personal digital assistant (PDA) and iTV interaction, little is known about dual device interaction in general or about such interaction in the context of educational technology applications in particular. In this paper we concentrate on the design and development of a cross-platform system for informal language learning. The system aims to capitalize on the strengths of two specialized technologies, iTV and mobile phones, which tend to be used in different settings and at different times. We first briefly give an overview on the existing literature on mobile and iTV technologies for language learning. We then discuss briefly the first stage of the project, learner-centred negotiation of requirements, which led us to the design and development of the TAMALLE system, whose technical architecture is sketched. The interfaces for the two devices are then described. Finally, we discuss a multi-method evaluation technique used to gauge the usability, perceived usefulness and desirability of the system.

Mobile technologies for language learning

The potential value of learning via mobile devices or m-learning has been widely realized (Sharples 2000; Attewell 2002; Leung & Chan 2003). Mobile devices enhance learning experiences by enabling communications, learning on-the-move and use on an ‘anytime and anywhere’ basis (Hardless et al. 2001; Roschelle 2003). For language learning in particular this realization also holds true. Second Language learners currently are often found with a pocket dictionary or a personal vocabulary book. As a result several researchers have begun to investigate the potential of mobile devices for language teaching (Mallio et al. 2002; Kadyte 2003; Godwin-Jones 2004; Tan & Liu 2004).

Godwin-Jones (2004) points out how mobile and wireless technologies could provide an opportunity for language and cultural learning. He describes a project to develop a wireless system called RAFT that can be used on a student’s field trip. RAFT helps an individual to store and retrieve information regarding their field trip on their handheld mobile device and to share it with other learners. Although RAFT was not specifically designed for language learning, its developers suggest that it could be used for cultural and language learning by learners who are on a trip abroad, for example, to conduct interviews with native speakers and to share this with other learners.

The AD-HOC project (Malliou et al. 2002) aims to develop a mobile language learning environment to facilitate ‘learning on demand’ for European travellers who want to acquire language skills in order to communicate with local people. The AD-HOC system acts as a tutor to teach linguistic and cultural knowledge through the use of multiple media presentations (e.g. text, sound, picture and video). The language learning environment offers representations of contextualized, authentic, real life situations for different level of competency and within different thematic fields (e.g. business travel, young travellers, etc.). The underpinning pedagogical principle of the AD-HOC project is self-directed learning (Malliou et al. 2002).

The M-Learn project is concerned with developing a mobile learning system for young adults (16–24 years old) in order to teach some aspects of literacy and numeracy, and to involve them in the development of their lifelong learning (Ultralab 2003). The Mobile Language Learning System, designed in Finland (Kadyte 2003), delivers lessons using sound and text to teach grammar and vocabulary. It tracks the learner’s progress and integrates voice technology for user interaction.

BBC Worldwide provides an English language teaching service via mobile phone in China. Learners receive a daily text message on their mobile containing a phrase in English together with the Chinese translation. A range of topics are covered (e.g. sport, business, lifestyle, etc.). The idea behind the system is to provide an opportunity for busy learners on-the-move to learn authentic spoken English (BBC Press Office 2003).

A project conducted in Taiwan developed a mobile-based (PDA) interactive language learning environment for elementary schoolchildren learning English as a second language. The activities aimed to help students to learn listening, reading and writing skills. For example, a scenario to teach words related to images showing a body part provides a word’s pronunciations and spelling when the image is clicked by the user. Evaluation showed a positive response from learners and indicates that the use of mobile devices can
significantly increase student motivation and interest (Tan & Liu 2004).

The Speak My Speak project is investigating the use of Short Messaging Service (SMS) as a communication tool between adult English language learners and native English tutors. They conclude that using SMS in language learning is feasible and promising. Students did reflect on texts sent and received, and were active in constructing the content of communication (Markett 2003).

The INLET project (Lingua) developed an innovative mobile phone support system to encourage tourists to learn Greek language at the Athens Olympic Games 2004 (Pincas 2004). The system provided a number of facilities for learning useful Greek phrases in a just-in-time manner. Language categories judged most beneficial for tourists were developed as follows: ‘basic’ (e.g. greeting, numbers, basic words), ‘where’ (e.g. phrases for asking direction, going by bus, taxi and trains), ‘when’ (e.g. asking times, today, now, tomorrow), ‘Olympic Sport’ (athletics, fencing, etc.) and ‘buying’ (asking price, money, expressions like expensive, cheap, etc.). Users, recruited at the airport in many cases, were able to register for SMS messages to be sent to their mobile phones freely and regularly containing useful phrases. They also could request SMS translations of other languages into Greek.

Thornton and Houser (2005) conducted the study of the use of mobile phones in learning English in Japan. English vocabularies at timed intervals were sent to students’ mobile phones and the learning outcome of those with other students who were using identical materials on paper or Web was compared. The result indicates that students receiving mobile email learned more than their counterparts.

Interactive television for language learning

Interactive television is a new media technology that has great promise for language learning (Pemberton 2002; Underwood 2002; Atwere & Bates 2003). Before turning to iTV though, it is worth considering that conventional television itself is already a powerful learning environment for language learners. Television offers a rich multimedia experience, where learners can immerse themselves in authentic materials from the target language and culture. This material may well be engaging in itself, with up-to-date ever-changing content displaying a range of speakers and contexts.

Many television shows constitute important cultural events in their own right providing a shared reference for people sharing or aspiring to share a culture. In its non-interactive state, it clearly affords watching, reading and listening, making it an excellent medium for learners to practice comprehension skills and also to acquire background cultural knowledge. Comprehension of spoken material is strongly supported. Sherrington (1973), exploring the potential of conventional television for language teaching, notes that a number of listening skills can easily be practiced via television, including recognizing and understanding:

- Segmental and supra-segmental features
- Vocabulary items, short phrases and longer segments of speech
- Syntactic structures
- Varieties of speech, such as registers and dialects
- Discourse patterns
- Pragmatically determined features

Lonergan (cited in McGovern 1983, p. 14) points out the benefits of viewing TV programmes in the target language, particularly TV’s multimedia aspect:

The suitability of television as a medium for bringing a living language to learners is undoubted. The dynamic combination of sound and vision can bring an air of reality into the classroom. The wealth of visual information available can convey the atmosphere of another culture, can show paralinguistic aspect of communication; the techniques of television can present material to learners in ways quite beyond the resources of the language teacher.

Woolford (cited in Wright 1994, p. 10) articulates a language learner’s view on television:

With its unique combination of sound and moving pictures TV is seen by many student as a medium that can present and contextualize the target language in a way that a book and audio tape alone are not able to do.

One disadvantage of TV broadcast over video or DVD is its ‘non-interruptible quality’ where it restricts learners from replaying the information available (Broady 1997, p. 3). Broady points out that one of the problems associated with target language TV is that the foreign language learners are not aware of the required background knowledge – something she refers to as ‘cultural knowledge’ – that needs to be acquired in order...
to understand the programme. She discusses the notion that a situation can be misunderstood by non-French viewers when the accompanying image does not support interpretations of the ‘verbal input’ in watching a French News channel. She further argues:

Because it [television] conveys ‘real’ language used by ‘real’ people in ‘real’ situation, it is generally perceived as motivating and interesting by learners. Yet this very cultural authenticity can render it frustratingly obscure. But is this a ‘real’ problem?

She later mentions that ‘non-native viewers are not the only ones whose understanding is impaired when picture and commentary do not correspond closely: it happens to native viewers too’ (Broady 1997, p. 4). One problem that non-native speakers sometimes have is that they ‘often lack the confidence . . . and assume that they need to understand every word. With such a strategy, the richness of authentic television are likely to remain buried.’ (Broady 1997, p. 5). For this reason, a number of researchers attempt to develop ‘viewing strategies’ that could be used by learners when watching authentic television programmes. These strategies explain how to maximize comprehension of foreign TV programmes viewing (Meinhof 1998).

Several projects (Bean & Wilson 1989; Spanos & Smith 1990; Parks 1994; Koskinen et al. 1996; Koolstra & Beentjes 1999) have analysed the use of TV with first language subtitles (L1 subtitling) and second language subtitles (L2 subtitling), as an aid to comprehension, retention of second language vocabulary and improving reading skills. One such study suggests that even TV with a L2 audio track and L1 subtitling could lead to incidental second language learning. These strategies explain how to maximize comprehension of foreign TV programmes viewing (Meinhof 1998).

Fridman argues for closed captioned videos as powerful tools for improving vocabulary and reading comprehension skills for EFL (English as a Foreign Language) learners. Bean and Wilson (1989) report the motivating influence of captioned television, and positive attitudes on the part of learners toward this medium. Neuman and Koskinen (1992) suggest that captioned television can be used as an effective instructional tool in learning vocabulary and concepts. Koskinen et al. (1996) studied the effect of captioned television on incidental vocabulary acquisition by adult ESL learners. They assessed vocabulary knowledge of viewers who watched TV programmes with and without captions, identifying ‘a statistically significant difference in favour of captioned TV’ and ‘a positive relationship between oral English language competency and vocabulary learning’ (Koskinen et al. 1996, p. 368). The participants with higher levels of oral proficiency learned more than less proficient subjects.

Kikuchi (1997) provides an overview of 37 studies on the use of English Subtitled Movie (ESM) for EFL learners in Japan. The main benefits of ESM were:

- ESM could bridge the gap between reading skills and listening skills.
- Movies are good for teaching authentic English.
- ESM facilitates learner understanding of linguistic information.
- ESM improves overall listening comprehension of viewers.
- ESM motivates students to listen to dialogues in the movies and to learn English.
- Fully captioned videos were much more effective than partially captioned or non-captioned video.
- ESM has educational value to be used in EFL classroom and improves overall listening comprehension.
- Groups with English captions scored higher than groups with Japanese captions in understanding English context-bound expression.
- ESM can be used successfully for improving learner’s listening comprehension, rapid reading and vocabulary development.

Borras and Lafayette (cited in Chapelle 2003) investigated the effect of L2 subtitles on comprehension and reading skills. They compared the performance of learners who had used video with and without subtitles. The results clearly favoured the subtitle option and they conclude that ‘when learning from “authentic video” in a multimedia environment, having the opportunity to see and control subtitles, as opposed to not having that opportunity, results in both better comprehension and subsequent better use of the foreign language’ (Chapelle 2003, p. 82).

Digital television adds a new dimension to learning from the TV by multiplying available channels (Moores 1996; Meinhof 1998). However, this is an increase in the quantity of available material rather than a change in the type of affordance provided by the medium. It is essentially more of the same. Digital iTV on the other hand offers genuinely new ways of using the television set. Interactivity adds new facilities for information...
retrieval and communications (Gawlinkski 2003). With interactivity viewers could:

• Select from alternative audio and video streams
• Make their own choice among subtitling or captioning options
• View supplementary information on screen – to access before, during or after a broadcast
• Use communication tools such as chat and email

The functionality provided by iTV is similar to that provided by the Internet, but it is displayed on the familiar TV screen. Despite the fact that current levels of interactivity are relatively limited, constrained by the components of the iTV set-up, that is, the set-top box and its software, the on-screen display and the remote control, the potential is clearly vast.

Learners’ requirements

To provide requirements for a system to support adults learning a second language, we gathered requirements from multiple sources: learners’ study, language learning theories and affordances of technologies, in this case iTV and mobile phones. To study learners we conducted focus groups to investigate the approaches that independent adult language learners have adopted towards their language learning and their attitudes towards a range of technologies including iTV and mobile phones (Fallahkhair et al. 2004a). The result of the focus group study and an overview of language learning theories were integrated into a discussion of the learning affordances of iTV and mobile phone technologies and shaped a framework for our design (Pemberton et al. 2004). This framework suggests adults self-directed learners can learn from an authentic materials broadcast on TV by receiving comprehensible input, constructing a personal learning space, communicating with other and engaging in performing enjoyable activities. On the basis of this framework a number of scenarios were developed (Fallahkhair 2004; Fallahkhair et al. 2004b) that were subsequently translated into a list of general requirements provided as follows:

• Support informal rather than formal learning
• Support learning in context
• Support learning while immersing into the environment
• Support learning from engaging and authentic materials
• Support learning on-the-move (anytime and anywhere basis)
• Support learners’ understanding by scaffolding
• Support learners in creating and managing their own personal knowledge
• Provide support for just-in-time learning
• Support learning in an unobtrusive fashion (by not introducing a new device or imposing educational materials on fellow viewers)

Description of TAMALLE prototype

The prototype of a cross-platform language learning support system via iTV and mobile phone (TAMALLE) was designed based on the requirements outlined in the section ‘Learners’ requirements’. The aim of the system is to support advanced learners of English as a second language in their television viewing, as just one element in their language learning activities. As the focus of the learners will be on media consumption rather than on conscious language learning, this support is designed to be as discreet and non-intrusive as possible. The system provides support, in the form of captions and other on-screen displays, for comprehension of specific language (or sometimes cultural) items for viewers as they watch English language programmes. These items can be incorporated by learners into their personal ‘learning sphere’, a private data storage area, which is accessible both via the TV and on their mobile phone. The mobile phone can further support learners’ understanding of the programme by enabling them to access the summary of programme as well as difficult language and cultural items that may appear in a programme. These language items can be accessed prior to, during and after the show. Viewers are also able to add, search for and remove items from/into their personal spheres. Even without television, the mobile service is useful for learning the new recommended language items and as a tool for managing personal knowledge.

Interaction design issues

Our design of the prototype interface had five aims:

1 to use the specialized device most suitable for the learning task in question;
to use the appropriate physical characteristics and learning affordances of each device both alone and in combination;

to support individuals as well as group of learners who may or may not be interested in learning;

to allocate learning content to a device that will be most suitable for providing a particular mode of presentation;

to provide consistency in terms of look (navigations, icons, words) and feel (learning tasks, activities and contents) across dual devices in order to ease the learnability of the overall system.

Interactive television was combined with mobile phones rather than other portable devices, such as laptops or PDA. Viewers are already using mobile devices to interact with iTV applications, for example SMS voting, playing along with a quiz show. Mobile phones could play the role of a companion device that has some specialized features (Cereijo Roibas & Sala 2005), which may offer more personalized learning materials for people who are sharing the television.

Technically both iTV and the mobile phone are capable of displaying and manipulating learning materials, which in this case are television programmes and accompanying textual annotations or other information. However, each device is different in terms of their strengths. It becomes clear that we need to study the capability of each device for supporting a learning task. For example, television is more appropriate for delivering picture, videos and audio materials, especially in combination. Mobile phones are suitable for displaying text and some graphics (although this may change with future models). Thus in our dual device scenario, iTV is preferred for taking care of presentation of videos, photos, spoken and textual materials where the mobile phones augment that with more textual information and annotations.

There are other issues concerning the physical characteristics and limitations of each device, such as screen size, resolution and memory capabilities, which constrain the user interactions possible. iTV users are limited to a menu-style interface with navigation and action carried out via the remote control or in some cases with an infrared keyboard. The remote control offers interaction via coloured keys (red, green, yellow and blue); numbered keys (0–9), arrow keys (up/down, right/left) and an OK action button.

The screen interface is similarly constrained. We followed guidelines developed by the BBC to decide about factors such as font style, size, contrast and positioning (BBC 2002; Gawinksi 2003).

Interaction styles with mobile phones are also limited in various ways: small screens (i.e. amount of data that can be displayed on one screen, as well as the size and placement of graphical, textual elements and navigations), soft key use (soft keys for selection and navigations are different in many phones) and memory constraints (Passani 2002). In designing TAMALLE, these constraints are tackled mainly by simplifying navigation, making navigation controls very salient and minimizing the navigation depth. This is in keeping with the ‘simple and shallow’ notion that requires minimizing the number of screens while keeping an appropriate amount of scrolling, balancing breadth and depth, therefore improving the usability and learnability of overall system (Kili 2002).

Cross-platform interface

In the following section we describe the main functionalities of TAMALLE that were prototyped and indicate how these are displayed and used on iTV and mobile phones interfaces. Four types of functionality are described: (i) scaffolding difficult language items, (ii) scaffolding overall understanding, (iii) just-in-time scaffolding, and (iv) managing personal learning sphere.

The idea of scaffolding can be traced back to Vygotsky’s (1978) notion of the Zone of Proximal Development, which refers to the support learners may need in order to enable them to accomplish a task in a self-reliant way. Generally, there are three distinct characteristics for scaffolding support:

- Modelling: model the support required, for example just-in-time annotations
- Support: provide the support required to enable learners to perform a task
- Fading: reduce the support to let a learner become self-reliant (Wood et al. 1976; Pahl 2002)

The scaffolding provided in TAMALLE prototype aims to support learners in understanding the TV programme by annotating difficult terms that are slightly above the
learner’s current language competence with their explanations, providing a general overview of the programme and tools to search and find unknown terms. Broadly, by keeping the learner’s interest while watching their chosen TV programme, the system provides tools and annotates materials that help in understanding the programme. These supports were modelled as a textual on-screen display, similar to subtitles, that accompanies television’s audiovisual materials. Although the design of the current version of the TAMALLE prototype does not explicitly support fading over time, it allows learners to make their own choice whether or not to use the supports provided. For example, the learner can decide not to use any scaffolding supports at all and watch the TV programme in its normal mode, or just to use just-in-time scaffolding supports or only to review recommended words prior to programme show time, for example via the mobile phone. In this way the learner will be able to fade scaffolding themselves as desired rather than it being reduced and imposed on them by our system.

The TAMALLE cross-platform interface is depicted in Fig 1. The application on the iTV side is activated by using the conventional ‘call to action’, that is, pressing the red button on the remote control, while watching a programme. From this point the viewer sees the news streamed into the TAMALLE application. Log-in is offered but not obligatory for non-personalized services. The broadcast programme appears reduced on the right side of the screen with interactivity on the left. For mobile phone use, learners are required to use a WAP-enabled mobile phone to connect to the TAMALLE mobile application.

The following is a brief overview of the system’s functionality.

**Just-in-time comprehension support**
The ‘Words in Action’ function provides textual annotation similar to subtitles on the television screen. The individual items may explicate a word (e.g. Tory = Conservative) or identify a scene or individual (10 Downing Street – the Prime Minister’s residence). The design locates the call-to-action dialogue on the iTV side rather than the mobile phone as this just-in-time support will only be beneficial during the programme show time and not before or after. However, if the learner prefers not to display annotations on the TV screen, perhaps to avoid inconvenience to others or embarrassment to himself, the ‘Words in Action’ content can be delivered to their mobile phone in synchrony with the programme.

**Recommended language items**
Difficult or unusual language items from the dialogue or commentary will also be transcribed for TAMALLE viewers in a static list. Viewers who are logged-in may select ‘Recommended Words’ to see a list of language items with explanation, which can also be added to their personal learning sphere. The service is also accessible via mobile phone (Fig 2).

**Supporting overall understanding**
The viewer’s overall understanding may be improved by having access to a summary of programme content. This will differ according to genre, with the news being summarized as headlines, a drama as a short
Managing personal learning sphere
The system enables learners to manage their personal ‘learning sphere’ via both iTV and mobile interfaces. The recommended words can be added to a personal vocabulary list for later practice. Learners can view all their saved language items from the main menu. They can also search for specific language items and remove those no longer wanted.

Cross-platform architecture
We have investigated two possible end-to-end solutions based on a multi-tier client/server architecture consisting of the broadcast-end tier, the back-end tier and front-end tier for developing the language learning service.

One solution is to develop a learning management system that can be located in the broadcast-end or back-end tier. This learning management system provides content to both set-top box and mobile devices and also holds learning content or learning objects in a database on the back-end tier (MySQL). In the front-end tier we have the set-top box and WAP-enabled mobile devices. Two-way communications can be established between set-top box and back-end tier through telephone modem, ADSL or broadband cable, while mobile phone devices communicate with the back-end tier through the WAP protocol. For interactive SMS messaging, we can use SMS gateway providers, the one that we are using in UK is SMS2MAIL (AllisBlue UK, London). This architecture is illustrated in Fig 3 and for TAMALLE development we used this architecture.

An alternative solution is to use Digital Video Broadcasting (DVB), Java enterprise development solution and Bluetooth® (Fallahkhair 2004). The language learning content and mainstream television programme can be encoded and multiplexed before being broadcast via the DVB stream. The learning content will be retrieved by a client-based Java application located in an MHP-based set-top box. This Java application provides the API required for content retrieval and presentation to the TV and mobile devices. Java 2 Platform, Micro Edition (J2ME) allows the set-top boxes and mobile devices to communicate wirelessly through Bluetooth® technology.

Discussion
In this section we explain some of the reasoning behind the design decisions. Simplicity and consistency were our ultimate criteria in designing TAMALLE. Simplicity is imposed by the constraints of the two devices, while consistency, both internal and external, will make for ease of use and learnability. To this end, the mobile phone version of the system can follow the conventions of the phone on which it is viewed.

This design solution is not the only one possible: another team could start with similar requirements and

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1 Multi-media Home Platform (MHP) is an European standard for the provision of a common deployment platform for delivering interactive content using Java.
end up with quite a different set of choices for functionality and interaction design. The chosen design was very much influenced by the research of Al-Seghayer (2001) who demonstrates significant improvements in language comprehension and incidental learning where a combination of media – audio, annotated text and video – were used.

For navigation and function activation, the iTV system has been designed to make user interactions as simple as possible using appropriate coloured and numbered keys of the remote control. Each menu item also has a numerical label allocated to it, giving an alternative selection mechanism. The navigation throughout the system is also consistent using coloured controls at the bottom of each page: Home (red), Back (yellow), Exit (blue). From the mobile phone interface the learners can move up and down the list of menu options using the direction keys and use the right and left soft key to choose a required option. The back button in mobile interface is consistent throughout the pages and always takes the learner to the previous page.

Media choice may also be worth commenting on. The justification for providing text annotations for just-in-time support was research by Koskinen et al. (1996), showing that combined video and textual annotation of spoken language in the form of subtitle or closed caption could aid learning vocabulary, improving listening, comprehension and reading skills (Neuman & Koskinen 1992; Koskinen et al. 1996).

The decision of whether to display video on the mobile phone, on the other hand, was based on our understanding of the affordances of the device. Despite the fact that, with the advent of the DVB-H standard, television can also be viewed on mobile phone screens, the physical limitations make this a much less attractive option for providing all the TAMALLE functionalities required for language learning. Television clearly affords watching more than the mobile phone. People already have a very well-established relationship with their television set, which we have chosen not to disrupt. Television is the device of choice for viewing broadcast video, while the mobile phone, on the other hand plays the role of a companion device that is also functional as a stand-alone to support learning on-the-move.

Evaluation

An evaluation of the prototype was carried out using a combination of observations, interview, questionnaire and card sorting. Data were gathered in different dimensions to test the usability of the software itself, the usefulness of the features provided, the desirability of system use and overall acceptance. The main aim was to explore how useful and desirable an application, such as
TAMALLE would be and how further improvements can be made in the future.

Methods

Evaluation sessions were held at the Brighton University’s iTV laboratory. The laboratory consists of a room, 4 m \( \times \) 3 m, fitted out as a domestic lounge. It contains two- and three-seat sofas, a coffee table and the television set. A two-way mirror is set in a side wall to enable observation of a user’s behaviour and interactions for evaluations. The users can be also recorded by close-circuit television cameras without being distracted. The user’s interaction with the system was simulated on iTV interface. The evaluator sitting outside the laboratory in front of the two-way mirror observes the user’s interactions made through remote control and imitates them using a mouse and keyboard. No simulations were involved for evaluating TAMALLE on mobile phone. The TAMALLE prototype was executed on a Motorola V600 phone and used for the evaluation session.

Three different genres were considered: News, a soap opera and a magazine programme about house hunting. Language learning materials (e.g. programme summaries and difficult words) to support learners watching were developed for the evaluation study.

Participants carried out a set of tasks using the TAMALLE system both on iTV and mobile phone interfaces. This took about 1 h 30 min and was followed by a further hour to fill out the usability questionnaire, give comments on the usefulness of TAMALLE features, carrying out the desirability evaluation and answering questions on overall acceptability.

For the usability evaluations we adapted the ISO Metrics questionnaire (Gediga et al. 2000). Six categories out of seven of ISO Metrics were selected: suitability for learning, self-descriptiveness, controllability, conformity with user expectations, error tolerance and learnability. For usefulness of its features we used feature rating methods. This part of the questionnaire aimed to ask how useful users found TAMALLE features and what features were liked and disliked. The participants were required to rate 21 features of the TAMALLE prototype (e.g. the provision of programme summary on iTV, the provision of recommended words on mobile) on a scale from 1 to 5 (1 = useless and 5 = useful). They identified three or more features that they liked/disliked the most with their comments.

To measure desirability we used the product reaction cards described by Benedek & Miner (2002). This method provides an effective way for evaluating those aspects of user’s experiences that are more intangible and difficult to measure in the laboratory setting. A total of 118 words including 40% negative/neutral and 60% positive statements were presented to users. The participants were required to pick those that best described the software. They then narrowed down their selection down to five cards that best express their opinion and to write down their detailed comments for these five cards.

The final phase of the evaluation sessions aimed to gauge the overall acceptability of the system. We asked users about overall attitudes to the software, its perceived strengths and weaknesses and the likelihood of them using it if it were to become commercially available.

Participants

Our study included 14 paid volunteers of varied age and nationalities. They composed of eight women and six men. Ten were 21–29 years old and four 30–39 years old. Participants were recruited among the staff, postgraduate and doctoral students of University of Brighton, who speaks English as a second language. Participants had reached a high level of English language competence from advanced to proficiency level. This was also mentioned in the call for help message as a prerequisite for participation. Eleven different nationalities were included: Brazilian (3), Hong Kong (1), Bahrainian (1), Korean (1), Egyptian (1), Iranian (2), Mexican (1), German (1), Romanian (1), Burundese (1) and Dutch (1).

All participants indicated that they were frequent users of computers. They all own and use mobile phone on a regular basis mainly as a communication tool and for texting, but less than half of them \((n = 6)\) mentioned using it for other purposes such as: email; music and movie download; dictionary; Internet browsing; games; weather forecast; ring tones and booking tickets. Twelve mentioned that they have used television for language learning before. The use of second language subtitles were also praised by 10 people who explicitly indicated that the use of subtitled TV (e.g. watching television show and movie with subtitles either through a broadcast programme or on a digital video disc [DVD]) had helped in mastering their listening and
comprehension skills in the past. However, only two participants had experience using the iTV application and services.

Results

Usability

TAMALLE scored an overall 3.9 indicating positive attitudes and statements towards TAMALLE cross-platform interfaces. Suitability for learning (3.9), self-descriptiveness (4.1), controllability (4), conformity with user expectation (3.8), error tolerance (3.6) and learnability (4.4).

Usefulness of TAMALLE’s features

Being able to learn via two devices was mentioned as a useful feature. All features scored on average more than 3.5 which shows the positive statements for their usefulness for learning. Four features that scored the highest on average (4.6) are: The usefulness of difficult language item provided, the provision of recommended words on mobile, accessing My TAMALLE via mobile phone and mobile dictionary. The most liked/disliked features that were selected by more than five people out of 14 were listed in Table 1.

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<tr>
<th>Liked features</th>
<th>Disliked features</th>
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<tr>
<td>The provision of recommended words on both mobile and iTV</td>
<td>The frequency of subtitled words (Words in Action)</td>
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<tr>
<td>The provision of programme summary on both mobile phone and iTV</td>
<td>The readability of annotated words</td>
</tr>
<tr>
<td>Annotations of difficult words with explanation similar to subtitles</td>
<td></td>
</tr>
<tr>
<td>while watching the programme (Words in Action) function</td>
<td></td>
</tr>
<tr>
<td>Adding/retrieving words from personal vocabulary sphere (My TAMALLE)</td>
<td></td>
</tr>
<tr>
<td>Mobile phone Dictionary</td>
<td></td>
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</tbody>
</table>

iTV, interactive television; TAMALLE, television and mobile phone assisted language learning environment.

Generally, participants mentioned difficulty in reading text from the television screen. Participants who gave readability as a problem suggested the reason might be related to their habit of watching TV with a bigger television screen than the one we used for evaluation sessions (24 inch).

Desirability

The negative/neutral cards most mentioned were: ‘busy’, ‘confusing’ and ‘slow’. Participants, however, found the TAMALLE interfaces very easy to use and learn. This confirmed results of the usability questionnaire. The audiovisual and textual materials appearing together on one screen made the interface look a bit busy. This factor might distract from normal television viewing.

The positive cards that were selected by more than half of our participants were: ‘Useful’, ‘Helpful’, ‘Motivating’, ‘Easy to use’, ‘Personal’, ‘Consistent’, ‘Engaging’ and ‘Familiar’. The result suggests that our participants have chosen 93% positives and 7% negatives out of the total number of choices they had made from the first and second rounds.

Overall acceptance

Despite the slowness and busyness of the interface on iTV, most participants (9 out of 14) said they would definitely use it. All participants mentioned they liked the concept of TAMALLE and would use it not only for language learning purposes but also for learning new information and cultural knowledge:

TAMALLE should not be seen as a pure language learning system, but more as a situated information base (relevant information to the TV you watch and everyday situations) or in other words everyday and entertainment dictionary.

The greatest advantage of TAMALLE was thought to be the ability to:

- Provide immediate access to dictionary and to words which are not in a classic dictionary.
- Learn new language items, such as vocabulary, expressions and slang:

It can be very helpful in the areas that most standard learning tools don’t, which is idioms and expressions.

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• Learn while doing ordinary and enjoyable activities:

It is entertaining rather than other tools like books and CD-ROMs that are not in our ordinary life as TV and mobile.

It is helpful, reliable, useful and easy to use and you can use it without having to switch from your favourite programme. You learn while watching TV, it is fun and useful at the same time.

• Learn on-the-move, ‘you can learn wherever you are’.

The greatest disadvantage of TAMALLE was thought to be the:

• Distractions from watching TV:

It can become obtrusive or in the way of just watching TV. On screen data can add up to too much information at the same time, distracting from the main focus.

Makes TV watching a learning experience, something you don’t always want.

• Difficulties to read the text on screen while viewing:

Lack of visibility, small font size.
I would like to have text bigger on screen.

• Costs of using the services.

Conclusions and further work

The TAMALLE design responds to the requirements we derived from multiple sources. The system enables learning from engaging, up-to-date and authentic materials that are of intrinsic interest to language learners. Learning in context is made possible, with rich multimedia content providing a comprehensible setting for the new language. Learning on-the-move is supported, while the leisure use of television is respected. Learners can also choose to take advantage of one device without the other. The scaffolding learning opportunities can aid in acquiring lexicon items and to improve learner’s comprehension of programmes. The textual annotations can facilitate just-in-time support for learning cultural specific knowledge and difficult language items. Finally, TAMALLE supports learners in creating and managing their own personal language knowledge accessible on an anytime and anywhere basis.

The TAMALLE evaluations gathered a rich range of data, evaluating the usability, the perceived efficacy and the desirability of the system. Participants perceived TAMALLE as a ‘Useful’, ‘Helpful’, ‘Motivating’, ‘Easy to use’, ‘Personal’, ‘Consistent’, ‘Engaging’ and ‘Familiar’ tool for language learning. The usability evaluation revealed an overall score of 3.9 indicating positive attitudes and statements towards TAMALLE’s cross-platform interfaces. Although users found the iTV interface rather busy and distracting, overall they found TAMALLE interfaces very easy to use and learn. They liked the concept of TAMALLE and mentioned that they would use it not only for language learning, but also for learning contextual and cultural knowledge. TAMALLE was also realized as an engaging and attractive tool for learning new vocabulary and expressions. The results can now be integrated into the next version of the system. It should be pointed out, though, that as a learning support system, its effectiveness can only be evaluated when it is deployed over an extended period in a realistic setting.

However, the design of TAMALLE as a cross-platform learning service raises a number of questions to be addressed in further research. A first question regards the source and nature of the support material. Ideally we would have liked to find guidance in the language teaching literature on selecting individual words or phrases for attention. However, little practical guidance is available to help us make a reasoned choice. Without such rules or guidelines, automating the functionality of TAMALLE, which would be necessary if it is to be widely used and sustainable, will not be possible. We have conducted the experiments with language learners to try to derive guidelines in this area (Fallahkhair & Pemberton 2007).

A second set of issue is concerned with the development of algorithms for selection and segmentation of learning materials from the broadcast television mainly by utilizing the result of our experiments. At the moment we are considering the use of closed captioned text to implement automated rules for the provision of these learning materials tailored in accordance to an individual learner’s language competence and preferences.
These issues will be addressed in our future version of the TAMALLE system.

References


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