Multi-Purpose Mobile Artefacts

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Abstract

Paper-based artefacts (e.g., forms, manuals, questionnaires) are used ubiquitously and pervasively to support a wide set of activities. Education and Health Care are major examples of such endeavour. However, given the passiveness of the medium itself, several problems (e.g., communication, adjustment, lack of interactivity) are usually encountered within these activities which hinder human efficiency or prevent users from achieving desired goals. This paper presents a framework that provides common users with tools to create interactive and adjustable digital artefacts for mobile devices. The artefacts can be adjusted to the users' needs, introducing different configurations regarding their look, interaction and behaviour, providing support to various purposes by coping with and enhancing different procedures. The framework has been validated through two case studies by providing support to mobile learning, and within psychotherapy, by offering means to achieve ubiquitous cognitive behavioural therapy.

1. Introduction

Mobile devices possess outstanding capabilities that set them apart from fixed technologies. They present excellent characteristics (e.g., size, autonomy, portability, multimedia capabilities, short usage learning periods, and low-intrusiveness) and adequateness to a wide variety of ubiquitous activities that can benefit from computational support. This support can be, among other alternatives, easily offered by replacing the traditionally used paper artefacts with a technological or digital medium [13].

In general, paper-based procedures lack multiple communication modalities, customization and configuration possibilities also introducing the usual archiving and search difficulties. Moreover, given their passiveness, paper-based artefacts are unable to (cor)respond to users' activities while interaction is taking place which might compromise their use in certain critical scenarios.

Mobile devices in particular can greatly enhance the underlying processes without changing paper-based procedures since they can be easily carried along with, still offering some similar interaction possibilities (e.g., touch-screen, cursive writing). Accordingly, concepts such as m-health or m-learning are currently gaining momentum and offering users ways to achieve specific tasks ubiquitously [5],[11].

However, current existing applications that focus this type of activities are generally pre-defined and focus particular domains. Most importantly, most are either too generic, and fail to grasp important user details, or too specific to certain subjects offering low-flexibility levels. On the contrary, in many of these domains, there is the constant need to update, re-use and improve existing artefacts on a daily basis. Generally, power users (e.g., therapists,

teachers) are not given the ability to quickly and easily modify and create their digital items and artefacts according to specific requirements.

These problems, together with a couple of on-going projects, that focused psychotherapy [15] and education [14], were the base motivation for the design of an m-artefact (m stands for mobile) development framework. The framework offers end-users the possibility of creating interactive artefacts and adjusting their content, interaction and presentation to their needs, including ubiquity and mobility requirements. Moreover, the system offers means to exchange and transfer existing artefacts to other users (e.g., students, patients) supporting cooperation and team work. Given the digital support, the framework also allows users to include behaviour in the resulting artefacts. This permits the creation of proactive tools that facilitate users' tasks and daily activities, reacting to usage behaviour, time triggers and interaction patterns.

This paper presents the mobile-artefact developing tool and the contribution that it has provided to the creation of effective tools that support multi-disciplinary activities. It focuses the specification of the artefacts' behaviour capabilities and explains how end-users, without programming or design knowledge, were able to map their needs into psychotherapy and educational tools. We start by addressing the current state-of-the-art within the aforementioned domains, stressing the features and problems that characterize most of the existing tools. Afterwards, the framework's architecture, components and features are detailed, also explaining the necessary steps to create a digital mobile artefact. The following sections present the case studies and the several steps that were taken to validate the framework and the resulting artefacts. Finally, results are discussed and future work is drawn.

2. Related work

Mobile computer applications directed to psychotherapy have been gaining some momentum in recent years. As in many other areas on the health care domain, they often focus on data gathering or visualization, analysis and especially organizational tasks [8]. Specific software, directed to the psychiatric and psychological use, allows patients to follow particular methods of therapy and even diagnosis [10]. Excluding patient solutions that, relying on expedite approaches of diagnosis, have revealed strong human rejection [7], studies have demonstrated the effectiveness of the computer role in the process of anxiety and depression therapy [12].

However, most of these systems provide either isolated therapist solutions or isolated patient solutions with no therapist control. Moreover, they only cover partial steps of the therapy process and do not allow the customization of the patients' tasks or artefacts. The majority is rather simple and allows simple measurements of the severity of pathologies, indicates drug dosage or provides therapists with reference information about diseases or drugs [9]. On the patients' side, some self-control or relaxation procedures are available on handheld devices [11]. Still, they are generic and offer no adjustment options that suit patients' needs and problems or even the therapy stage.

Within education, mobile devices are also generating some buzz and conquering the e-learning domain [17]. For instance, experiences in schools show that, when PDAs are used by children, besides lightening up their enthusiasm, they allow them to play games, read e-books, communicate and collaborate with each other in safety [3]. Since PDAs are lightweight and generally peripheral device free, they are particularly suited

to be used by children [4]. Their use in higher education has been tested as well. A group of computer science majors used PDAs as an adjunct to their student lives [1]. Results proved that most of the students frequently used their PDAs for lesson preparation, information sharing and even programming [1].

However, despite the abovementioned cases, their application on educational contexts is far from what it could be. Among others, the main reason for this low use, by teachers and students, is the limited number of relevant educational software for handheld devices [5]. The existing software is mostly non-collaborative, which contrasts with researches that show that the learning process is more successful where there is strong collaboration [2]. Their use is generally limited to the assessment and evaluation of students. Nevertheless, results from previous studies [6] show that PDA-based artefacts used by students, provide efficacy and efficiency levels that are identical or superior to paper-based ones. Moreover, advantages such as real-time scoring, for students, or less time spent on grading, for teachers, also promote the use of PDAs within schools and universities. However, some relevant issues regarding the variety of items and artefact customization, the chosen subjects and courses or even the information exchange between users still retract from a more common use of such devices within or outside classes.

Overall, users within these domains (e.g., therapists-patients, teachers-students), given their pervasive activities, share the need to carry artefacts with them, the need to extend their presence to ubiquitous locations and adjust their usage to specific requirements. Contrastingly, none of the existing applications offers ways to introduce behaviour within the artefacts, easily programming them to react to students' behaviour or usage problems, extending teachers' or therapists' presence ubiquitously. Furthermore, the possibility of reviewing such behaviour and analyzing the users' activities through online or deferred tools is never available retracting from possible improvements and innovations both on the applications and on the teaching and therapy processes).

3. Artefact framework

The main component of the framework is a wizard-based user interface which allows users to easily compose interactive and proactive artefacts that suit their or other users' needs [16]. These artefacts are then exported to a runtime environment which recreates it according to the used device (e.g., PDA, cellphone, TabletPC). This exchange is supported through a synchronization tool that facilitates dissemination and data transfer between users and devices. The last component of the framework is a log player which re-enacts users' activities while using their artefacts, providing a powerful analysis tool. All the components are available for desktop/Tablet PCs and PDAs (Pocket/PalmOS). The following subsections provide a detailed description of each of the framework's components.

3.1. The artefact wizard - ScWiz

The artefact wizard (Figure 1) is the application that allows users to arrange artefacts, customizing their content and presentation, their interaction and behaviour. Overall, the process of creating artefacts/applications is driven by a simple to use interface that comprises three steps: (1) creating items by selecting their content and respective presentation (e.g.,

typing a question's text for a questionnaire, inserting a picture for a book); (2) customizing the items' interactions components and modalities (a set of standard types is always available) and; (3) organizing the sequence between items. This process is detailed in one of the following subsections.

A special remark goes to the enforced usability guidelines (e.g., type and amount of content, location of buttons, adjustment to the device's screen) that are included in each artefact, preventing users from creating poor applications/artefacts regarding their interactivity and usability.

Content/Presentation: Regarding the content and presentation modalities, users are allowed to compose items that show content using various text formats (e.g., different sized fonts or highlighted words) and images. This provides a certain flexibility regarding the presentation of the m-artefact. For instance, users can create pictorial-based artefacts that contain items that are mostly composed by images; or include reading material through items that contain texts and information about a specific subject. These items can later be interconnected to each other according to a sequence or certain criteria, much alike pages within a book. This metaphor is used in order to demonstrate the framework's modular nature and easy creation process.

Interaction: Several interaction possibilities are also available, allowing users to configure the way in which artefacts will be used. Overall, there are four main interaction modalities available to select.

Multiple-choice/lists – allow users to choose one or more answers, sentences or images from an array of possible options. They can also be used on artefacts to display different types or information on a specific item (e.g., when used in conjunction with an image they can display captions of it's various areas).

Gauge/Track bar – are generally used to quantify information or manipulate the item's values.

Text/Open-ended questions – require users to write text on their own words, possibly following available hints, or to easily create and store structured annotations.

Point/Touch-screen – interaction is normally used with images where users can point on the screen and interact directly with images or drawings.

These four alternatives can be used in conjunction with each other composing fairly elaborated items and highly interactive artefacts such as navigational questionnaires, manuals, role play games, etc. Still, the simple construction process is straightforward and wizard-based, allowing users with no programming or design experience to build and adjust the mobile-artefacts, easily and quickly materializing their vision into a specific tool.

Multi-modalities: The wizard and the construction tool also support the use of multi-modal elements. These are presented separately since they have been added to the framework after the initial experiments. From these experiments, it was noticeable that there were occasions in which richer elements than text and images were necessary, particularly for specific domains (e.g., physiotherapy, education). Here, video and audio could greatly improve the artefacts and the underlying processes, providing users with tools that would facilitate both the using and the learning curve while using the artefacts. Accordingly, video and audio were included as presentation modes and can be used in similar ways to images or text.

Regarding interaction, multi-modal options include gesture recognition (e.g., particularly important for users that have difficulties using styluses and have low-accuracy towards small buttons) and speech recognition where some navigational commands were introduced (e.g., next, previous, start, stop) which extends the usage possibilities to visually impaired users. These can be used alternatively (e.g., the user will complete a questionnaire on a library – hence he/she cannot use sound and, instead, uses gestures to navigate) or redundantly in order to overcome limitations of both modalities and trying to improve accuracy and usability.

The inclusion of multi-modal elements also provides additional benefits. Using the audio or video entries, users can also record and store richer data. For instance, in a physiotherapy scenario, a specific artefact can also request the user to perform a set of stretching exercises and, using the device's camera, when available, to record a video clip of him/her performing those exercises. These can be later reviewed and analysed together with the therapist. Moreover, these elements can also be used to record information about the settings and locations in which users are currently using their artefacts, providing additional data for the analysis of the user´s behaviour or any other purpose depending on the domain in which the artefact was used (e.g., taking pictures or taping the sounds of animals that a student can attach to his/her annotations during a field trip to the zoo).
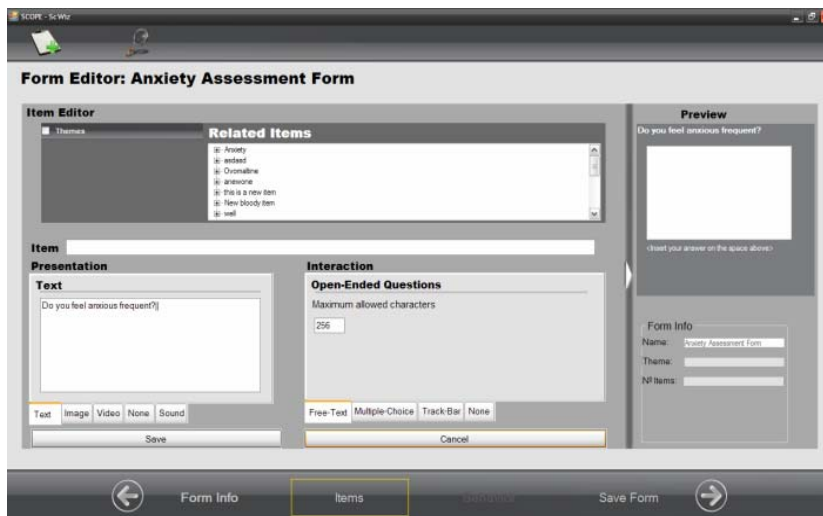

Figure 1. User Interface of the desktop artefact wizard.

3.1.1. Behaviour and proactive artefacts: In order to create proactive digital documents/artefacts that offer hints and aids to users, manuals that omit or show new information according to the user's performance while completing it, ScWiz also includes the customization of the artefacts' behaviour. The applications' behaviour can be configured through the definition of rules. Rules are composed by time, interaction and content triggers and a consequent behaviour. They can be attached to a specific item or to the entire artefact. On the former, depending on the interaction or usage within a specific item, certain behaviour can take place. On the latter, the interaction within various items of the artefact (e.g., sequence of navigation or time to browse through various items) defines the entire artefact's behaviour.
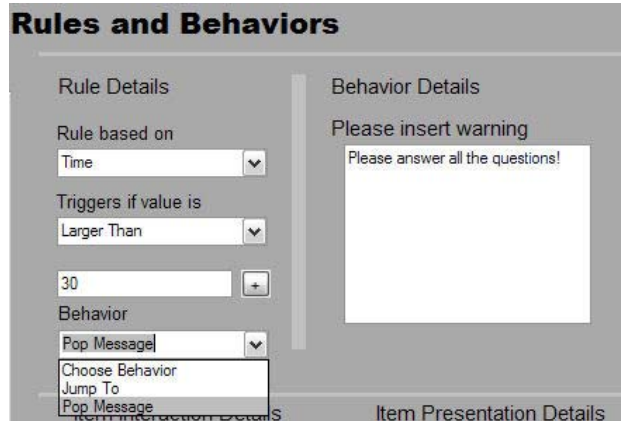
Figure 2. Rule adjustment interface.

Time-based triggers: can be configured to prompt warnings or change items according to the time the user is taking to review/complete it. They can also be used to define alarms that alert users to use or complete an artefact at a given time. Figure 2 shows how users can configure time triggers and their corresponding behaviour. On this example, the user is composing a rule that will trigger a warning if the user takes more than 30 seconds to respond to a particular item.

Interaction triggers: analyze the user's interaction with the device by counting clicks or detecting where on the screen the user has interacted.

Content based triggers: activate behaviour depending on the content of the items. For example, if the user chooses a correct value or a specific option from a list or a value within a defined threshold, certain behaviour can be triggered.

Behaviour: In concert with the rules that are defined for each item or artefact, two different types of behaviour can be selected. The first one prompts a message that is composed by the user while the second jumps from the current item to another item within the artefact (e.g.,first item, end of the artefact, drawing, previous item).

3.1.2. Examples of customized tools/applications: With these dimensions and corresponding functionalities, users can customize artefacts according to the users' context. Using different presentations; different interactions; different navigations and behaviours the artefacts can be modelled to whatever is needed according to the requirements of a specific content, user, situation or available equipment. Overall, the artefacts can be adapted to:

(1) Content – different types of media (e.g. images, text, video) can be easily inserted, composing content or fetching information from several sources and compiling it into specific artefacts. These can contain various subjects (e.g., pain therapy, depression assessment, geometry, English). Together with the possibility of adjusting the content with different interaction types (e.g. touching the device's screen and pointing at a picture; selecting an option from a list of choices or writing free text), our system allows users to create a varied set of tools for multiple disciplines and purposes.

(2) Location and time – using the same mechanisms mentioned above, users might compose artefacts according to the predicted location and time in which the tasks will be completed. For instance, if the user isn't restrained by time, the artefact may be composed by

open-ended questions. However, if the artefact must be completed while walking through a specific setting or similar context, lists and choice groups are better suited. The same applies when using text entry or audio entry elements.

(3) User requirements – different users (e.g., students/patients) have different requirements. Therefore, the system allows teachers or therapists to personalize the studying/therapeutic material, including help and warnings, rewarding sentences, etc, according to the user and to his/her behaviour while completing the task. Furthermore, the inclusion of different media types and content might also enhance the usage process for users with different ages (e.g. pictorial content for younger ages and textual or both for older students).

These capabilities allow end-users to configure their artefacts to specific situations (e.g., free-text interaction when user has time to write, multiple-choice with audio when user is walking); specific users (e.g., images for infants, text for adults, both for teenagers); critical scenarios (e.g., pop a warning when user needs to take his/her medicine).

3.1.3. Creating artefacts: In order to create artefacts, users can follow two different steps. The first one is an advanced mode which provides drag'n'drop mechanisms where users are able to easily compose artefacts by arranging different elements within screens/pages and by defining the sequence between these pages. Here, constraints can also be defined between different pages, using the triggers and rules, providing alternative navigational schemes even within the artefacts.

The second creation mode is, as previously mentioned, wizard based (figure 1). Here, users are guided throughout the process and the design is usually straightforward and supported from beginning to end. The following example details the step-by-step construction process of a physiotherapy form.

The user wants to create three items. The first item is composed by a sentence asking the user to register his/her thoughts and detailing the amount of pain and difficulties felt during the current day. The size of the font for the text is also adjusted at this stage. Once the text and its presentation are defined, the user is able to select a type of interaction. For this particular item, the most appropriate modality is a free-text entry, where the user is able to type his/her actual feelings and thoughts. Here, the therapist configures the text-entry element to limit user input to 300 words. Alternatively, taking advantage of the multi-modal possibilities, a recording element, composed by a record and a replay buttons, can be added to the item, replacing, if chosen by the user, the traditional text-entry. However, the therapist also creates a drop-list with several usual thoughts and sensations (e.g., depressing, very painful, exciting, no pain) that can aid the user while performing his/her activity. The second item is composed by a short video clip that demonstrates the stretching workout that the user must accomplish while at home. The video can be imported from a previously existing clip or it can be directly recorded by the corresponding option on the wizard (figure 3). In this example, the user records a short clip of a stretching exercise using a webcam and the corresponding ScWiz interface. Finally, one last item requests the user to suggest an hour in which the artefact will be shown again.
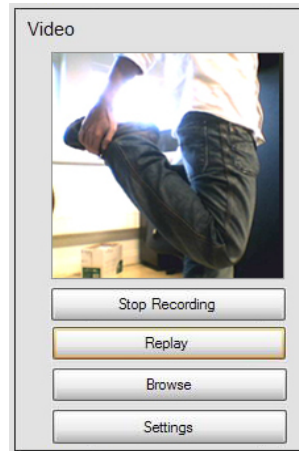
Figure 3. Video editing/recording screen.

Once all the items are defined, the user is able to configure the sequence between the elements. To achieve this, the user easily drags'n'drops every element on the desired position, rearranging the order and list in which they appear. Also, to promote re-usability, the same items can be organized in different sequences in order to create different artefacts or they can adjust to specific triggers even when being used. To do so, rules can be defined for transitions. For instance, in the example that is being described, if the end-user (patient) selects the "no pain" from the list, the following screen, with the item that shows the short video clip, can be passed and the user might jump directly to the final screen, where he/she suggests a new hour to complete the artefact again.

Finally, in order to aid users with more difficulties, or reward those that are improving, therapists/power users can include behaviour on the artefacts, as mentioned, through the use of rules. On the given example, instead of jumping to a new screen when the user selects "no pain" from the list, the therapist can define a warning to be popped up if a negative option is chosen. For instance, if the user selects "unbearable pain" from the list, a warning with an emergency phone number can be shown or a set of questions in order to assess the actual amount of pain that the patient felt can be shown.
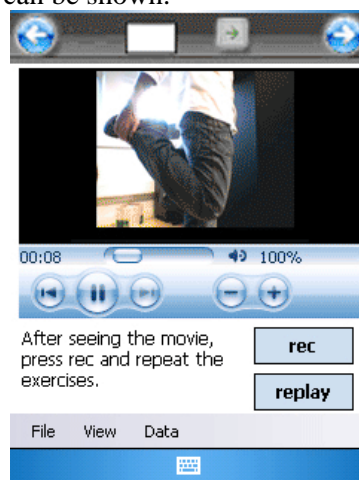
Figure 4. Artefact with a multi-modal element composed by video presentation and interaction/recording options.

3.2. Synchronizer

The toolset also offers means for users to transfer all the information and artefacts to and between devices as needed. It also includes real-time browsers that facilitate the visualization and selection of artefacts and usage logs, automatically detecting the connection type, the device or exporting possibilities (e.g., to device, to XML file).

The synchronizing tool provides mechanisms for data management between several devices simultaneously allowing users to disseminate artefacts to several devices simultaneously.

3.3. Running environment

The artefact running environment is a simple software module that is installed on a mobile device and is responsible for re-creating all the artefact/applications' descriptions, stored within XML files and built using the artefact editor. The environment is driven by a simple to use user interface which allows users to select which artefact to use as well as to review previously completed artefacts and results. The runtime environment application also includes a logging mechanism that, if switched on, gathers information about artefact usage for posterior analysis. Gathered data can be composed by the amount of clicks, location of the clicks, chosen values, typed characters, time to complete each question, etc. Currently, there are runtime environments for PocketPCs, PalmOS based PDAs and desktop computers.

3.4. Log player

All the information generated by the runtime environment and utilisation of every artefact can be analyzed on the logging module's counterpart. This counterpart is embodied by a player which re-enacts every action taken by the user while using the artefacts on the mobile device. The player analyses the logs and generates all the events stored on the log, creating a "movie" that pictures the user's interaction with the artefact. This provides detail on the user's navigation through items/questions, the number of times he/she presses each button, selects an option from a list, etc. Furthermore, as on the recording, the revision of the usage behaviour can be modelled according to several granularities, browsing through high-level interaction events (e.g. selecting an option from a list) or low-level events (e.g. every tap on the screen). Search mechanisms and index navigation are also included. Specific events such as selecting options from lists, navigational sequences, types of interaction, etc., can be filtered, retrieved and browsed.

The use of the log player can be directed to complex analysis activities as well. For instance, comparing two different logs simultaneously allows users to analyse the difference between the user's behaviour on the initial stages of using the framework/tools and his/her performance on later stages. When applied to particular domains, this feature provides very interesting data. For instance, within psychotherapy it allows therapists to understand the patient's evolution throughout therapy. Other possibilities are also relevant to particular domains or on a general sense. For example, by analyzing the logs generated while using an artefact while the user is seated and comparing it to the log generated while the user was interacting with the artefact while walking, provides information on the adequateness of the

artefact to several situations. Finally, this also supports the comparative analysis of logs from various users, which is particularly interesting when interaction and cooperation between users is frequent. Reviewing logs of two or more users simultaneously allows for the comparison of behaviours, performance and so on.

The log player is available on a desktop version where users can analyze and compare several logs at the same time and on a mobile stand-alone version.

4. Case studies

Throughout the development stage, several domains were experimented (e.g., prototyping, physiotherapy) and a wide set of artefacts was created using the framework (e.g., short interactive tutorials, organized diaries, multimedia exercise manuals, etc). However, to fully evaluate its potential, assess its usability and flexibility, the entire system was used on two real domains for real-life case studies. The first domain was psychotherapy and the second was education.

4.1. Psychotherapy

Cognitive-Behavioural Therapy for the treatment of depression, anxiety or associated disorders relies heavily on the completion of paper questionnaires and thought registries, by the patients, throughout their daily lives. Therapists provide patients with pre-existing forms and questionnaires that try to assess patient's disorders and conditions or activity planning tables and thought registries which aim at acting as therapy through self-help techniques. Accordingly, the introduction of a mobile-artefact developing framework was particularly suited to this scenario. Besides providing means for patients to complete an entire set of commonly used artefacts on their mobile device, the digital medium offers features that enhance the process. In particular, the ubiquitous nature of the entire therapy process greatly benefits of the immediate availability of the various artefacts on the mobile device, facilitating data gathering and an easier recollection of events that can be promptly annotated and registered as needed without the need to write on paper those events on posterior opportunities. Furthermore, the introduction of behaviour and pro-activeness without disregarding ubiquity was greatly needed in order to react to the patients' needs while away from therapy.

The artefact development framework has been used by psychotherapists and cognitive behavioural therapy researchers to create a wide set of existing therapeutic tools aiming to enhance the therapy process and patient improvement [15]. Several of the specific data gathering artefacts which are currently used (e.g., questionnaires, thought registering tables, pleasant activity records) have been emulated and adjusted to patients (Figure 5, left).

Moreover, new approaches were also experimented and new artefacts were created. Some examples include anxiety assessment forms, pain measurement questionnaires, and relaxation tutorials. For instance, Figure 4, on the right, depicts an innovating pain therapy artefact that was arranged by a therapist, using the framework. The artefact allows users to select the location of their pain through the image or the multiple-choice options [18]. A similar artefact was created where users could point on an image their dislikes about their body and quantify them by using a track-bar. On thought registration forms, using the various interaction features, therapists included quantifying components that allowed users to catalogue their thoughts and problems according to severity.

Using the log player to review how patients completed their questionnaires and registered their thoughts, therapists were able to identify problematic thoughts where patients felt more uncomfortable (e.g., thoughts that took more time to register or were frequently revisited) and those that required further intervention during therapy sessions. This feature was particularly appreciated by therapists.
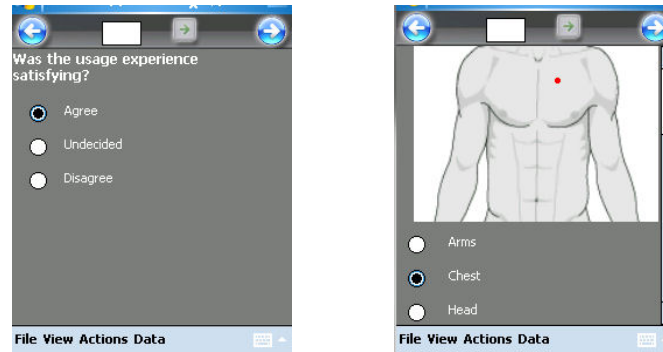
Figure 5. Cognitive Behavioural Therapy m-artefacts.

According to the involved therapists, the easiness of configuration and the ability to easily exchange both artefacts and results with patients was also very pleasing, allowing them to quickly re-arrange artefacts as therapy evolved. Furthermore, artefacts that were difficult to fill due to longer questions and that were demanding to complete in stressful situations (e.g., register/writing a stressful argument with a friend immediately after its occurrence) were configured to allow users to record their thoughts orally rather than writing. Besides facilitating the use of the artefact, this also provided richer data for therapists to work with. In this particular situation, therapists were able to assess the amount of stress and anxiety just by the tone of voice and speed with which the patient recorded the incident.

4.2. Education

The framework has also been used to create educational artefacts for students on a university setting, for a computer science course.

Here, the main goal was to provide students with evaluation tests that could be answered on personal mobile devices (e.g., PocketPCs) but also allowing them to carry, on the same device, educational and studying material. Teachers also wanted to assess students' difficulties while using the tests and to understand if those problems pertained to the selected configuration of the artefacts or to the subject and content itself. Similarly, they also wanted to understand which subjects and particular content was more interesting and more often read and reviewed by students.

ScWiz was provided to teachers in order to create the evaluation tests and content. Tests and short books with content pertaining the consequent test included audio and video clips as well as several questions with different presentation and interaction modes (Figure 6) and were distributed to a class through the synchronizer. This process was replicated at the university and at each student's home (e.g., tests sent to students through e-mail). All the results were gathered through the synchronizer or sent by mail and later reviewed by the teachers. The logging mechanisms allowed teachers to detect which questions took longer to respond, those that were revisited more frequently and those whose value was changed more

than once. These three dimensions in conjunction allowed teachers to isolate questions that probably posed more difficulties to students. Moreover, it also provided some detail on which type of interaction components and presentation modes were more suited for that specific scenario [14]. The same type of results was easily extrapolated to the content that was studied with more care. This analysis was then extended in order to correlate the amount of time that students spent reading about a specific content and their results on questions that were related to that matter.

On a qualitative analysis, students appreciated the fact of conveying within one device most of their annotations, exams and manuals provided by the teachers. Hints, the varied pictorial and multimedia content and the visual appeal were also very well received. For teachers the major contributions were the ability to configure artefacts according to various dimensions and the groundbreaking analysis that the log player provided for both class and homework.
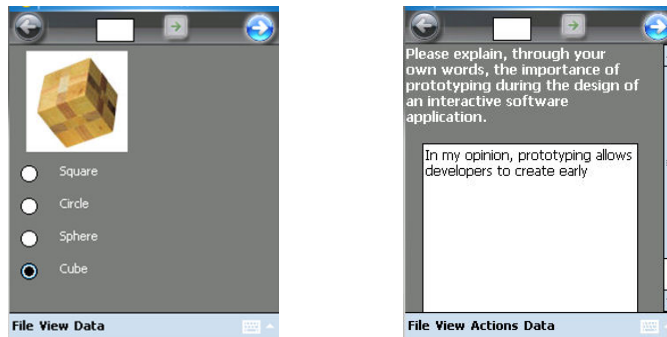
Figure 6. Mobile Learning m-Artefacts with different presentation and interaction options.

5. Results and discussion

The two case studies provided positive results regarding the functionalities and usability of the entire framework. The possibility of including rules and reactions within the artefacts allowed therapists to extend their presence outside of the therapy sessions, aiding patients whenever it was necessary. Patients also were able to complete their therapeutic artefacts more promptly, immediately after specific situations occurred and whenever alarms requested them to do so. Using the log player, therapists were also able to identify problematic issues and concentrate their efforts on the most relevant problems. Teachers were also able to isolate questions that posed more problems to their students thus focusing specific subjects or customizing their tests accordingly. For students, advantages emerged from the possibility of using several artefacts on the same device and even being able to carry on with their tasks (e.g., homework) wherever they were.

Overall, the framework's adequateness to these two domains suggested that new boundaries can be found and other activities can be enhanced or supported by using mobile devices with proactive and customizable e-artefacts. Creating simple artefacts that serve the purpose of prototyping for complex applications can also be a possibility for ScWiz. Complementing this use, the log player and analysis tools can also be used within usability evaluation research, detecting when and how users have difficulties using certain components or the device itself.

6. Future work

Given the positive results from the evaluation stage and the benefits found while using the framework on real-life scenarios, the main goal for the near future is to apply the framework on other fields and domains, namely other healthcare areas.

Secondly, a group version of the log player is being developed. Its main objective is to provide detailed insight of user interactions within a working group. The same mechanism used for the individual version will capture events for each user depicting their activities as well as their interaction with other users, showing with whom they exchanged information and what information was exchanged. An on-line, real time version, supporting the management of on-going sessions or classes, supported by large interaction displays and mobile devices is also being developed.

The extension of the multi-modal elements is also envisioned as a future development goal. Besides including the adjustment of the gesture recognition patterns and behaviours for specific artefacts, we plan to include the configuration of speech recognition features which will allow power-users to create their own commands.

Finally, the runtime environment is also being updated in order to support the adjustment and extension of the artefacts on mobile devices. This will support the creation and customization of artefacts to on-going activities and will broaden the scope of the tool allowing its use for probing and prototyping purposes.

7. Acknowledgements

8. References

[1] Alford, Kenneth L., Ruocco, A., 2001. Integrating Personal Digital Assistants (PDAs) in a Computer Science Curriculum. Frontiers in Education. Reno, October 2001.

[2] Inkpen, K. M., 1999. Designing handheld technologies for kids. Personal technologies, volume 3, 81-89.

[3] Mandrik, R. L., 2001. Supporting Children's Collaboration Across Handheld Computers. In CHI'01 extended abstracts on Human Factors in Computing Systems.

[4] Perry, David, 2003. Handheld computers (PDAs) in schools. British Educational Communications and Technology Agency (Becta). Coventry, UK.

[5] Savill-Smith, C., Kent, P., 2003. The use of palmtop computers for learning. Learning and Skills Development Agency. UK.

[6] Segall, N., Doolen, T. L., Porter, J. L., 2004. A usability comparison of PDA-based quizzes and paper-and-pencil quizzes. Computers & Education. Elsevier.

[7] A. K. Das. Computers in psychiatry: A review of past programs and an analysis of historical trends. Psychiatry Quarterly, 73(4), 2002.

[8] C. S. Garrard. Human-computer interactions: can computers improve the way doctors work? Schweitz Med Wochenschr, 130:1557–63, 2000.

[9] M. A. Grasso. Clinical applications of hand held. In Computing. Proc. Of the 17th IEEE Symposium on Computer Based Medical Systems, 2004.

[10] J. G. Proudfoot. Computer-based treatment for anxiety and depression: is it feasible? Is it effective? Neuroscience and Biobehavioral Reviews, 28:353–363, 2004.

[11] A. Przeworski and M. G. Newman. Palmtop computer-assisted group therapy for social phobia. Journal of Clinical Psychology, 60(2):179–188, 2004.

[12] J. H.Wright and A.Wright.Computer-assisted psychotherapy. Psychotherapy Practice Research, 6:315–319, 1997.

[13] Ljungblad, S., et al, 2004. Augmenting paper-based workpractices. In Ubicomp 2004 Adjunct Proceedings.

[14] Sá, M., Carriço, L. Detecting learning difficulties on ubiquitous scenarios. In Proc. of HCII'07, Beijing, China.

[15] Sá, M., Carriço, L., Antunes, P., Ubiquitous Psycotherapy. Pervasive Computing, vol. 6, nº 1, pp. 20-27 IEEE.

[16] Sá, M., et al. Multi-Purpose Proactive m-Artifacts. Proceedings of SAC'08, ACM Symposium on Applied Computing, Ubiquitous Computing Track, Fortaleza, Brazil, pp. 1629-1633. ACM Press, March 2008

[17] Pownell, D., Bailey G. D. The next small thing - handheld computing for educational leaders. Learning and Leading with Technology, vol.27, no.8, International Society for Technology and Education.

[18] Reis, J., Travado, L., Lucas, H., Carriço, L., Sá, M. Cognitive-behavioral Therapy with an Oncological Patient via Handheld Computing. Proceedings of 8th World Congress of Psycho-oncology, Venice, Italy, Psycho-Oncology (2006), Suppl. Meeting Abstract, pp. 905-906. Willey, October 2006