Wong, L.-H. et al. (Eds.) (2013). Proceedings of the 21st International Conference on Computers in Education. Indonesia: Asia-Pacific Society for Computers in Education

Mobilogue: Creating and Conducting Mobile Learning Scenarios in Informal Settings

Adam GIEMZA*, Nils MALZAHN & H. Ulrich HOPPE
[a]*University of Duisburg-Essen, Germany*
*giemza@collide.info

Abstract: Mobilogue is a tool to support educators and students in authoring and deploying learning support with location awareness and guidance to mobile devices. The application area of the framework covers informal learning settings like field trips, museum visits as well as formal classroom settings. The focus of the framework is on the simplicity and flexibility of the domain independent content authoring and content deployment. We present an authoring tool that uses a workflow-related, graph-based paradigm to model and author a path across different locations. Locations relate to physical places or artifacts through QR codes and provide supportive information. The guidance takes place by identifying the user's location by scanning the QR codes and visualizing the appropriate information on the smartphone. Finally we describe possible scenarios for such informal learning settings and report on an evaluation of one scenario authored by students for a museum.

Keywords: mobile learning; field trips; museum; authoring; quiz; simulation; informal learning settings

1. Introduction

Field trips are still a very popular alternative or addition at the same time to in-classroom learning (DeWitt & Storksdieck, 2008). Such out-of-school settings usually focus on informal learning environments like museums, zoos or other outdoor settings like cultural or historic heritage places. These places often do not serve for visitors only, but also provide classes, tours and other activities targeting schools. The added value for the students is the real experience of an exhibit, a historic place or technical equipment that is not available in the classroom and therefore cannot be learned by the students (Kisiel, 2005).

Mobile devices are very well suited for informal learning scenarios (Sharples, Taylor, & Vavoula, 2005). Due to the small size and the high portability, mobile devices can be used outside, e.g., in museums (Vavoula, Sharples, Rudman, Meek, & Lonsdale, 2009; Yiannoutsou, Papadimitriou, Komis, & Avouris, 2009) or other informal settings. The continuously evolving technology brings new generations of mobile devices year by year, each iteration making them more powerful and more feature rich. GPS sensors and high-resolution cameras increase the potential to utilize modern smartphones in outdoor activities, like location based games (Giemza, Verheyen, & Hoppe, 2012) or treasure hunt games (Botturi, Inversini, & Maria, 2009).

Many museums have already made use of the potential of the smartphone as a digital assistant or tour guide for the visitors and provide dedicated smartphone applications (e.g., the „Love Art" app of the National Gallery in London) through smartphone app markets, like the Apple App Store or Google Play. While these mobile guides support the visitor, they are usually very specific for the given location and do not necessarily provide adapted material for educational purpose. On the other hand many other locations for outdoor activities, e.g., historic heritage places, usually do not provide any kind of digital support for visitors.

Thus, we decided to develop a framework for the flexible development of location based guidance scenarios. Such a system should provide the opportunity to embed the creation of a location specific guide as a basis for informal learning activities by letting the students not only conduct a scenario prepared by third-parties (e.g. teachers, museums etc.), but prompting them to create a guide through a particular site or domain by themselves. This can foster the engagement of the students with the topic or domain of the place in question and therefore increase the learning effect and the identification of the learner with the task itself.

An important requirement for realizing such activities is a system that is on the one hand powerful and flexible enough for creating mobile guides, and on the other hand easy to understand and applicable for school teachers and students.

This paper presents a framework for authoring and running mobile scenarios with quizzes and location guidance for various application domains targeting simplicity and universal applicability. The environment called Mobilogue ("MOBIle LOcation GUidancE") provides an authoring interface that allows for creating guided trips based on locations, which contain information about the particular location, plus optionally a quiz and/or multimedia data, and a recommendation for a next location. The framework provides a mobile Android application for executing the scenarios in the field.

2. Mobilogue

Mobilogue is a flexible tool for creating and running mobile learning scenarios. It maps the concept of field trips onto guided tours across multiple (physical) locations supported by a mobile device. Its basic pedagogical underpinning is learning at stations (also known as learning circles). The learning takes place at stations, i.e. specific locations, by providing content related to the place or an object at that place and additional stimuli to foster interaction and curiosity by challenging the learner with a quiz. Locations can also be seen as stations of a tour in a certain order. Mobilogue guides the learner across the different locations of the tour, i.e., the learning scenario. Each location has a name and optionally GPS coordinates that can be used for a map-based navigation between locations in outdoor settings. The actual localization of the user for presenting the related information is done through a QR code available at the location. The content for a location is organized in separate "pages". Each "page" represents a single smartphone view. This approach allows creating multiple pages for one location and therefore presenting content on separate pages to avoid scrolling of long texts. These pages on the other hand may contain different types of content. In addition to plain text, they can contain images, quizzes and raw HTML content packages. The quiz element enables the scenario designer to include gaming aspects in the learning activity. It should require the learner to engage with the location and the context to succeed in the quiz. Mobilogue provides two basic types of quizzes: a question with a free text answer and a multiple-choice quiz with single-choice answers. The answer of a free text quiz will be checked against a set of correct strings provided by the author to avoid errors due to different phrasing. Each answer of a multiple-choice quiz can be linked to a specific score and an individual feedback telling the learners if their answer was correct. Additionally, an explanation is provided for further reflection. HTML content packages allow for embedding multimedia information like videos and audio files and even JavaScript based applications, e.g., for embedding simulations into a scenario. Additionally the page setup can be authored to vary the sequence of pages according to a quiz result. This feature can be used to create scavenger or treasure hunt scenarios.

This flexible concept can easily be mapped to real-world scenarios, e.g., guidance across areas or rooms in a museum or compounds in a zoo. However, it can also be mapped to non-spatial entities, e.g., like computer parts for supporting learners in assembling a PC by scanning tags and providing instructions (El-Bishouty, Ogata, & Yano, 2007). In Mobilogue a location is always associated with a QR code, i.e., each location is identified physically by a QR code that has to be scanned to retrieve the content. The code itself only encodes a unique id that is a reference to the location information. This allows presenting arbitrary content for any kind of object referenced by a QR code.

In summary, Mobilogue consist of three elements: the authoring environment to create mobile guidance scenarios, the repository for storage and exchange and the mobile application for running the authored scenarios. In the following we will elaborate on all three parts of the framework. The figures show a scenario created in a student project in cooperation with the espionage museum "TOP SECRET – Die geheime Welt der Spionage"[14]. The exhibition offers a glimpse into the past and present of espionage and provides information and exhibits from the Second World War and the former DDR for history classes as well as an Enigma machine or an interactive disk with the Caesar cipher to enrich computer science classes.

[14] TOP SECRECT http://www.spionage.de (last visited May 2013)

2.1 Authoring Environment

The main idea of Mobilogue is to empower teachers as well as students to create field trip scenarios without the need to learn a complex authoring tool or to care about the technological background. The basic concept of the authoring environment is related to the activity of consuming (multimedia) content in different locations in a certain (guided) order. The authoring tool allows to create such locations and to organize them in a certain sequence as the guided field trip for the learner through different locations.

The Mobilogue authoring tool has been developed as a Plug-in for the graph-based modeling environment FreeStyler (Gassner, 2003; Niels Pinkwart, 2005). FreeStyler plug-ins typically define a set of graph nodes (objects) and links, building the plug-in's domain language. Each language provides a "palette" of options to select from, which is displayed at the right hand side of the FreeStyler window (see Figure 1a). FreeStyler allows organizing the work on multiple workspace pages. Figure 1a shows FreeStyler with a Mobilogue scenario and location nodes on the left hand side and the creation of content pages on the right side (Figure 1b). The presented scenario is the "spy training" scenario for the TOP SECRET museum.

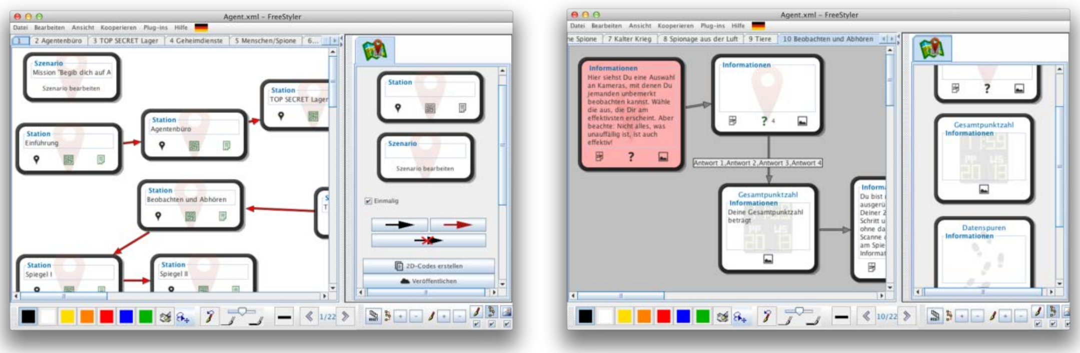

Figure 24. FreeStyler with Mobilogue Plug-in - (a) scenario editing mode and (b) page editing mode

The creation of a scenario can be seen as a workflow modeling process that utilizes the Mobilogue modeling language followed by filling the content into the appropriate elements. The modeling language provides five elements, i.e. graph nodes (Figure 2). The scenario node describes the scenario. The author can specify a name, a description, the author's name and a copyright license (e.g., Creative Commons) in a dialog available through the "Edit Scenario" button. Optionally, the author can provide a HTML template file for the content visualization inside the pages on the mobile phone and specify if quiz elements will have a score within the scenario. When activated, quiz scores are collected throughout the scenario and can be presented to the user within a score overview page using the score page node (Figure 2d).

The main building block of a Mobilogue scenario is the location node (second node in Figure 2a). This node identifies a learning station in the scenario. The name of the location can be specified using the text field in the center of the node. The buttons below (left to right) allow for setting the GPS position of the location using OpenStreetMap (Figure 3b), assigning a QR code (from a customizable and reusable QR code pool) and opening the related Freestyler workspace for the page configuration and content. Figure 1a shows the location editing mode on the first FreeStyler workspace. Figure 1b shows the mode for editing pages of a location that happens on additional workspaces that are linked to the according location nodes. This allows for a quick navigation from the location to the content editing mode and back.

The mobile application guides the user on the basis of the graph-based location configuration. This configuration supports two types of guidance represented by two edge types; one edge creates a strict order (i.e., only the connected locations will be accepted after scanning) and a second edge that creates a recommendation for the following location (i.e., the application will recommend this location as a following location to the user but will also accept any other location after scanning). This empowers authors to create strict routes as well as free and open routes where users have the choice.

Figure 25. Elements of Mobilogue's modeling language – (a) scenario node (b) location node (c) information node (d) score node (e) data traces node

The last three nodes in Figure 2 (c – e) form the graph in the content editing mode for pages. The main node to visualize content is the information node. Authors can provide texts (text field in the center of the node), images (right hand side button), quiz (centered button) and the aforementioned HTML packages (left hand side button) for the scenario. The text content will be rendered in the mobile application using the HTML template defined in the scenario node. This allows customizing the look of the information presentation pages and providing a custom design per scenario.

The quiz button opens the quiz-editing dialog (Figure 3a). A quiz consists of a question with an optional image, a variable number of questions and optionally images as answers. Furthermore, each answer can provide an explanation and a score. The explanation should give the learner a better understanding of the quiz result in contrast to simply returning "correct" or "wrong". This supports the learners' reflection on the previously given answer. Scores will be collected for the whole scenario – if activated in the scenario configuration – and presented to the learner on a score page represented by the score node (Figure 2d).

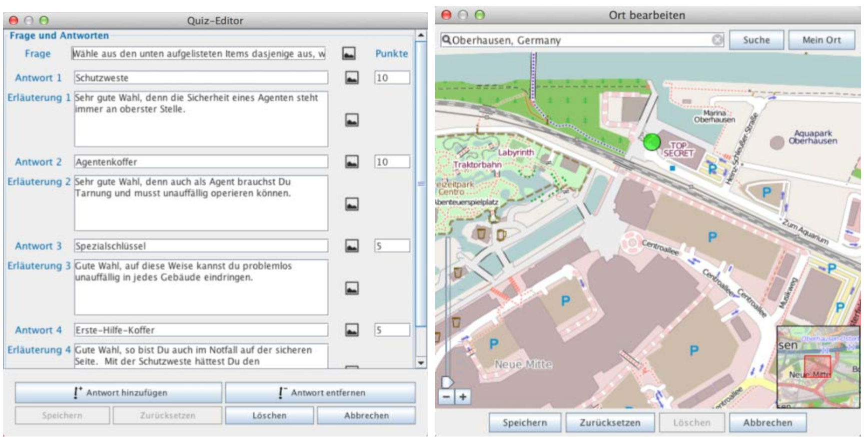

Figure 26. Mobilogue dialogues for (a) editing quizzes and (b) setting GPS coordinates of a location

The last node in Figure 2 (e) shows the data traces node. This node creates a page in the mobile application that presents the progress traces of the user in the scenario, i.e., the user sees the up to now visited stations with name and timestamp of the visit. This gives the user a kind of process awareness of his or her scenario run.

To determine the order of the pages of a single location, they are connected by edges (Figure 1b). Nodes containing quizzes can have multiple outgoing edges with conditions depending on the answer given in the quiz. This allows for an adaptive sequencing of the pages based on the user's answers to quizzes. This feature can be used especially in scavenger or treasure hunt scenarios to provide wrong information or a wrong way as a kind of penalty.

After having finished the scenario modeling process, the final step is the scenario export. This step includes two activities; the printing of the QR codes and the deployment of the scenario to a central repository. The QR codes are automatically generated by the system when clicking the "Create QR Codes" button in the palette. This will open a dialog where the author can specify the output format of the document, e.g., the size of the codes (100 x 100 pixel up to 500 x 500 pixel) or the printed information (location name, scenario name, GPS position, etc.). The tool creates a PDF document that can be printed to paper from which the single QR codes can be cut and attached at the intended place or artifact. This allows for creating location markers with very low costs (esp. appropriate for schools), but the PDF may also serve as a template for a sustainable installation like a metal plate. The scenario content itself will be published to the central repository using the "Deploy Scenario" button. This will publish the scenario making it available for the learners to be played on their smartphones. Changes to the published scenario can be delivered, since the system detects updates of a scenario and updates the latest version on the repository accordingly. The next section will present the repository as the mediator between the authoring environment and the mobile application.

2.2 Repository

The repository is the mediator between the authoring environment and the Mobilogue app. The authoring environment publishes scenarios to the repository and makes them thereby available to the mobile application. First, scenarios are serialized into a JSON representation by the authoring client and stored via a RESTful webservice to the server, which is implemented in nodejs and express. The server stores the scenarios in the NoSQL database mongoDB. The Android application on the other hand retrieves the scenarios via the webservice and stores them in the local database on the phone. The advantage of this architecture (Figure 4) lies in the open and standardized access via HTTP to the resources and the programming language independent document format JSON. The JSON document format has also the advantage of direct storage into the database without any conversion steps. This approach allows for integrating extensions or new implementations of Mobilogue into the open architecture, e.g., Mobilogue for iPhones or Windows Phones.

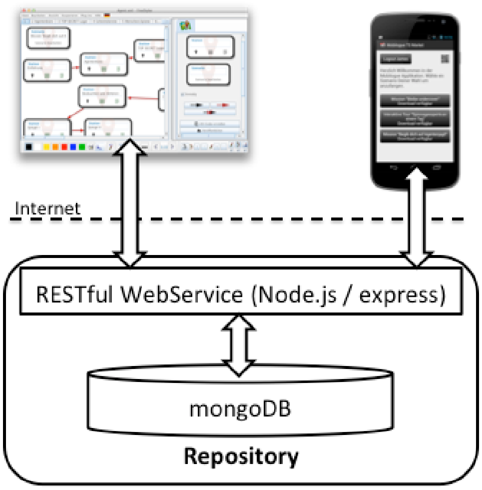

Figure 27. The Mobilogue repository as the mediator between the authoring environment and the mobile application

2.3 Mobile App

The Mobilogue App is the runtime for scenarios. The application has been implemented as a native Android app with special care to create an intuitive and easy to use application. The app connects (if an Internet connection is available) automatically to the repository looking for new scenarios and updates of the installed scenarios. Currently available scenarios will be presented to the user in the Mobilogue market (Figure 5a). The user can click on a scenario and read the description before downloading. The app will download the scenario from the repository and cache it in the smartphone's database for offline access. Before the user can start the scenario, he or she needs to create an account and log into the application. This account is used to identify the user across multiple scenario runs on the same phone and therefore allows sharing one phone with other users. This is particularly important in a school context. With this approach students can share one device and play a scenario one after the other. Therefore the Mobilogue app provides user scalability on one device (Giemza et al., 2012). Currently the collected data (progress, scores) stays exclusively on the device only and the access to this data is limited to the user.

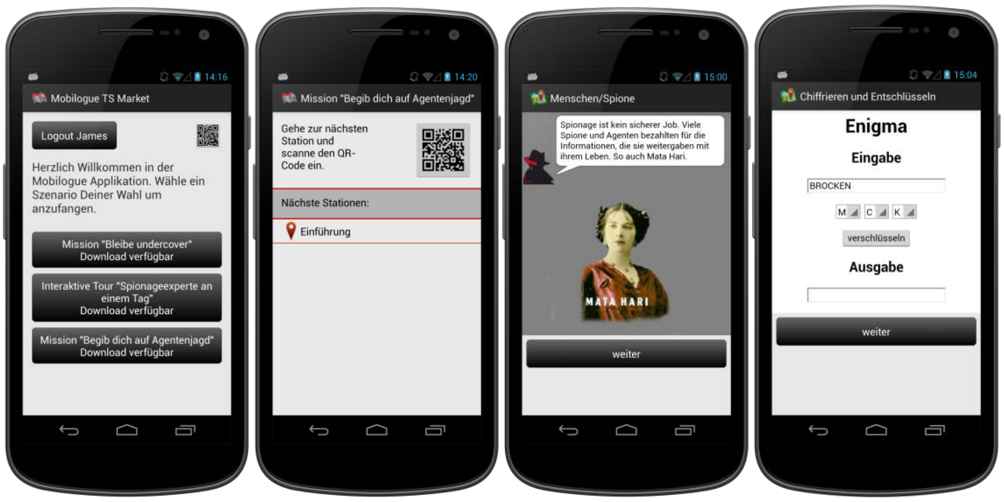

Figure 28. Mobilogue App – (a) Market, (b) Scan screen, (c) Content screen, (d) Enigma simulation

After starting a scenario, the user needs to find the first location and scan a QR code (Figure 5b). A click on the QR code button opens the integrated QR code scanner that uses the smartphone camera to scan the code and decodes it afterwards. A QR code only encodes a unique id in the scenario assigned to one location – instead of containing the actual content data. This enables the re-use of QR codes in other scenarios and allows for multiple scenarios at one place using the same codes. Once the scanner has decoded the id from the QR code, the app will lookup the location in the currently running scenario on the user's mobile phone. If the code is wrong (i.e., not available in the scenario or not complying to a strictly defined route) the user will receive an error message. Otherwise the user will see the first content page for this location (Figure 5c). The figure shows an introduction text from the aforementioned "spy training" scenario embedded into the custom HTML template and a picture below. This content screen is the representation of an information page node presented in Figure 2c. A quiz will be visualized with a question and a list of radio buttons to answer the quiz. The button in the bottom of the screen navigates to the next page (alternatively to a data traces, a quiz or a score page) and the following until the user has seen all content for this location which will finally bring her/him to the code scan page (Figure 5b). The code scan page presents the next possible and recommended location for the user. If a next location has been marked with GPS information, the user can open a map based on GoogleMaps and use it to find the next location. Finally Figure 5d shows a content page rendering an Enigma machine simulation. This simulation has been developed using JavaScript and HTML and has been imported as a HTML content package into Mobilogue. It is rendered inside an Android WebView component. This requires the author of the simulation to take the limited screen size and the limitations of mobile browsers into account. This approach allows the integration of arbitrary content like interactive simulations, videos, audio files and many more without any Android specific programming skills.

Once the scenario has been finished, the user will see a final list of her/his data traces, i.e. the progress of the scenario run with all visited locations and timestamps, and links to solved quizzes and the scores. As mentioned above, the collected data is only visible to the user and will allow for individual reflection of the scenario run and virtually revisiting the place.

3. Related Work

The topic of mobile content authoring tools is no longer only a research topic but has already been commercialized. Currently the most popular device with a high acceptance in schools is the Apple iPad (Henderson & Yeow, 2012). The advantage to the classical textbook is the availability of interactive content and applications for education. As an alternative to prefabricated content, Apple provides iBook Author as an authoring tool for creating interactive (proprietary) textbooks. This empowers everyone to create (educational) content.

GoMo Learning (GoMo Learning, 2013) is a commercial content authoring tool specialized on multi-device content delivery by utilizing web-technologies (HTML, JavaScript and CSS). It supports a collaborative and web-based creation of content that can be delivered as a HTML package or a native application for the different devices. In contrast to Mobilogue, GoMo created scenarios do not support location based content delivery based on QR code detection. Finally, the high yearly license fee might be an obstacle for the application within the school context.

Treasure-HIT (Kohen-Vacs, Ronen, & Cohen, 2012) is a research project that supports a treasure hunt game in the field on mobile devices. The system offers an authoring environment for teachers to create station-based activities for GPS-identified locations with content, tasks and feedback for the learners. These games are shared through a repository and can be run on mobile phones in the field. Treasure-HIT also uses Web-technologies for content visualization on the devices, thus making it platform independent. Although this project is similar to Mobilogue, it does not support scenarios inside buildings, as GPS is the only trigger for location detection.

A crucial issue with guidance or navigation applications is the awareness of the user's location. Many projects (Ballagas, Walz, & Borchers, 2006; Giemza et al., 2012; Kohen-Vacs et al., 2012; Spikol & Milrad, 2008) for outside activities rely on GPS to detect the exact location. Indoor activities need to handle the position detection using alternative techniques. Bahl and Padmanabhan (2000) present a framework for detecting and tracking the user's position based on radio frequency (Wi-Fi) triangulation. Other examples (Föckler, Zeidler, Brombach, Bruns, & Bimber, 2005; Ruf, Kokiopoulou, & Detyniecki, 2008) introduce frameworks that use on-device object recognition to present the appropriate information to the user. Mody et al. (2009) propose RFID tags as indicators of the user's position by explicitly scanning a RFID tag attached to an exhibit. The downside of these technologies is that they either rely on an existing infrastructure at the application location (Wi-Fi signal), require complex pre-configuration of the settings (creating an object database for the recognition) or require technologies that are not widespread on current smartphone generations (e.g. RFID/NFC scanners are still limited to few (high-end) smartphones).

In contrast, Mobilogue uses a simple but widely applicable solution to detect the user's position. The authoring environment can generate QR codes (see Figure 5b) from authored locations without any complex configuration or preparation. These codes can be printed out and put to the physical location at very little cost. These codes can be scanned with almost all Android-based smartphones thus making it applicable in many contexts and school environments.

4. Evaluation

The mobile application was evaluated using one of three scenarios developed for the TOP SECRET museum by a student group (bachelor level, computer and media science). The study focused on the hedonic quality of the software product (the aspects of a user interface that appeal to a person's desire of pleasure and avoids boredom and discomfort) using the AttrakDiff (M. Hassenzahl, 2006; 2003) standardized questionnaire. Additionally the perceived entertainment quality was evaluated by a non-standardized questionnaire and finally the usability of the software product was evaluated based on ISO 9241/10 (without personalization items) as a basis.

A knowledge test was conducted before and after the guided tour through the museum to evaluate the learning effect of the used scenario. The test consists of 10 items dealing with exhibits that are part of the guided tour and 10 items concerning exhibits that are not directly part of the tour, but located in the immediate vicinity of the locations directly mentioned in the scenario. The pre- and post-test were slightly different from each other, covering the same topics, but trying to avoid a curiosity bias by the pre-test.

The study was conducted with 46 pupils coming from two classes on high school level. The students were of age 13 to 15 and were equally distributed between genders. They were divided into three groups. Six subjects used a usability survey orientating at ISO 9241/10 design principles, 22 subjects as experimental group. Both groups used the Mobilogue guided tour on Android smartphones. The third group with 18 subjects was not using the Mobilogue app, but was guided through the exhibition by two students following the same scenario that is implemented by the Mobilogue app. This group functions as a control group (between-subjects design).

Those subjects using the Mobilogue app were sent into the museum in groups of two with a short delay between each group to avoid pile-ups in front of the exhibits. The control group, taking part in a more traditional tour, entered the museum first. Each group was asked to return from the museum exactly after 60 minutes. This was enough time to conduct the guided tour and spent some self-directed time within the exhibition.

The results of the usability study were positive. The arithmetic means of the collected criterions are between 5.1 and 6.2 (7 Likert scale; 1 worst – 7 best: Suitability for the task: M=5.8, SD=.71; Self descriptiveness: M=5.68, SD=.97; Controllability: M=5.1, SD=.95; Conformity with user's expectations: M=6.2, SD=.73; fault tolerance: M=5.9, SD=.83; Suitability for learning: M=5.84, SD=.79). Only the controllability items are below average. The scenario may explain this. It forced the user on a strict path through the museum and therefore through the application.

The hedonic quality of the application is slightly above average (7 Likert scale; 1 worst – 7 best: Identity: M=4.6; Stimulation: M=4.8; Attractivity M=5.0). The analysis of the 14 non-standard items was mostly positive throughout the dimensions fun, learning, recommendation to others, distraction from other exhibits, orientation, and perceived difficulty of the questions. There are differences between the experimental group and the control group. The experimental group using the Mobilogue app reported that they felt more focused on the contents of the tour (M=4.59, SD=1.14) than the control group (M=3.94, SD=1.12). Focusing on the exhibits presented within a learning activity without being distracted by other nearby exhibits may be a desirable property of a guided tour. In contrast to that, a museum is usually also interested in motivating its visitors to be aware that there are more exhibits than seen during a tour, which might also affect the motivation of students and other visitors to spent some time in the exhibition after having conducted the Mobilogue guided tour.

Nonetheless, the knowledge tests showed that both the experimental group (Ex) and the control group (Co) achieved a significant learning effect concerning the topics of the guided tour. (Percentage of correct answers; Pre-test: Ex M=10.43%, Co M=15.03%; Post-test: Ex M=29.41%, Co M=56.86%). It is remarkable that the control group performed considerably better than the experimental group, although the formation of these groups was completely random (within the two different gender, to achieve an even distribution of females and males in each group). The performance of the control group may be explained by the presence of the students' teachers accompanying this group so that their mindset was oriented towards learning. The knowledge tests also show that there is only a small learning effect concerning those questions that deal with exhibits that are not part of the guided tour (Pre-test: Ex M=12.43%, Co M=15.66%; post-test: Ex M=15.45%, Co M=18.86%). This confirms that participants of a guided tour are usually strongly focused by the tour and do not acquire a lot of knowledge about surrounding exhibits. Of course we would have liked the subjects to use the remaining time between the end of their tour and debriefing to look at other exhibits, but this does not seem to have happened. On the other hand this may be explained with the playful events offered by the museum (like a laser tunnel that allows for dexterity contests). These activities were very popular among the students, so that they did look around further.

5. Conclusion

This paper presents Mobilogue as a tool for creating and conducting mobile learning scenarios in informal settings. The evaluation shows that the presented approach and the developed software products are suitable for the design and implementation of mobile learning scenarios. The system is flexible and generic enough to be used in many domains. The results of the usability study confirm that the system complies with the general usability criterions for such a system.

Concerning the ease of use of the authoring environment, we can report that the bachelor students, who created the evaluation scenario for the museum, created two additional and meaningful scenarios from scratch. Therefore we can conclude they have acquired domain knowledge and tool knowledge to design a reasonable scenario. Of course the acquisition of the necessary domain knowledge took more time than the actual design of the scenario in Mobilogue's authoring environment. Since the evaluation subjects showed a significant improvement of their knowledge on the scenarios' topics, we think that the students were successful. Additionally, the Museum, where the evaluation took place, installed the scenarios (esp. the QR-Codes) as a permanent offer to their visitors.

Obviously, the Mobilogue system is not only suited for informal learning, but also for another type of learning activities: learning through teaching (Gartner, 1971). The students took the role of the teacher and learned a lot about the field of history while creating the storyboard for the scenario and they were quite enthusiastic doing that. Actually, the system is especially targeted at students instead of teachers – which still have to play the role of moderators and domain experts for the students. A previously conducted study with the Mobilogue system shows the same effect with K12-level students (Giemza, Malzahn & Hoppe, 2013). Even students of this age were capable of designing meaningful scenarios for other kids with Mobilogue.

Building upon theses research results we are currently developing a set of different kinds of scenarios to confirm the flexibility and the general applicability of our system. Besides a scenario for a Roman museum, we are creating a scenario that deals with guiding students through the process of assembling a computer by providing textual and video instructions – similar to scenarios by El-Bishouty et al. (2007). In this scenario, the QR codes are attached to the computer parts. Furthermore, we are currently revising the museum scenario used for the evaluation based on the results and try to identify stimuli and best practices with respect to designing mobile learning scenarios, which motivate participants to pay more attention to information not explicitly mentioned in the Mobilogue guided tour – e.g., nearby exhibits – to relax the focusing effect of guided tours. Thus, we will move from formal learning in informal settings to informal and self-directed learning.

A second line of development focuses on the creation of a Mobilogue platform for scenario creators and scenario users. On the one hand, this platform will provide information on the overall scenario usage as well as in depth statistics, e.g., the time spent at a location, popular routes through a scenario etc. Thereby this platform will be a source for learning analytics research. On the other hand, the platform will allow scenario users (e.g., students in a class) to review their Mobilogue runs and reflect on the scenario and the learned content, e.g., by having access to their quiz results. This will be very useful for follow-up activities and reflections in the schools context.

Acknowledgements

We want to thank the students of the bachelor project "Spyologue" for their participation in the project and their work preparing and evaluating Mobilogue. We also want to thank the TOP SECRET Museum fort their cooperation during this project.

References

Bahl, P., & Padmanabhan, V. N. (2000). RADAR: an in-building RF-based user location and tracking system. In INFOCOM 2000. Nineteenth Annual Joint Conference of the IEEE Computer and Communications Societies. Vol. 2, pp. 775–784.

Ballagas, R., Walz, S., & Borchers, J. (2006). REXplorer: A Pervasive Spell-Casting Game for Tourists as Social Software. *CHI 2006*.

Botturi, L., Inversini, A., & Maria, A. Di. (2009). The City Treasure: Mobile Games for Learning Cultural Heritage. In J. Trant & D. Bearman (Eds.), *Museums and the Web 2010 Proceedings*. Toronto: Archives & Museum Informatics.

DeWitt, J., & Storksdieck, M. (2008). A Short Review of School Field Trips: Key Findings from the Past and Implications for the Future. *Visitor Studies*, *11*(2), 181–197.

El-Bishouty, M. M., Ogata, H., & Yano, Y. (2007). PERKAM: Personalized knowledge awareness map for computer supported ubiquitous learning. *Educational Technology Society*. *10*(3), 122–134.

Föckler, P., Zeidler, T., Brombach, B., Bruns, E., & Bimber, O. (2005). PhoneGuide: museum guidance supported by on-device object recognition on mobile phones. *Proceedings of the 4th international conference on Mobile and ubiquitous multimedia* (pp. 3–10). ACM.

Gartner, A.. (1971). Children Teach Children: Learning by Teaching. Harper & Row.

Gassner, K. (2003). *Diskussionen als Szenario zur Ko-Konstruktion von Wissen mit visuellen Sprachen*. Universität Duisburg-Essen.

Giemza, A., Malzahn, N., Hoppe, H.U. (2013). Mobilogue – A Tool for Creating and Conducting Mobile Supported Field Trips. *12th World Conference on Mobile and Contextual Learning (mlearn)*. Qatar.

Giemza, A., Verheyen, P., & Hoppe, H. U. (2012). Challenges in Scaling Mobile Learning Applications: The Example of Quizzer. *2012 IEEE Seventh International Conference on Wireless, Mobile and Ubiquitous Technology in Education* (pp. 287–291).

GoMo Learning. (n.d.). Retrieved from http://epiclearninggroup.com/uk/platforms/gomo-learning-authoring-tool/ (last visited. May 2013)

Hassenzahl, M. (2006). Hedonic, emotional, and experiential perspectives on product quality. In C. Ghaoui (Ed.), *Encyclopedia of Human Computer Interaction* (pp. 266–272). Idea Group.

Hassenzahl, Marc. (2003). The thing and I: understanding the relationship between user and product. In M. Blythe, C. Overbeeke, A. F. Monk, & P. C. Wright (Eds.), *Funology From Usability to Enjoyment* (Vol. 3, pp. 31–42). Kluwer Academic Publishers.

Henderson, S., & Yeow, J. (2012). iPad in Education: A Case Study of iPad Adoption and Use in a Primary School. *2012 45th Hawaii International Conference on System Sciences*, 78–87.

Kisiel, J. (2005). Understanding elementary teacher motivations for science fieldtrips. *Science Education*, *89*(6), 936–955.

Kohen-Vacs, D., Ronen, M., & Cohen, S. (2012). Mobile Treasure Hunt Games for Outdoor Learning. *IEEE Technical Committee on Learning Technology*, *14*(4), 24–26.

Mody, A., Akram, M., Rony, K., Aman, M. S., & Kamoua, R. Enhancing user experience at museums using smart phones with RFID. , 2009 IEEE Long Island Systems Applications and Technology Conference 1–5 (2009). IEEE.

Pinkwart, Niels. (2005). *Collaborative Modeling in Graph Based Environments*. dissertation.de.

Ruf, B., Kokiopoulou, E., & Detyniecki, M. (2008). Mobile museum guide based on fast SIFT recognition. (M. Detyniecki, U. Leiner, & A. Nürnberger, Eds.) *6th International Workshop on Adaptive Multimedia Retrieval*, *5811*, 170–183.

Sharples, M., Taylor, J., & Vavoula, G. (2005). Towards a Theory of Mobile Learning. (H. Van Der Merwe & T. Brown, Eds.)*Mind*, *1*(1), 1–9.

Spikol, D., & Milrad, M. (2008). Physical activities and playful learning using mobile games. *Research and Practice in Technology Enhanced Learning*, *03*(03), 275–295.

Vavoula, G. N., Sharples, M., Rudman, P., Meek, J., & Lonsdale, P. (2009). Myartspace: Design and evaluation of support for learning with multimedia phones between classrooms and museums. *Computers & Education*, *53*(2), 286–299.

Yiannoutsou, N., Papadimitriou, I., Komis, V., & Avouris, N. (2009). Playing with ” Museum Exhibits : Designing Educational Games Mediated by Mobile Technology. *Context*, 6–9.