Active Learning in the Museum

Using Technology to Enhance Learning

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***Abstract*—This short paper describes a recent development of an app for use by young student museum visitors. The idea is built on the concept of active learning where students are encouraged to actively engage themselves in the learning process. The app allows students to take photos, make notes, make sound recordings and retrieve online information. All collected information is sent to a server. The students can download the information and make it into a final report from the visit.**

Keywords-active learning; lean startup;museum; app.

I. INTRODUCTION

A museum is a place where objects are stored, preserved and exhibited. The objects are regarded as part of our cultural heritage. To promote understanding and experience, some museums use interaction and technology to make visits more interesting. Still, many museums mainly consist of static exhibitions. Visitors walk around and look at objects on display. Schools use museums as an alternative arena of learning. The challenge is to include the museum in the learning process in a way that enhances learning [1].

University College of Southeast Norway has for some time collaborated with local museums to experiment with technological solutions to enhance visitor experience. The first project was an augmented reality application focusing on deportation of Jews during the Second World War. The second project is described here: A smartphone/tablet app for active learning in the museum.

The rest of the paper is structured as follows. Section II introduces active learning, and a model for active learning in museums. Section III describes the active learning app. Section IV discusses how data from the app can be used to enhance the experience from visiting the museum. Section V presents results from testing the prototype. The last section discusses other application areas, and ideas for further development.

II. ACTIVE LEARNING

According to Weltman [2], active learning is a method of learning in which students are actively or experientially involved in the learning process. To learn, students must do more than just listen: They must read, write, discuss, or be engaged in solving problems [3]. Active learning often involves learning by doing. Creekmore and Deaton [4] argue that learning retention rates from active learning are much higher than from passive learning. The best learning retention rates is made when students are teaching their fellow students. If students are required to present their findings in front of the class after visiting the museum, the learning outcome may be improved.

A. A Model for Active Learning

As part of the project we made a model for active learning. The students collect information in the field (e.g., in the museum), which is later used for reflection. Instead of using a traditional paper notebook, the students use a mobile device with camera (phone or tablet). The technology provides new opportunities to capture information by taking photos, recording voice, writing notes and retrieving online information.

After collecting information, the students can reflect upon their (recorded) observations. This includes asking themselves questions and finding answers. The reflection is important for learning. The result is documented through a report or presentation made by the students, not from scratch, but from the collected data, enhanced with the results of the reflection.

The museum visit is reiterated and not forgotten.

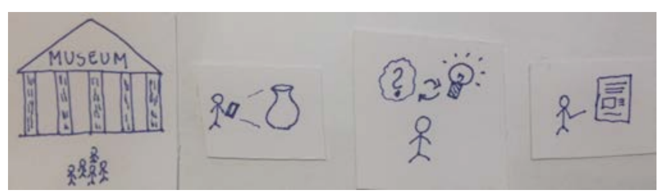

Figure 1. Model for Active Learning

The process is visualized in Figure 1. The students come to the museum, and walk around exhibitions making notes and collecting data with their mobile devices. Back in the classroom they reflect upon the data they collected, and make the report or presentation.

III. THE ACTIVE LEARNING APP

The information is collected by mobile devices (phones or tablets). This simplifies the data collection itself, but also provides opportunities to upload the data to a server. The students can then download the data and embed the data into their report or presentation.

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As part of the project, we developed an Android app as a "proof-of-concept" prototype. The prototype was tested by real users (junior high school students) in real situations (visiting an exhibition). The feedback from the users was used to improve the prototype.

We followed the methodology developed by Eric Ries in his book "Lean Startup Methodology" [5]. His methodology uses a "Build-Measure-Learn" loop to iteratively improve a product. The "Build-Measure-Learn" loop is shown in Figure 2.

The first step of the methodology is to develop what is called a minimum viable product (MVP). The MVP is a prototype with enough functionality to enable a full turn of the "Build-Measure-Learn" loop.

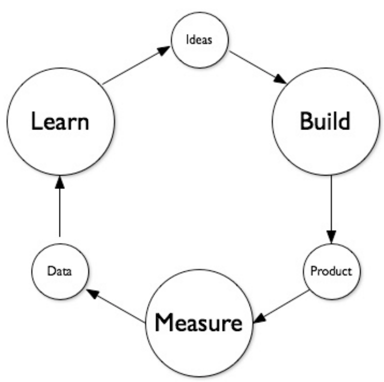

Figure 2. The "Build-Measure-Learn" loop

The "Build-Measure-Learn" loop starts with some ideas about the products. These ideas are developed into a product or a service. Users are asked for feedback. The data is used to learn from the users, which brings new ideas on the table.

The prototype was developed through two iterations with real users (students).

A. Functionality

The initial idea was to include four actions initiated by the user (student):

- Retrieving information about an object
- Adding text
- Adding audio
- Adding a photo

All actions upload collected data to a server, where the students can access the data after returning to their homes or school.

Figure 3 shows the main user interface of the app, consisting of four large buttons with both icons and texts to invoke the four different functions described above.

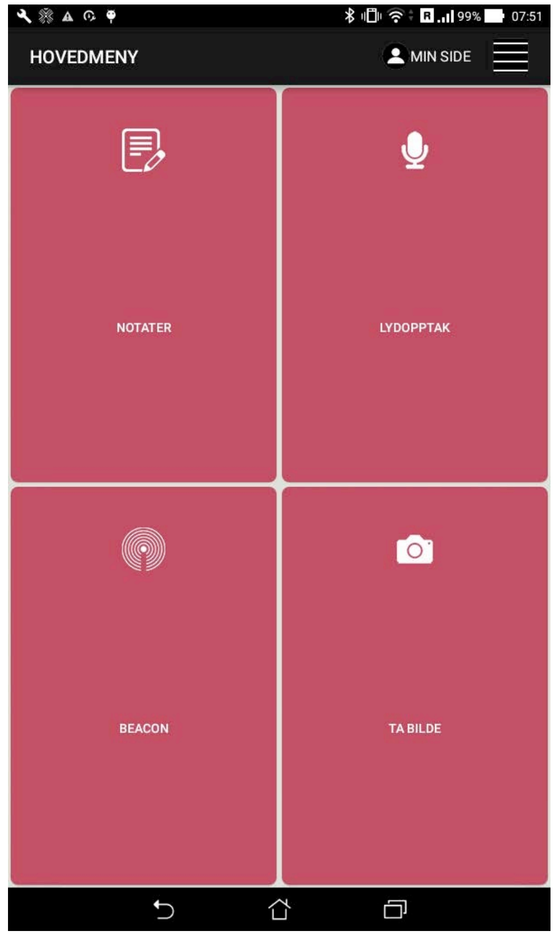

Figure 3. Main user interface

The captions are in Norwegian. The upper left button is used to take notes, the upper right button is used to make a sound recording, the lower left button is used to retrieve information, and the right left button is used to take a photo. *(The text may look small, but this screenshot was made on a tablet, not a phone)*

1) Retrieving information

Beacon technology [6] consists of small radio transmitters (beacons) sending messages at regular intervals. The range of the radio transmitters is very short, and can be adjusted. When close enough, the app detects the beacon and retrieves the message. Each message contains an identifier, which identifies the physical transmitter. This identifier can be used by the app to access a service providing information about an object. In our prototype, we associated the identifiers with links to web pages describing the individual objects.

Figure 4. Two types of beacons

Figure 4 shows a couple of beacons. The one on the left includes a battery and can operate for months without recharging. The one on the right does not have its own power supply, but can be placed in an USB-charger.

2) Adding text

The beacons provide the possibility to retrieve online information about an object. This information is not complete, and does not capture the perceptions and feelings of the user. Therefore, the possibility to add notes is an important function. Standard text input functions are used, and in some smartphones and tablets, this also allows the use of handwriting with a stylus.

3) Adding audio

Audio is a complement to textual input. In many situations, it is easier to just talk to the smartphone or tablet instead of using the built-in keyboard. But audio also provides the unique opportunity to capture sounds emitted by objects. This can be engines, live animals or music instruments.

4) Adding photo

Adding a photo gives the opportunity to capture visual impressions. The value of a photo cannot be underestimated, as it captures details that may not be covered by a textual description.

B. Login

It was also necessary to include an authentication mechanism. Security is not a major concern, but it is necessary to make a connection between the collected data and the user to provide access to the data at a later stage. One of the important ideas in our project is to use the collected data for a report or presentation after returning from the museum. The prototype provides two different kinds of authentication. The traditional method uses a login name and a password. First time users need to register and select a username and password. For this kind of app, most users will be first time users, and the registration procedure will be an obstacle. The alternative method uses Facebook credentials to log in. Facebook provides an application program interface (API) to authenticate users. In this case, users do not have to go through a registration procedure.

Junior high school students testing the app showed a clear preference for using Facebook credentials, since they already have Facebook accounts. The registration procedure was reported as more cumbersome.

IV. From App to Server

Captured data is uploaded to a server. Figures 5 and 6 shows two examples of the user interface. The screen in Figure 5 is used for text input, and the one in Figure 6 for audio input. Both screens include buttons to upload content.

The prototype stores audio and photos as files in the file system, and stores links to these files and text in a database. The database is good for storing structured data in an efficient way, and connects the user id with the content belonging to the user.

Figure 5. Text entry screen

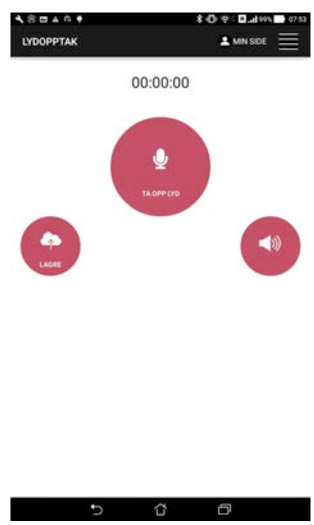

Figure 6. Voice recording screen

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V. TESTING

The final prototype was tested by a group of nine junior high school students, four girls and five boys. Their ages were from thirteen to fifteen. All had their own mobile phones (skills). All were Facebook users.

We used a Likert-scale from 1 to 6, where 1 is the lowest and 6 is the highest value. When asked if the functions (buttons) were easy to understand, they all answered 5 or 6. They were also asked about how easy it was to use each function. Again, all answered 5 or 6 for notes, photos, sound, and using beacons. They also answered 5 or 6 for button size and text size. The only question that did not receive only 5 or 6 was the use of colors. One of the respondents gave a 4 for the use of color.

VI. CONCLUSIONS AND FUTURE PLANS

The app itself has been tested with real users in real situations. Improvements were done during an iterative design process.

Even if our prototype app was made with museum visitors in mind, it can be used for a broad range of applications. When students are doing field-work, it can be used to document what is happening, and later be refined into some written record of the event. This approach can be applied to any learning experience, e.g., a car mechanic or a carpenter; the app can help capture data that can later be transformed into knowledge. All of these are learning cycles that consist of information collection, processing, reflection and conceptualization. In many ways, it substitutes the traditional notebook with a more powerful instrument that also allows capturing visual images and sound.

A future version will incorporate ideas from gamification to further encourage students to do more work during their visit. Students will be rewarded when they perform activities, by getting badges or stars. This information may be shared with other students through pop-up messages.

On the server side, it is possible to embed the data directly into a document or presentation. Both Microsoft Word and Microsoft Powerpoint have application program interfaces (API´s) that allow an external program to create documents or presentations, and then fill in content. In this way, the students are relieved of the task of inserting the data themselves, and can spend more time on editing the result.

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