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PhotoStudy: Vocabulary Learning and Collaboration on Fixed & Mobile Devices

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Abstract

PhotoStudy is a system that supports vocabulary study on both wired and wireless devices. It is designed to make it simple to annotate content with multimedia such as images and audio recorded on these devices. This paper presents a prototype system that uses wireless markup languages and Java MIDlets. User evaluations have been conducted, and are being continued in our iterative design approach. We report the results from questionnaire evaluations, observational studies and interviews.

1. Introduction

Vocabulary study is an important part of learning a new language. The simple paired associate format of much vocabulary content makes it an attractive first step for study systems on mobile devices such as cellphones. Mobile devices allow the user to take advantage of occasional study opportunities while the gradually increasing prevalence of camera phones is making digital image generation easier and easier.

This paper addresses a challenge facing any learning system: providing users with a broad range of content relevant to their needs. While a large community of desktop computer users might efficiently prepare enough text-based material to make a study system of interest, initially there will be a dearth of material. Thus a "PhotoStudy" system that allows users to collaboratively build up a body of image-vocabulary or picture flashcards is an attractive proposition.

The goal of PhotoStudy is to encourage users to collaborate and to perform "deep-processing" of content in a number of modalities. Research suggests that all these factors should improve learning and retention. Johnson & Johnson [4] claim that students working in a collaborative environment experience a higher degree of learning as well as increased levels of satisfaction. Groot [3] presented results indicating that delivering material in such a way as to promote deep processing will yield better long-term retention. Various studies [1,2] have shown improved retrieval performance when a target vocabulary is rehearsed through a variety of different modalities.

Recently several academic studies have addressed mobile vocabulary learning. Thornton & Houser [12] performed a comparison between the use of pull (web-based) and push (email) approaches to delivering vocabulary content to mobile phones. Ogata & Yano [9] showed substantial increases in vocabulary recall compared to control when subjects were provided with the CLUE system, which provided a vocabulary concept map over a PDA. Kadyte [6] presented a mobile system for learning Finnish language that includes audio; a "Language Learning Guide" explains Finnish grammar rules to the mobile user. In addition a number of commercial products exist that provide vocabulary content on mobile devices, including AppliLearning, XapWords, M-Learning and BiteSize Mobile [8].

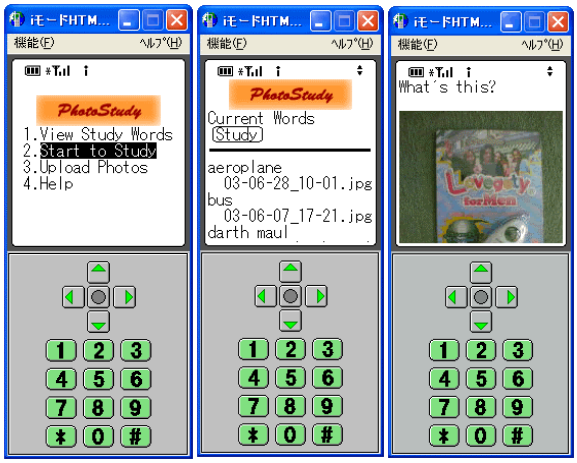
2. PhotoStudy Basic System Overview

To the extent of our knowledge PhotoStudy is the first mobile vocabulary study system to support collaborative use of images generated by cameraphones. The initial prototype also supported a degree of passive collaboration, i.e. access to content created by other users. The intention for subsequent versions of PhotoStudy is to move towards more active collaboration, support for deep processing and a greater variety of content modalities.

The initial PhotoStudy prototype was designed with a number of mobile device usability principles in mind. In particular, simplicity is key, options per screen should be limited and navigational hierarchies should

be shallow [7]. The basic premise of PhotoStudy is that it will be used by a community of "English as a Foreign Language" (EFL) students to improve their vocabulary, by studying word-image paired associates that have been uploaded to a shared database.

Assuming some images have been uploaded and associated with vocabulary terms, the system supports a study session in which the user is presented with an image and a multiple choice quiz in which they need to select the word that most closely describes the image. Upon selection a feedback screen is displayed including a next button that leads to a new quiz.



a) Main menu, b) Content overview, c) Example image

d) Multiple choice, e) Failure, f) Success feedback

Figure 1. cHTML output displayed on the Docomo emulator

As shown in the figure 1e an incorrect choice results in the image associated with that choice also being displayed. One additional function allows the user to view a list of all words and images currently in the system (fig 1b.).

While image upload process on a wired system uses an HTML file upload operation, this operation is not supported in mobile markup languages like cHTML and XHTML-MP. An email interface is provided for mobile users to upload photos. Photos are mailed as attachments to a particular address, and become associated with any vocabulary term placed in the email subject line.

The system is set up to make it as usable as possible for the restricted I/O of a mobile device. The user never has to type in any text, and all operations involve selections from lists. The site hierarchy is not very deep, and is effectively just a loop through a sequence of about three screens. In order to make the whole system navigable a "return to main menu" link is placed at the bottom of every screen. This allows the user to continue studying for an arbitrary amount of time, and then to be able to back out to the main menu at any point.

Rather than just adding functionality purely on the basis of intuitions, current Human-Computer Interaction (HCI) design approaches emphasize the importance of getting users involved early and often in iterative development cycles [11]. Accordingly, the PhotoStudy prototypes were subjected to a series of user-centered evaluation methods.

3. Alpha Evaluation

The system was initially made available to subjects over wired devices, the intention being to give participants some idea of what might be possible on a mobile interface. Rather than focusing exclusively on the merits of this prototype, the intent was to try and gather ideas about the kinds of mobile educational systems that EFL students would be interested in using. Hyperlinks to the prototype and a web questionnaire were distributed to potential subjects.

The questionnaire contained 27 questions designed to highlight major flaws with the existing prototype and the assumptions on which it was based, and to gather information on how EFL students with different levels of English thought they might study with a cell phone. After a week 16 participants, of whom all but one were non-native English speakers, had filled out the questionnaire. However, of the remaining 15, 5 had reached a level of English such that they were no longer regularly studying English, so the number of EFL students participating was effectively 10. The participants were recruited from University of Hawaii

graduate courses in computer science and EFL study programs. Average age was 28.4; 4 male, 11 female.

3.1. Questionnaire Results

Usability and ease of learning were rated around 4 on 5-point Likert scales, as shown in figure 2. The question as to whether PhotoStudy was a good system to have on a mobile phone met with near unanimous support, and 3/4 of the participants said they would use the system, which most users suggesting they would use the system between two and three times a week.

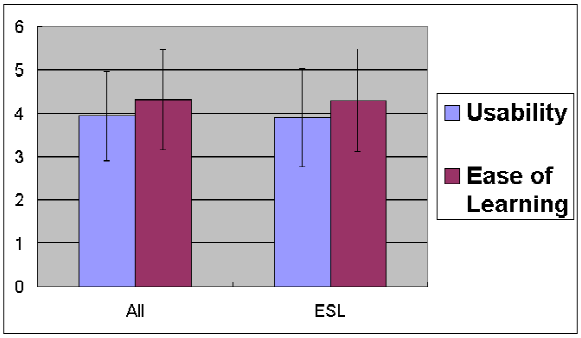


Figure 2. Average usability and ease of learning

Questions regarding study style produced an interesting variety of results. The appearance or structure of the word seemed to play a strong role in memorizing vocabulary, while the spelling of the word was not frequently selected as a memorization strategy. However, as many participants selected an "other" option as the "structure" category. Comments from the "other" category included mention that multiple methods should be employed simultaneously, while several participants indicated that vocabulary study took place as part of media or social interaction, e.g. print, film or talking with friends.

Approximately half of the participants said they collaborated with others while studying. The collaborative techniques mentioned included trying to speak English with other EFL students and testing each other on vocabulary. One English teacher who took part in the study described her collaboration with students in terms of making up stories and role-plays.

The majority of participants indicated that they would like to be able to access study material data popularity, forward study material, and set quizzes for friends. Given the presence of a wired infrastructure it follows that support for more complex things such as threaded discussions associated with words could be useful. Particularly for complex words and concepts that had many candidate images, an online discussion of some sort might be valuable. This data could be browsed on a wireless device, and interacted with on a wired device, while the results of the discussion could help manage content for display on wireless devices, e.g. which image was considered most appropriate by the community.

One potentially interesting trend was that the users who indicated that they would *not* be interested in sharing study material with others over mobile devices included all three of the 16+ hour a week EFL students. This is the same three who indicated they did not collaborate with anyone during normal study; a trend that could indicate either that those studying English intensively tend to do so alone, or that these three were consistently misunderstanding the questions.

A multiple-selection question on the types of study aid that the participants would like to see on cell phones indicated that pronunciation, idioms and special phrases being strong favourites, with reading and writing only occasionally selected.

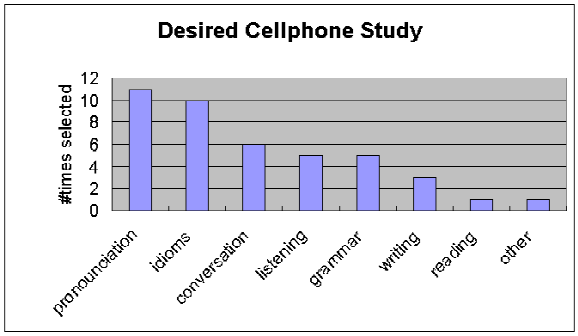


Figure 3. Desirable mobile study methods

Pronunciation support certainly seems a natural addition in the context of a cell phone. However, creation of quality pronunciation content is expensive compared to images, where anybody with a camera can contribute materials. It is a greater challenge for non-native speakers to generate pronunciation content. A second problem is that while cell phones support taking and displaying images in a fairly consistent way, this is not the case for the submission and reproduction of audio data.

Various issues also emerged from the questionnaire results such as the need for multiple associations between words and images, since many images could be associated with more than one word. Many participants also said they would like the system to categorize words by difficulty, language and linguistic categories, since this would enable them the level, or language most appropriate to their current study.

One participant noted that by using multiple-choice tests the system was testing only recognition memory and not recall memory. While there is evidence to suggest that recall memory tests produce longer retention [5], a recall style test is at odds with the limited input capability of a mobile phone. Naturally a wired version would not suffer from the same problem, but even in that case the input simplicity of recognition tests is a powerful feature not to be discarded lightly.

One participant said that the presence of a default selection in a multiple choice question was potentially distracting, and another said she would prefer that the selection of the multiple choice option should lead to the next page, rather than having a separate "select" button. The presence of a separate select button allows the user to reflect after making an initial selection, while removing the select button reduces the number of clicks required: certainly a plus on a cell phone. The default selection is needed if a select button is present in order to avoid the form being submitted without a selection. An alternative in a browser is to have an alert if no options are selected; something more difficult to achieve with phone markup languages.

Finally, some of the uploaded pictures were much too large for a cell phone display, and they also came in a variety of formats since they were uploaded from a variety of different sources

4. Development Based on the Evaluation

While the evaluation highlighted various areas for improvement of the PhotoStudy system, it seemed expedient to implement a limited subset of them before further evaluation. Participants in the evaluation had noted that they did not like seeing the same image twice in a row leading to an easy adjustment of the algorithm to prevent the same image being displayed twice in succession. Multiple categories/word-image associations were also a key request, and the system was modified to allow more than one image to be associated with each word.

PhotoStudy was also adjusted to automatically resize submitted images and convert them into a number of different image formats. However, even with smaller images testing on a cellphone indicated that the time to download these images was prohibitive, prompting the development of a Java version. This allowed PhotoStudy to run without pauses since multiple images could now be downloaded simultaneously while the user continues with other activities.

a) Content Selection, b) Success feedback, c) Summary

Figure 5. Java MIDlet on T610 Emulator

The operation of the PhotoStudy J2ME MIDlet is similar to the earlier markup language interfaces and the new components can be seen in figure 5. The first screen (fig.5a) shows a list of the different study items from which the user can select the ones they would like to study. Once the start button is pressed the user is taken to the first study screen that, as before, presents them with a four option multiple-choice question based on the image displayed underneath. Selection of an incorrect answer leads to the feedback screen that provides the correct answer, and displays the image of the answer the user actually selected. Figure 5c shows the final screen that is displayed once the user has studied all the items they originally selected for study.

5. Observation Studies

Using a Java application allowed a complete log of the user activity to be recorded, something that is currently difficult to achieve with either video camera or HTTP logs from cell phone applications using markup languages. The observed trial was also run on a wired device for comparative purposes. All the participants of the observation study were non-native English speakers who had been involved in the first round evaluation and thus were familiar with the system concepts. They were asked to first try the MIDlet, followed by the modified web prototype. There was then a short interview in which the participant was encouraged to talk freely about the web prototype and the MIDlet version, and any differences between them. The experimenter took notes throughout.

5.1. Observation Study Results

Participants indicated that the initial study item selection screen was confusing in that the meaning of the checkboxes was not obvious (fig.5a), and that the MIDlet suffered from not having an always-accessible main menu. Subjects also appeared to prefer, and in some instances stated explicitly that they preferred, the MIDlet function that allowed them to choose which items they wanted to study. One subject said that a system that mixed the desktop and mobile components would be preferable; while another stated that she would prefer all of the action to take place on the mobile device. The subjects also alluded to the need for multiple categories of words; an issue that had been highlighted by the earlier questionnaire, suggesting this as urgent priority.

Examination of the user traces showed lots of scrolling up and down when images were displayed; one subject suggested that the image should appear above the multiple choice options, as it does in the web prototype. Another issue was the need to switch from the select button to the side button when going from answering multiple-choice questions, to jumping to the next screen. It would seem less effort for the user if they could use the same button over again - although this would require further modification of the base J2ME GUI classes with potentially unpredictable compatibility with different phones.

6. Discussion

Further modifications were made on the basis of the second round of evaluation, enabling users to select sets of study items to make their own quizzes, which can then be sent to friends via email. Preliminary evaluation suggests that this will be a popular feature, with subjects asking for features such as being able to send to multiple friends at a time, to add notes to friends explaining the nature of the quiz, and to distribute final scores to both sender and recipient.

There is also need for a collaborative "policing" of the study material since even our simple prototype has become a victim of email spam, which leads to failed image links. There is also the problem of incorrectly marked up images. Content could be categorized into moderator approved and not, but this places a burden on the moderator. Storing the frequencies with which different study items were included in users' personal quizzes and those they send to friends could support "popularity" navigation. Care is needed to create a mobile interface that supports navigation of a large amount of material. Of course popular content could be the result of frequent misperceptions, so there is certainly a role for a moderator or native-speaking participants to provide checks. If more than one language were supported native speakers could provide adjudication support for each other.

Much work remains to turn the PhotoStudy system into something that could realistically be used by EFL students. So far the PhotoStudy project has focused on trying to have the system run on all the different devices on which it might be used, and to put in place key components such as the image upload from a cell phone and the modification of the J2ME base classes to allow traces to be taken of user activity. Following another round of re-design and implementation it should now be possible to conduct some very revealing studies about the system's practicality.

7. References

[1] Chun, D. M., & Plass, J.L. (1996). Effects of multimedia annotations on vocabulary acquisition. Modern Language J., 80, 183-197

[2] Gathercole S.E. & Conway, M.A. (1988) Exploring long-term modality effects: Vocalization leads to best retention. Mem. Cogn. 16: 110-19

[3] Groot P.J.M. (2000) Computer Assisted Second Language Vocabulary Learning. Language Learning & Technology 4(1):60-81

[4] Johnson, D.W. & Johnson, R.T. (1989) Toward a Cooperative Effort: A Response to Slavin. Educational Leadership, 46(7): 80-81.

[5] Joseph, S.R.H., Smith Lewis, A. & Joseph, M.H. (2004) Adaptive Vocabulary Instruction, Proc. 4th IEEE ICALT, 141-145.

[6] Kadyte, V. (2003) Learning Can Happen Anywhere: A Mobile System for Language. Proc. of MLEARN, London.

[7] Lee, Y.E. & I. Benbasat, (2003) Interface Design for Mobile Commerce. Comm. ACM 46(12): 49-52.

[8] Luecker, W. & Ash C. (2003) GCSE Revision with Mobile Phones: Developing a Java-based Quiz Game. Proc. of MLEARN, London.

[9] Ogata, H. & Y. Yano, (2004) Knowledge Awareness Map for Computer-Supported Ubiquitous Language-Learning. Proc. 2nd IEEE WMTE, 19-26.

[10] Perlman, G. "Web-Based User Interface Evaluation with Questionnaires" http://www.acm.org/~perlman/question.html

[11] Rosson, M.B. & Carroll, J. (2002). Usability Engineering. Scenario Development of Human-Computer Interaction. Academic Press.

[12] Thornton, P. & C. Houser (2004) Using Mobile Phones in Education. Proc. 2nd IEEE WMTE, 3-10.