Social Constructivism in Mobile Learning:

Designing a Mobile Application to Allow Students to Learn Through Sharing

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Mobile learning has recently become a hot topic in educational technology and learning. Smart phones, hand held tablets, and other light weight devices are now able to provide access to content and run mobile software (applications or apps) that rivals what large bulky desktop computers were able to accomplish just a few years ago. But these new devices go one step beyond the desktop in that they can go with a user where ever they go. Users are no longer tied to a one location. So the question that many educators began asking was: can these devices be used to solve various pedagogical and theoretical problems in education?

In general, educational problems often arise when goals and objectives are not being met. One major goal of education is to help students learn something in the classroom that will connect with something in the real world. Learning something in a classroom or other controlled setting is one thing, but the ability to connect that learning to something outside the classroom is another. Various solutions and concepts have been proposed to deal with this issue. Bouillion & Gomez (2001) noted:

> "Vygotsky (1986) and others in the sociocultural tradition (e.g., Moll, 1992) argue that learning is mediated by highly articulated tasks and activities in the social contexts of day-to-day living. Patterns of activity from school often do not fit the more articulated activities that children observe or in which they participate outside school. This disconnect can lead learners to perceive school learning as separate from life learning."

Moll (1992) also notes how Vasily Davydov identified the need to connect labor-related activities with school-related and Lev Vygotsky focused on the child-in-context theory. All of these theories identify the need for learners to connect what they are learning in class with something outside of the classroom, preferably while interacting with that outside context. The problem with making these connections is that learners often need tools to help them learn or make sense of what they are seeing. Computers can provide many of these tools, but not if they are tied to a desk in a classroom or home office. On top of

that, even many non-computer tools are often tied to classrooms. Some other solution is needed to provide the ability to make in-context learning a possibility.

Based on these factors, the problem that was identified for this project is that learning is taking place in classrooms, but then students go out into the world around them without any tools that can help them connect what they see with what they learn. Kloper, Squire, Holland & Jenkins (2002) suggest that mobile devices have the ability to enhance education because of their context sensitivity (the ability to gather data unique to a location). If an application can be developed that allows students to document what they see in the world around them and then connect what they saw to a particular lesson, this application would be one tool to help solve this problem.

Other educators have also noted that mobile devices are ideally suited to help students learn in the context of everyday life. Norris & Soloway (2013) noted that:

> "Mobile technologies enable students to go directly to all manner of information, people, places, data, events and locations; the teacher (or the classroom textbook) no longer is the mediator. With a mobile device in each learner's palm, each learner can be active and engage in a learn-by-doing pedagogy."

One method that student can engage in learn-by-doing is by finding their own examples (artifacts) of the lessons that they are learning (rather than relying on the instructor to provide these examples for them). An application on a mobile device would be a possible assistant in helping students create their own examples of lesson content.

In addition, mobile devices also have unique characteristics that make them ideal for collecting these artifacts. Dede & Bjerede (2011) summarized Dr. Paul E. Jacobs, Chairman and Chief Executive Officer of Qualcomm, list of six unique "senses" that mobile devices possess: (1) knowing where you are, (2) interacting with networks, (3) sensing local content and services, (4) discovering relevant things, (5) enhancing your surroundings with information and simulation, and (6) learning your interests as well as how and with whom you like to learn (p.2). These unique senses would help make mobile devices ideal for collecting artifacts. If designed properly, an educational application that takes advantage of these

unique senses would help students bridge the gap between what they learn in the classroom and what they see in real life.

Because of these characteristics, mobile devices are perfectly positioned to be one solution for the problem of in-context learning. Mobile devices contain most, if not all, of the tools that desktop computers can provide. These devices can collect data of various types (text, photos, videos, recording, geographic location, etc) in context and even process some of that data on the spot. In addition, mobile devices have their own power source and can go where ever the learner goes. Therefore, these devices provide many of the tools needed to make connections between classroom learning and the "outside world."

However, one problem with the current state of mobile application software is that the information and data that they collect can be slightly to extremely disorganized. Pictures stay on the "camera roll" application, geographic location data stays with the map application, and any other data that is collected stays with the application that collected it. This is great if the application program is designed for education, but most are not. How can students collect artifacts that prove they are learning a specific topic and then share those artifacts with their instructors or classmates?

This last issue – sharing artifacts with instructors and classmates – is the key point to consider when examining the usage of mobile devices for this proposed solution. Vygotsky (1978) developed the social constructivist theory of knowledge that proposes that learning happens when learners reach the "zone of proximal development." One effective way to reach this zone is through collaboration with other learners. Technically, students could use any tool they want to describe what they saw around them and then take this description on paper or some other medium and share it with other learners. This would basically work, but it could lead to the learner leaving out important details that others need to make sense of what they are reading. This basic method would also still work like a one way flow of information that is not really collaborative in nature. Therefore, a solution is needed that would accurately capture artifacts as they appear in real life, and then lets other students share their thoughts on those artifacts to create a shared understanding of what those objects mean. Many mobile applications exist that could allow

students to collect their thoughts or images, but most of these are not really designed with social constructivist theory in mind. A new mobile application is needed to fill this gap.

Proposed Mobile Application Design

As previously discussed, if students need to connect what they learn in the class to the world around them, they can possibly use a mobile device because they have this device with them most of the time. However, the application they use must be designed to accommodate social constructivist learning theory. The basic design of the application being proposed in this solution is one that would help students connect what they learn in a particular lesson, unit, or module with something they see in real life. Students would collect artifacts that demonstrate this connection. These artifacts could be pictures, recordings, videos, pins on maps, notes, or other forms of data. For the sake of simplicity, the initial stages of the proposed app will focus on pictures. The working title of this application when it is referred to in this paper is “This Picture.”

At the most basic level, the pictures that students take could go back to the instructor for grading. However, since the goal of this app is to take advantage of social connections to help students construct shared, the pictures will be shared with other students as well as the instructor. Students will then be given the option to comment on the picture to see if they can guess how the image relates to the current lesson. This would add a game-like element to the activity. At some point, the student who took the picture would create an analysis of what they took a picture of as well as rate how other students guessed how the picture related to the lesson.

Future versions of this app would allow for greater flexibility in how students and instructors can set up the app. Students could be placed in groups which allow users to take turns as the finders and guessers. Students could potentially be given the option of rating each other’s responses, or even in starting a discussion about the pictures in the same way Facebook users can discuss an uploaded picture. Other future options for the application will be based on user feedback after the app is developed, but a few ideas will be discussed at the end of this paper.

Mobile Application Functionality

The first screen that students see would allow them to take a picture or see a list of the pictures that other students have already taken. This would allow them to choose between commenting on other pictures or taking a picture of something they see. Students would also have the option of uploading a picture that was previously taken from a camera roll if they needed to quickly take a picture when they didn't have time to open the app:

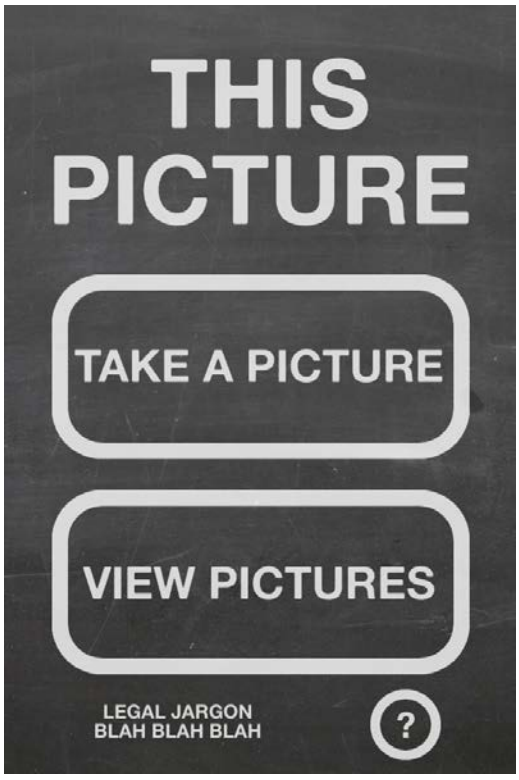

Figure 1: Opening screen for This Picture app

If students select to take a picture, they are taken to the camera app of their phone to take the picture (or be given the option to open the devices' camera roll):

Figure 2: Example of the camera app on a smartphone

Students would preview the picture and choose to retake or save. This action would add the picture they took to a running list of all pictures taken by other students in their class or group. This running list function of the application would be the main interaction area for the app.

When a student chooses to see the pictures taken by other students, they would next see a scrolling stack of these pictures with the most recent ones on top. Pictures that they have commented on would have a green border around them, while new pictures that they need to comment on would have a red border. This visual clue would help them quickly see new pictures or review older pictures that they were initially unsure of:

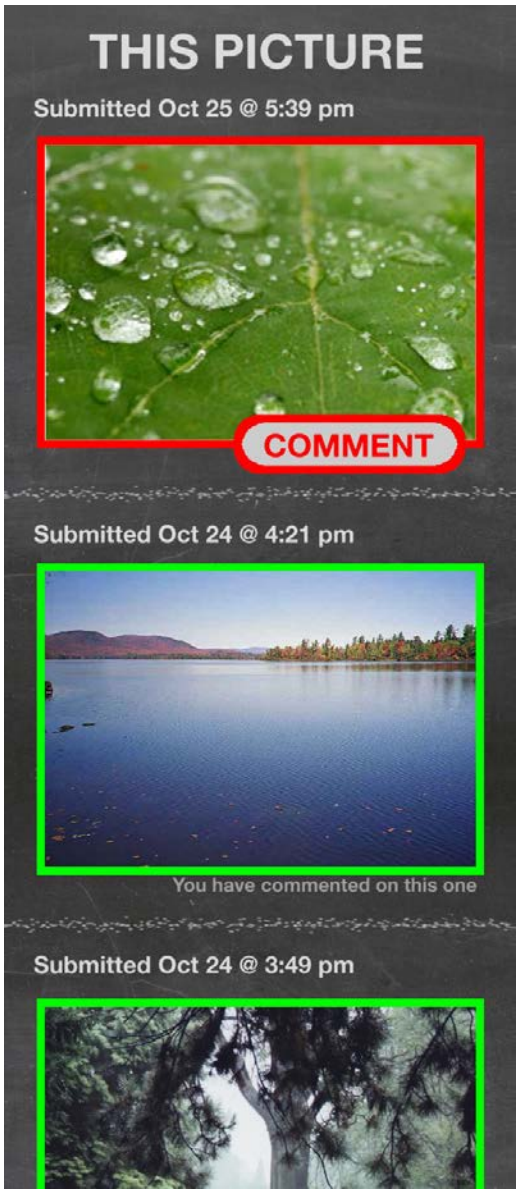

Figure 3: Scrolling stack of student pictures, with new image on top awaiting a comment.

Students would click on a picture to add their response to the picture. This response would basically consist of how they think the picture relates to the current lesson. Tapping on a picture would bring up a screen with a virtual keyboard that allows them to type in their comment:

Figure 4: Comment screen for This Picture app

Once they have added their comment, the border around the picture would change green:

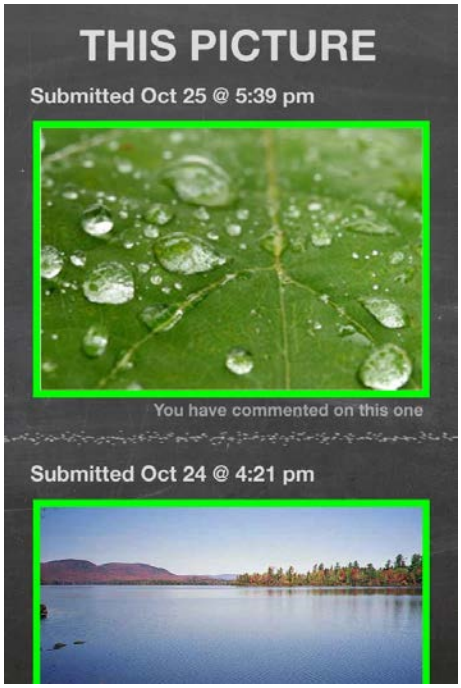

Figure 5: Border changed to green once a comment is entered

In the initial stages of this app, students will not see the comments from other students. In future versions, this option will be open for instructors to add. Ideally, students would not be allowed to see

other comments until they first enter their thoughts. This feature would be intentionally designed this way in order to cut down on cheating. After the comments are opened up, students can then discuss their responses and even rate other student responses.

Using This Application as a Solution

With this theoretical application, students will be able to collect artifacts of objects in the world around them that connect to a recent lesson. This connection will be shared with other students, who will have to guess how the shared artifact connects with what they recently learned. Of course, students may already be doing this as they go about their daily life by using popular sites like Instagram and Facebook. So the real issue is that there needs to be a way to document this connection.

In addition, some student may not be thinking of how their lesson connects to the world around them. This application will help motivate those students to begin looking for those instances. Using an interactive social format will help students to engage one another in the challenge of seeing who can guess what they are doing.

Mobile devices are a unique solution for this problem because they are usually always with the student and can take pictures or collect other artifacts at a moment's notice. A student can always write a paper about what they saw that day, but it could be easily fabricated. Collecting artifacts such as pictures in context is a good way to prove that the students actually saw something in their daily life and made the connection with the lesson. Having other students guess what the picture is or how it connects with the lesson by submitting comments is also a good way to share learning and to give students many practical examples of how lesson content connects with the world around them.

Of course, there are other ways to accomplish something similar. Students could do an image search online and find pictures that relate to the lesson. However, these images will not be from the actual student's life and therefore would not truly achieve Vygotsky's child-in-context theory. In addition, students would also have access to text with most images that could potentially tell them what they need to know about how the image connects to the lesson. This would not be the case if they are collecting the images in context.

Another device that could take the place of this app is a personal camera. But the problem with a personal camera is the lack of internet connectivity, as well we the lack of the social function of the app. In order to share pictures from a camera, the image would have to be downloaded from the camera and then emailed to other classmates. This would be a time consuming process that might discourage students from sharing. This app would simplify the process, possibly encouraging students to share more pictures and interact more. Additionally, future expansion of the app could contain audio, video, maps, or other location information that most cameras don't provide.

Finally, the portability of mobile devices makes the best case for why this app would be better than other solutions. Most students would be unlikely to carry a laptop or desktop computer around with them in order to achieve in-context learning. Often these larger devices don't have a camera built in, and even if they do, they can take a long time to start up. Therefore, mobile devices with this app installed would be an ideal solution for the educational problem previously discussed.

Initial Development Stage

Based on the in-class presentation of the application idea, Dr. Elliot Soloway from the Department of Electrical Engineering and Computer Science in the College of Engineering at the University of Michigan in Ann Arbor, Michigan offered to recruit a group of students from one of his classes to design the initial stage of the app. We agreed that the first version of the app should be the minimally viable product (MVP) initially, since time would not permit the development of the full app. After pitching the idea to his course, four students were identified to work on the app: Shuheng Huang, Jordan Kaye, Steve Huang, and Jea Gon Park.

I met with the group and Dr. Soloway initially via phone conference in order to discuss the development path. We decided that the app would be developed for Android operating system as this is the system the group in most knowledgeable in. The basic ideas for the app were discussed and the group went to work. I also created several mock-up screenshots for the group members to work from (see figures 1-5).

The group worked diligently to create the app and asked questions as needed. As the work progressed, we communicated by email to discuss issues. Two of the largest issues identified were that of storage of images and bandwidth needed to serve the images to mobile. Even a small group of students using this app could use up a large amount of storage and bandwidth in a short amount of times. The initial design is using a free version of Google App Engine to process and store images. The free version of Google App Engine has very small limitations on storage and bandwidth, so another alternative will be needed to continue future development.

In a very short period of time, the student group was able to produce the MVP version of the app. The following are screenshots of that version in action. The first screen shot shows what students will first see when they open the app:

Figure 6: The initial screen as actually designed.

If students choose to view pictures, they are taken to an area that displays a stack of all of images shared by other students:

Figure 7: Photos taken by the trial version of the app.

And finally, students are allowed to comment on individual pictures:

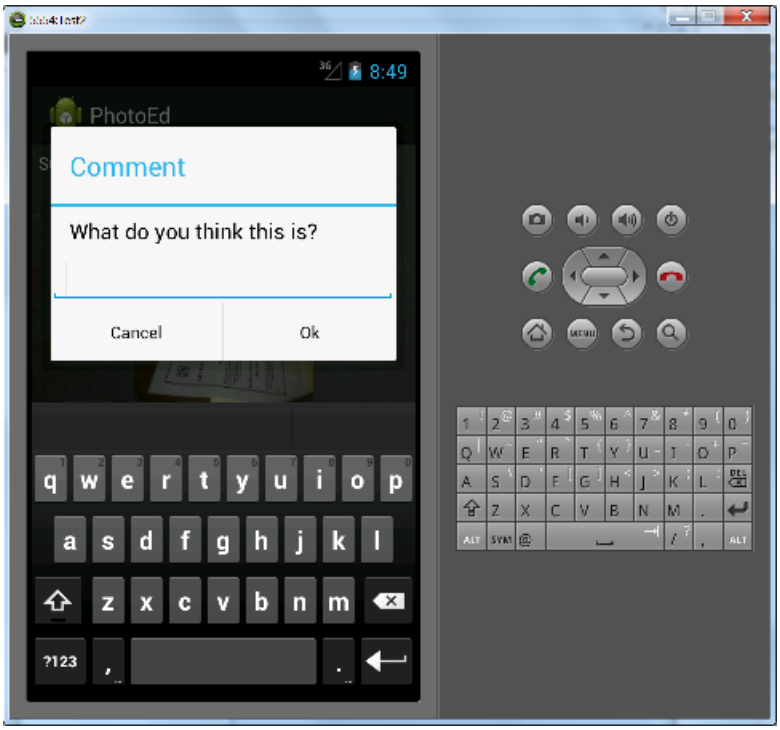

Figure 8: Comment area for an individual image

Application Trial

Application trials with actual students are forthcoming. Dr. Soloway has identified Dearborn Christian School as a possible test site for the MVP version of the app to provide “alpha version” end user feedback. Due to time constraints, this trial will be occurring after the end of the current semester. But feedback from this trial will be used to improve the end user experience and functionality of the MVP version of the app.

Shuheng Huang from the development group also met with a research group connected to Dr. Soloway to present the basic MVP version of the app. This group was investigating whether or not the This Picture app could be used in their own projects. This group like the idea and methods but had some questions about the functionality. As Huang described the concerns:

> “They feel that in order to gain widespread usage the app needs to be more generalized. The best way they think to achieve this is to make a Facebook photos/piazza type of app. Their main complaint was that comments are hidden and there is no way to for students to interact with each other’s posts. Other than this the feedback was mostly positive.”

These are valid concerns, but ones that can be addressed in future versions of the app.

Future Update Possibilities

The initial idea for this app was a much broader and complex design than was possible for the initial stage. Many ideas were cut out to create the MVP. These ideas and possibilities for the future of this app include:

- Take videos as well as pictures. Students can then video occurrences as well as artifacts. This could also allow students to act out ideas, add snippets of television, news, or movie scenes they see that apply to the lesson, or even submit performances (art, theater, music, etc.) for review.
- Submit audio recordings. This would have many benefits of the video update, but allow students to focus just on sounds or music. Another benefit is that audio recordings would allow students to take away the visual layer to make it more difficult to guess what the occurrence is.
- Tag photos or maps with geographic locations. This would allow students to use places as artifacts. Other students would have to look up the student’s location on a map and guess how

that relates to the lesson. Students could also be sent on a scavenger hunt of some kind, with a geo-tagged photograph proving they visited each location.

- A forum of some type that allows students to interact with each other while discussing the artifacts and occurrences. This function could be a “Facebook Photos”-like way of commenting on images or even tagging other users.
- Rating system that allows students to rate the best responses and comments.
- Some kind of editing system that allows students to take several images and place them together in a collage, including filters and other editing tools to add graphics (arrows, boxes, etc). This would allow students to create story boards and collages based on class pictures.
- Flexibility in settings that allows different people to be admins, finders, and guessers.
- Security and editing settings that allows the instructor to step in and stop off topic or inappropriate behavior.

These are just some of the possibilities for the future development of the app. Feedback from students, instructors, and researchers will be critical to ensure that all functions are necessary and not just extraneous fluff. The focus will need to rest mainly on social interactions and in-context learning as development moves forward. If the app is allowed to develop further, it will quite possibly prove to be a very effective tool in mobile learning.

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