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EVALUATING THE ACCEPTABILITY AND USABILITY OF EASEL: A MOBILE APPLICATION THAT SUPPORTS GUIDED REFLECTION FOR EXPERIENTIAL LEARNING ACTIVITIES

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ABSTRACT

Aim/Purpose	To examine the early perceptions (acceptability) and usability of EASEL (Education through Application-Supported Experiential Learning), a mobile platform that delivers reflection prompts and content before, during, and after an experiential learning activity.
Background	Experiential learning is an active learning approach in which students learn by doing and by reflecting on the experience. This approach to teaching is often used in disciplines such as humanities, business, and medicine. Reflection before, during, and after an experience allows the student to analyze what they learn and why it is important, which is vital in helping them to understand the relevance of the experience. A just-in-time tool (EASEL) was needed to facilitate this.
Methodology	To inform the development of a mobile application that facilitates real-time guided reflection and to determine the relevant feature set, we conducted a needs analysis with both students and faculty members. Data collected during this stage of the evaluation helped guide the creation of a prototype. The user experience of the prototype and interface interactions were evaluated during the usability phase of the evaluation study.
Contribution	Both the needs analysis and usability assessment provided justification for continued development of EASEL as well as insight that guides current development.
Findings	The interaction design of EASEL is understandable and usable. Both students and teachers value an application that facilitates real-time guided reflection.

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Recommendations for Practitioners	The use of a system such as EASEL can leverage time and location-based services to support students in field experiences. This technology aligns with evidence that guided reflection provides opportunities for metacognition.
Recommendation for Researchers	Iterative prototyping, testing, and refinement can lead to a deliberate and effective app development process.
Impact on Society	The EASEL platform leverages inherent functionality of mobile devices, such as GPS and persistent network connectivity, to adapt reflection tasks based on location or time. Students using EASEL will engage in guided reflection, which leads to metacognition and can help instructors scaffold learning.
Future Research	We will continue to advance the application through iterative testing and development. When ready, the application will be vetted in larger studies across varied disciplines and contexts.
Keywords	experiential learning, mobile devices, smartphones, technology, application supported learning, reflection, metacognition

INTRODUCTION

Lectures have been the standard classroom activity for many years. However, approaches to teaching and learning vary widely in modern academia. Within the past few decades, active learning techniques have gained popularity in the academic community. Bonwell and Eison (1991) summarized the literature on active learning, concluding that students engaged in active learning environments demonstrated improvements in thinking and writing and had a more positive attitude. Further, active learning can lead to richer understanding and deeper learning because students participate in the revelation of the learning material (Prince, 2004). Their involvement shapes the lesson and they feel a sense of ownership of their own learning. Active learning could increase academic performance by a standard deviation of 0.47 (Ruiz-Primo, Briggs, Iverson, Talbot, & Shepard, 2011). Additionally, some students are 150% more likely to fail in courses dominated by traditional lectures over courses that feature active learning strategies (Freeman et al., 2014).

Experiential learning is an active learning approach in which students learn by doing and by reflecting on the experience (Joplin, 1981). Examples of experiential learning activities are laboratory experiments, field exercises, shadowing a professional, and engaging in live performances. Based on the theories of Dewey, Lewin, and Piaget, D. A. Kolb (1984) noted, "learning is the process whereby knowledge is created through the transformation of experience" (p. 41). In order to foster transformation, reflection must be included as part of the experiential learning process (Mezirow, 1990). If reflection is completed days or weeks after an experience takes place, the concern of the researchers is that this would potentially lead to memory loss about the event due to a gap in time (Bridge & Voss, 2014).

To counteract any time delay for students when reflecting, we sought to find an automated way to facilitate just-in-time reflection. However, no current technology existed. To meet this need, we developed an educational platform titled EASEL (Education through Application-Supported Experiential Learning). The purpose of EASEL was to provide time-based and location-based reflection before, during and after a learning experience.

In order to conceptualize, design, and evaluate EASEL, we conducted a needs analysis and a usability evaluation. As part of conceptualizing and designing EASEL during the needs analysis phase, 23 Freshman students were surveyed about their experiences with reflection and using mobile technology. To evaluate the acceptability of EASEL and to inform its design, the perceptions of students and faculty members who might utilize a tool such as EASEL were sought. During this part of the needs analysis, a different group of 22 undergraduate students and 13 faculty members viewed a concept animation that illustrated a typical interaction with EASEL and filled out a questionnaire. Once a prototype of EASEL was developed, ethics approval was sought for a usability evaluation as the final part of the study. For this stage, eight further faculty and six different students were asked to complete tasks using a low-fidelity prototype of EASEL on their mobile phones. Their interactions were both videoed (using screen recording) and observed by a facilitator, and they were asked to fill out brief post-task questionnaires about their experiences. Once all the tasks were completed, they were asked to complete a usability questionnaire and discuss their experiences individually with the facilitator.

The primary inquiry question at the crux of the usability part of the study was:

Is EASEL an appropriate mobile learning technology for facilitating experiential learning and guiding reflection before, during and after an experience?

Sub-questions included:

- Is the interface design of EASEL easy to use and understand? and
- Would students and faculty want to use EASEL in a class?

In this paper, we provide a brief history of experiential learning, the role of reflection in experiential learning, and the value of technology to facilitate it. We explain the EASEL system and the methods the research team used to evaluate the conceptualization, the design, and usability of an early prototype. Finally, we discuss our current development efforts and future directions.

EXPERIENTIAL LEARNING, REFLECTION, & METACOGNITION

D. A. Kolb (1984) developed a cyclical model of experiential learning in which the learner forms concepts and generalizations based on reflections on experiences (Figure 1). In Kolb's model, effective learning occurs when a person progresses through a cycle of four stages: they have a concrete experience followed by observation of and reflection on that experience. This leads to the formation of abstract concepts and analysis followed by generalizations and conclusions. These generalizations form the basis of hypotheses, which the learner tests in future situations resulting in new experiences and renewing the cycle.

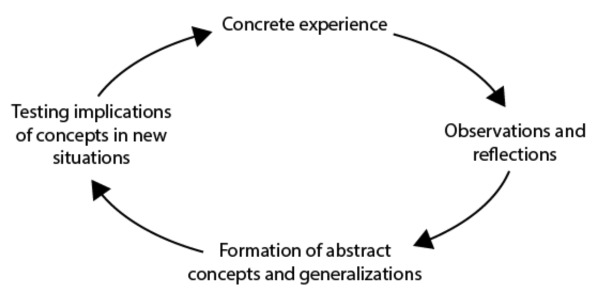

Figure 1. David A. Kolb's model of Experiential Learning (1984)

Experiential learning also requires that students adapt their thoughts and behaviors to the context of the environment in which learning occurs. It promotes self-regulated learning and encourages students to employ metacognitive skills (Lin, Hmelo, Kinzer & Secules, 1999). In effect, experiential learning helps students *learn to learn*. In John Dewey's highly influential *How We Think* (1933), he identified that reflection on an experience is a key step in the cycle of learning. Boud, Keogh, and Walker (1985) expanded on Dewey's model by decomposing reflection into three steps: 1) Recalling the details of the experience, 2) Recognizing the feelings present at the time of the experience, and 3) Reexamining the experience considering the original intention and how it relates to existing knowledge. Schön (1987) further distinguished between reflection that helps students' process during a learning activity (reflection-in-action) and reflection that helps students' process after a learning activity (reflection-on-action), both of which are valuable to learning. Boyd and Fales (1983) emphasized that the reflection stage is crucial for allowing the learner to think and to develop and integrate new knowledge. They considered "The individual experiences a 'coming together' or creative synthesis of various bits of the information previously taken in and the formation of a new 'solution'" or change in the self" (Boyd & Fales, 1983, p. 110).

When students reflect on their experiences, they are more likely to internalize them. The lessons they learn become imprinted on their consciousness and shape their future perceptions. When students are cognizant of their learning, they experience metacognition, which leads to deep learning (Desautel, 2009). Metacognitive thinking, or thinking about thinking, includes being self-aware of current knowledge and thought processes and then synthesizing new knowledge and thought processes, enabling the development of critical thinking skills and deeper learning. Metacognitive skills not only include being aware of ones' own knowledge and thought processes, but also the ability to synthesize new knowledge and processes. Reflection is needed for metacognition as it can help to develop this awareness. Therein forms a cycle in which the evaluation of these processes continues the recursive process of learning (Flavell, 1979; Lai, 2011). Metacognition has been shown to help students learn more effectively from experiences through reflecting, thinking, and acting upon what they learn (A. Y. Kolb & Kolb, 2009). Doing so promotes self-regulation (Lin et al., 1999).

In order to document and assess experiential learning, students are typically asked to write a journal entry or take a post-survey based on a field experience (Xie, Ke, & Sharma 2008). Students who engage in such reflection maximize learning and engagement in the activity (Voss, 1988). Because the experience is augmented by a deliberate consideration of its effectual aspects, the student more easily identifies valuable lessons (Wong, Kember, Chung, & CertEd, 1995). Furthermore, students are more likely to understand the implications of the experience and tease out deep observations (Husu, Toom, & Patrikainen, 2008). Reflection activities tend to be either free-form or guided. Free-form reflection occurs when students are not given specific direction about what to write. Often teachers ask students to write journal entries to capture their thoughts and observations, but do not give them specific objectives. Contrastingly, guided reflection activities involve specific instructions in which the teacher prompts the student to focus on certain aspects of the experience and provides objectives for the student's writing (Sturgill & Motley, 2014).

Free-form reflection is useful because students often identify unanswered questions that arose directly as a result of an experience. While revisiting the memory of their experience, they often identify what they found most impactful and what they had not previously considered. In contrast, guided reflection offers an important opportunity for an instructor to scaffold the students' learning (Welch, 1999). It is particularly useful when an instructor's goal is to achieve specific learning outcomes. Reflection prompts can elicit responses before, during, and after the experience (M. Jacobson & Ruddy, 2004). A study by Sturgill and Motley (2014) compared the efficacy of three different models of written reflection. Four groups of students each reflected in a different way. The researchers compared each student reflection across axes of guided versus free-form reflection, dialogic versus expressive reflection, and public versus private reflection. Among other findings, the study revealed evidence of deeper learning for students who engaged in guided reflection over those who used free-form reflection.

Reflection has different outcomes depending on when it occurs, whether before, during, or after an experience. From the researchers' perspective, when a student is asked to reflect *before* an experience, the instructor can guide the response so that it reveals prior knowledge, preferences, assumptions, biases, and feelings about a topic. This knowledge can form a baseline that is useful to the instructor when comparing future reflections. It also helps the instructor to develop empathy for the student and deeper insight into the learning process. For students, a reflection prompt before an experience allows them to write openly about their feelings, thoughts, and ideas, while still addressing specific objectives. Students reflecting *during* an experience are aware of the significance of their present context. This results directly in metacognition because they can identify valuable lessons as they learn (Schraw & Moshman, 1995). For the student, this allows them to become familiar with how they learn, what they're comfortable with, and what they would change in the process of their learning. For the instructor, the student's thoughts and ideas on how they're learning can inform future curricular modifications.

Reflection *after* an experience has occurred allows the student to analyze what they learned and why it was important, which is vital in helping them understand the relevance of the experience. Additionally, students will synthesize prior knowledge and expectations with the newly acquired knowledge to arrive at novel discoveries and conclusions, which is essential to critical thinking (Boud et al., 1985). Furthermore, Boud et al. (1985) and Moon (2013) recommend that reflections be done as soon as possible after the experience to ensure the most accurate recall.

This discussion highlights the important differences between approaches to reflection and the time they are made relative to the experience. A tool to facilitate reflection should be able to accommodate both free-form and guided reflection. It should also support reflection before, during, and after the experience.

TECHNOLOGY TO FACILITATE EXPERIENTIAL LEARNING

In our review of literature, we did not identify an existing technology that adaptively scaffolds course content and provides opportunities for students to reflect in real-time before, during, and after an experience. However, previous work that integrated technology into experiential learning provides insight into how such a system might be implemented.

Researchers have not only recognized the growing trend in mobile learning, but also identified the key benefits of flexibility and the potential for students to engage in self-regulated learning (Cochrane & Bateman, 2010; Fakeek, 2016; Rossing, Miller, Cecil, & Stamper, 2012). Further, mobile applications that adapt to learners can be tailored to their particular educational needs leading to a more effective learning experience (Gómez, Zervas, Sampson, & Fabregat, 2014; Subramanian & Rajkumar, 2016; Tseng, Chu, Hwang, & Tsai, 2008). Al-Hunaiyyan, Bimba, Idris, and Al-Sharhan (2017) established a model of the student learning process within the context of mobile learning. In particular, their work focused on the importance of self-assessment and the evaluation of newly acquired knowledge leading to metacognition. Van den Boom, Paas, Van Merrienboer, and Van Gog (2004) provided reflection prompts to students in a web-based learning environment. They found that reflection prompts, especially combined with tutor feedback, have positive effects on the development of students' self-regulated learning competence.

Graesser, McNamara, and VanLehn (2005) explored the use of technology to guide students during a field experience. They demonstrated that content could be delivered to the learner in different phases of the inquiry process and lead to explanation-centered learning in which the student creates and validates dynamic hypotheses. Their AutoTutor software provided students with supplemental material to enhance their experience, engaging them in a natural-language conversation to help students flesh out their ideas. Holden and Rada (2011) used technology to scaffold material and provide reflection opportunities using platforms such as blogs and journal apps to support reflection. However, the reflection was not done immediately. Reflections recorded long after an experience may lead to a distorted recollection (Bridge & Voss, 2014).

In order to foster metacognitive skill development and self-regulated learning, the researchers believed a real-time procedure should be put into place to solicit reflection before, during, and after a learning experience. While blogs and digital journaling systems facilitate submission and aggregation of the student's reflections, they do not necessarily promote just-in-time reflection. While microblogging or note taking on a smartphone may enable a convenient way for students to quickly record their thoughts, an adaptive technology that prompts reflections in real-time would be more likely to guide learners to explore the context of their experience.

The development of such a technology should follow an established software development lifecycle (I. Jacobson, Booch, & Rumbaugh, 1999). Particularly important phases of this cycle include needs analysis, during which information is gathered from potential users to inform the design (Gould & Lewis, 1985), and usability testing, in which users evaluate prototypes of the technology (Nielson, 1994).

DESCRIPTION

EASEL is a mobile platform that allows instructors to deliver reflection prompts and content before, during, and after an experiential learning activity. It puts direct contact between the student and instructor at the core of the learning environment. The EASEL platform leverages the inherent functionality of mobile devices, such as GPS and persistent network connectivity, to adapt reflection tasks based on location or time. EASEL facilitates multiple input modalities such as text, voice recording, photography, and video – offering students convenient and effective options to record their reflections.

Reflection and content prompts can target specific milestones throughout a learning activity, being triggered by the location of the device, the time of day, or a combination of the two. When students receive a notification, they swipe to open a screen within EASEL that pertains to a specific prompt. The interface is adaptive based on the location of the student and time of the field experience. This allows instructors to anticipate reflection opportunities and direct student feedback.

Instructors can assign an experience independent of time, leaving scheduling up to the student if desired. Instructors can specify reminders or media to pop-up for the student to review based on time or the student's location. Prompts can also be scheduled to appear after the activity, allowing students to immediately reflect on the experience. An instructor can then evaluate the responses, or review data from a series of events for individual students, by groups or by class. Instructors enter prompts through a web-based portal that connects with the EASEL system and allows them to create questions, provide text or links before, during, and after an experience.

The instructor can select from several types of pre-programmed events or create a custom type. She can also choose from several prompt types such as open-ended, multiple choice and true/false. Answer modes can be specified as well, including text, audio, video, or the option to choose from several formats.

The entire system consists of two parts: The client, which runs on students' smartphones, and the administrator, which teachers access through their web browser. Both components are linked through a shared database. We are implementing the client component as a native IOS application because the system needs to access features of the smartphone not available through a web application, such as the camera and GPS.

JUSTIFICATION FOR A MOBILE APP

A 2014 survey revealed that 86% of U.S. college students owned a smartphone (Dahlstrom, Brooks, & Bichsel, 2014). Moreover, students tend to use mobile devices for academic purposes such as course interactions, in-class research, message board interactions and communication with instructors (Foti & Mendez, 2014). By all indications, that number has increased and will continue to increase substantially in the near future, as students expect that mobile devices will be an important part of their learning in the future.

An informal survey of the forty-six students in our Visual Communication and Video Production classes indicates that nearly all of them not only own smartphones with persistent connectivity (Figure 2), but also carry them nearly everywhere. We see evidence of this across our campuses as well. University students typically have a smartphone on their person at all times. This ubiquitous trend presents an important opportunity to leverage the students' smartphone as a tool to connect them to their coursework. It is particularly useful considering our intention to push reflection prompts when students are engaged in learning activities outside of class meetings.

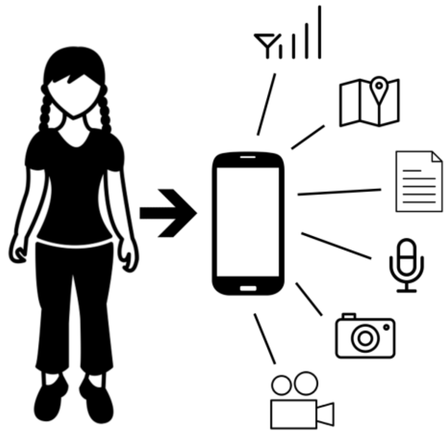

Figure 2. Most students have smartphones with persistent network connectivity

Another advantage of leveraging smartphones is that the device has a persistent connection to the network. In addition to pushing reflection prompts, instructors could potentially provide real-time and continuous feedback. When student work involves artifacts that cannot be patently categorized as correct or incorrect, formative assessment helps students develop skills that lead to higher quality work (Sadler 1989). Teachers providing real-time feedback to students engaged in an activity could guide their actions or inquiries to specifically align with learning outcomes.

Modern smartphones have integrated GPS radios that continuously update to track the device's location. This location data can be used to trigger events such as reflection prompts, which would be particularly useful in field activities where specific locations are closely associated with experiences. For example, a teacher could configure a reflection prompt to appear when a student arrives at a particular location. Also, network-based applications facilitate automatic time-stamping. Recording the timing of activities requires no action from the user since each interaction is streamed to the server and logged. It is, therefore, trivial to establish the sequence and duration of activities. Even so, stopwatch functionality that allows users to start and stop timing is easily implemented in a mobile application.

Perhaps the most compelling reason to access EASEL on a smartphone is that it facilitates immediate reflection. Not only can students record their thoughts and observations on a device that is convenient and reliably available, but they can do so using a variety of input methods such as text, voice recording, photography, and video. The flexibility is convenient. Moreover, students who immediately record their observations are considered more likely to develop a deeper understanding and appreciation of their experience (Mezirow, 1990). The act of reflecting soon after the experience also reduces the tendency for distortions and false memories (McGaugh, 1966).

Lastly, persistent network connectivity affords students the option to use network resources to augment their interactions. For example, a student could include images from a web search to supplement her reflection or look up pertinent information to include.

A Case - Students Interview an Industry Professional

EASEL can be integrated into the learning environment as a seamless part of the students' digital lifestyle. For example, the instructor might assign students to conduct an interview with an industry professional. The description in Figure 3 illustrates how a student might complete such an assignment.

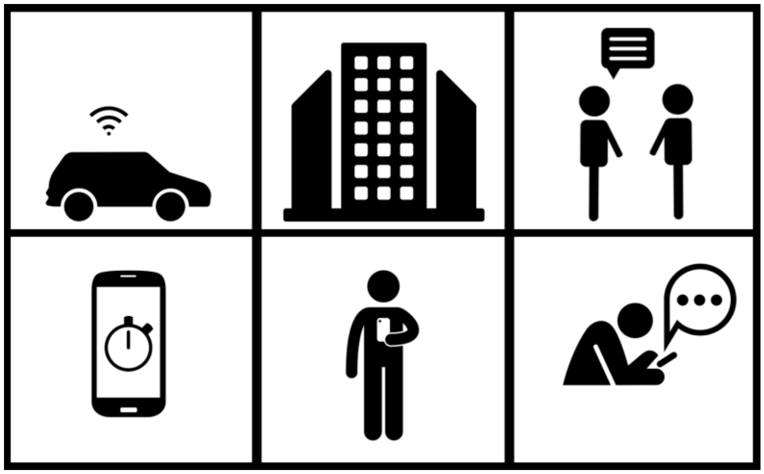

Figure 3. A typical workflow of a student, using EASEL to reflect on an interview. She drives to the interview location and is prompted to enter a pre-interview reflection. She meets the interviewee and initiates the stopwatch function. When the interview ends, she receives a notification to view a post-interview reflection prompt and uses the smartphone keyboard to enter the text of her reflection.

When the student first learns about the assignment, she logs into EASEL and selects the course. She schedules the interview and specifies the address where it is to take place. On the day of the interview, the student receives a notification reminding her to review a video to help her prepare for the interview. An hour before the interview, as specified by the instructor, the student receives a notification to take a survey. As the student nears the location of the interview, a notification appears to remind the student to track her time. The student can swipe to reveal a time tracker. When time tracking is engaged, location services are enabled so that the instructor is aware of the length of the interview and its location. Once the student finishes the interview, she stops the timer and views a set of reflection prompts. The application notifies the student of the time frame in which she is to complete the reflection survey. Screenshots of the stages that might appear in the application's user interface are shown in Figure 4.

The student can use multiple modalities such as voice-to-text or the keyboard on the device to answer text prompts. She can use the camera and microphone for video and audio recording. Reflection questions may be either qualitative or quantitative as designated by the instructor. At any time, a student can monitor progress on an experience by accessing that specific experience in the EASEL app. The instructor designates experiences for students to schedule through a web-based interface, which is also used to review and export student responses.

The methods used to evaluate EASEL prior to development and once a prototype was prepared and launched with students and faculty were necessary to ensure the application was fit for purpose.

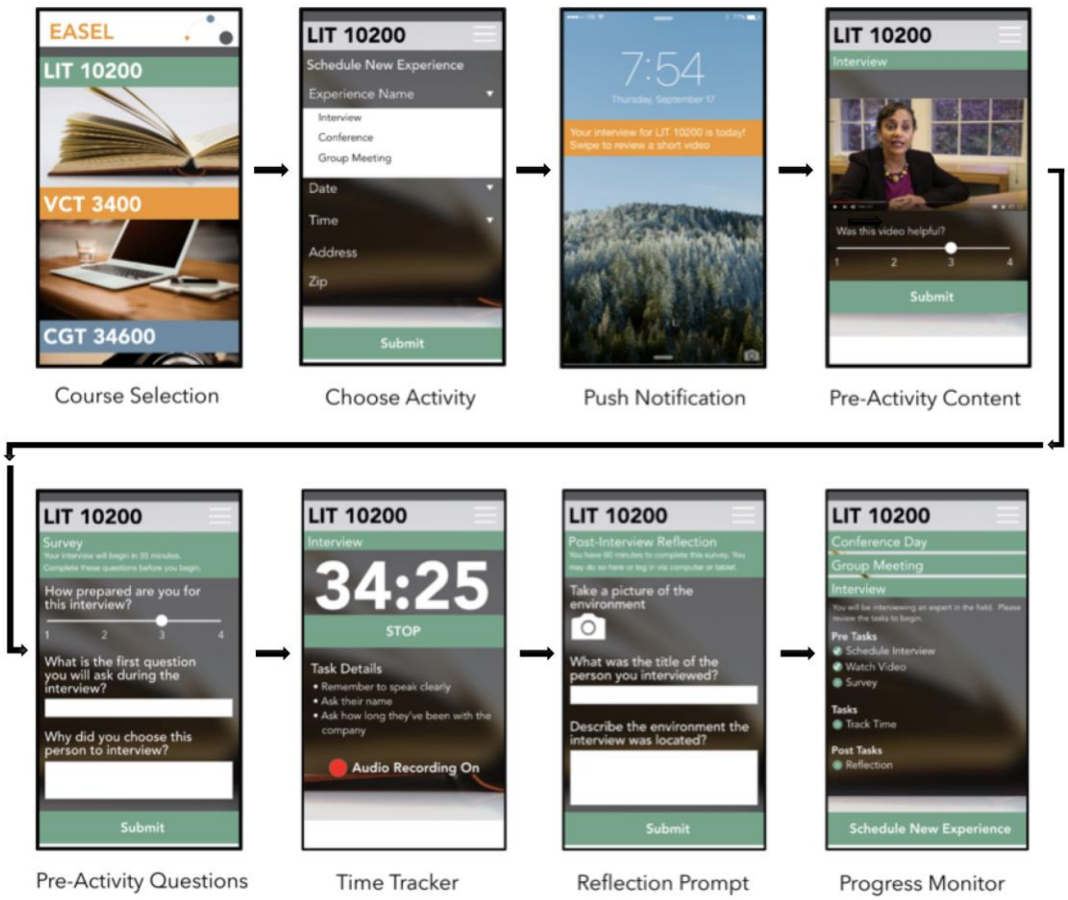

Figure 4. Screenshots of the EASEL interface

EVALUATION METHODOLOGY

An evaluation was carried out in two stages: a needs analysis and usability testing of a prototype. These methods of evaluation are regarded as formative and are commonly used to inform the design and development of technological solutions and multimedia applications and systems (I. Jacobson et al., 1999).

For the needs analysis phase, twenty-three freshman students were surveyed about their experiences with reflection and using mobile technology. Their responses helped guide the creation of a concept animation depicting EASEL in use. Twenty-two different students and thirteen faculty members were shown the concept animation and answered questions about their opinions and perceived value of such an application.

For the usability phase, six students and eight faculty members were observed as they interacted with a click-through prototype of EASEL. Participants completed standardized tasks and answered questions about their experience using the application. Their interactions were both videoed (using screen recording) and observed by a facilitator, and they were asked to fill out brief post-task questionnaires about their experiences. Once all the tasks were completed, they were asked to complete a usability questionnaire and discuss their experiences individually with the facilitator.

Both quantitative and qualitative data was collected during the evaluation. The following is a detailed description of the evaluation methodology.

NEEDS ANALYSIS

Questionnaire 1 – Self-reflection habits

When forming the idea for a technology-supported reflection tool, the authors conducted a small questionnaire to evaluate students' self-reflection habits. We administered the questionnaire with twenty-three students in a freshman transition course at a Midwestern university. Because the questionnaire was part of an existing class and participants were given the option of opting out of the study, it was exempt from institutional review board approval. At the completion of an experiential learning activity and subsequent set of reflection exercises, students completed the questionnaire that included both quantitative and qualitative questions. Students were asked questions related to whether they personally reflect on learning activities without being prompted, on what types of things they typically reflect, what methods they use for reflection, and their use of a mobile devices for reflection (see Appendix A).

Questionnaire 2 – Acceptability of EASEL

To evaluate the acceptability of EASEL for both students and teachers, we produced a short animation that depicted the app in use. Following a viewing of the animation, we surveyed twenty-two undergraduate students and thirteen faculty members at a different Midwestern University from those who completed the first questionnaire. The institutional review board approved the study (IRB: 965015-2). We invited participants through a departmental email announcement list and participants self-selected. This part of the study involved a single focus evaluation of the EASEL application in which participants viewed a concept animation that illustrated a typical interaction with EASEL. Faculty participants answered seven mixed quantitative and qualitative questions while students answered five. Questions for faculty related to their use of EASEL as an instructor, such as whether they taught or participated in an experiential learning activity, how reflection was conducted and their initial perceptions of EASEL. Questions for students related to their participation in experiential learning activities, journaling, and how they would anticipate students might interact with EASEL (see Appendix B). All responses were collected and coded for common themes. Based on data collected during the needs analysis, we developed a low-fidelity prototype that allows users to interact with the interface.

USABILITY - ASSESSING THE USER INTERFACE AND USER EXPERIENCE

In the usability phase of the evaluation, the researchers were interested in how students and faculty interacted with the EASEL interface and how they found the experience. Data was collected during real use of the prototype using a combination of post-task questionnaires and facilitator/observer interviews and a usability questionnaire at the end. This questionnaire was based on the Systems Usability Scale (SUS), a common instrument employed in usability study design (Brooke, 1996). The interface developed for the prototype enabled users to complete typical tasks when given a set of objectives. While the application did not transmit responses over the network, the interface behaved and responded in such a way that a typical interaction was simulated.

Six students and eight faculty members participated in the user experience phase of the study at a Midwestern public university. The institutional review board approved the study (IRB: 16604494104) and participants were invited through a departmental email announcement list and self-selected to participate. The usability phase of the study involved a single focus evaluation of the EASEL application on mobile phones displaying the low fidelity prototype.

We asked each participant to perform four tasks based on a hypothetical scenario involving an experiential learning interview and then answer questions about their experience completing the task. Participants did not actually engage in an experience and reflection, rather they clicked through the application as if they were engaged in the hypothetical scenario. Students and faculty members completed different tasks, although each task for the student group matched a similar task for the faculty group. Participants were read a scenario aloud and asked to complete the following tasks.

Student Tasks

1. Schedule an interview after an instructor assigned it to students.
2. Respond to pre-interview questions.
3. Track time of the interview.
4. Respond to reflection questions.

Faculty Tasks

1. Create an interview experience for students and create a task.
2. Evaluate a student's pre-reflection question responses.
3. Evaluate student's completion of an interview.
4. Evaluate student's reflection questions.

Tasks were specified verbally and individually in sequence. For each, participants used the touchscreen to navigate the prototype and attempted to complete the task. Interactions were captured using screen recording in order to examine and understand how participants navigated the prototype. Sessions were also video-recorded to document verbal and nonverbal behaviors.

We encouraged participants to "talk-aloud", verbalizing their experience, reactions, and thought processes. The facilitator observed and noted participants' behavior, comments, and app interactions. After each task, participants answered five-questions, also adapted from the SUS, inquiring about the difficulty of the task and what they might suggest to make it easier. They were also prompted in individual interviews to elaborate on the task experience with the facilitator, who wrote notes. After they had completed all task scenarios, participants completed a post-activity questionnaire. Questions related to participants' general use of technology and the features of the prototype as well as their perception of the application. Questions that came from SUS utilized a 4-point Likert scale while questions related to perception were qualitative.

RESULTS

In the task analysis phase, initial questionnaire data revealed that participants typically did not reflect on experiences unless a reflection activity was assigned to them. After being introduced to the concept of EASEL by viewing an animation, most members of a second group of participants indicated they would recommend including EASEL as a part of an experiential learning activity. They cited the usefulness of prompts and ease of use as the application's most valuable features.

Results collected during the usability phase indicated that participants could complete tasks using an EASEL prototype. They found the application easy to use and most would anticipate using the system frequently.

The following section contains details of the results.

Needs Analysis

Questionnaire 1 – Self-reflection habits

Of the twenty-three students who participated, only seven indicated that they typically reflect on their own learning experiences unprompted. When asked on what they typically reflect, only two students indicated that they reflect on items they learned. Others responded that they reflect on emotions they experienced or that they simply recorded reminders or things to remember.

The results of this initial inquiry precipitated discussions that would lead to the conceptualization of the mobile application. We began by compiling a list of features that might be useful for students engaged in experiential learning. We imagined scenarios, posited interactions, and sought similar existing applications. We identified specific tasks that would utilize such features. While most of the tasks we identified could be completed using existing software, no one software package could do *all* that we required. Our solution was to create a low-fidelity prototype that we could evaluate and iteratively refine, eventually developing a working application.

Questionnaire 2 – Acceptability of EASEL

Twenty-two undergraduate students and thirteen faculty members viewed a concept animation depicting EASEL in use, and participated in a questionnaire. We asked faculty members whether they have taught a course that includes an experiential learning component and how they evaluated their students for such activities. The majority of the faculty members (N=11) had taught in this way. Those who responded affirmatively indicated that they used various formats to elicit and record student reflection including assigning a written paper, journal, status report, or other open-ended question format. Additionally, some stated that they asked students to complete oral presentations, face-to-face interviews, discussion sessions or a web-based timeline.

Eighty percent of all participants (N=28) responded that they would recommend including EASEL as a part of an experiential learning activity. When asked to describe EASEL in one word, participants offered “efficient”, “useful”, “convenient”, “quick notation”, “streamlined”, “prompted reflection”, “provided a task assistant” and “was straightforward”. Eighteen of the responses referred to efficiency or ease of use. Only one person responded negatively, offering the word “pointless” and another provided the word “caution”, presumably because he perceived potential technical issues, as the system is technology-based. When respondents were asked to compare EASEL to traditional forms of reflection and journaling, the most common response identified better memory recall (N=11). Other common responses mentioned words related to ease of use (N=7) and structure/tools (N=6).

When asked to identify something that might be frustrating about the platform, two participants indicated technical malfunction as a potential culprit. Three participants indicated that they would have to use the platform in order to provide a fair assessment. All others did not provide an answer. When asked to provide recommendations for additional features, the most frequent suggestion was to have the ability to adjust the notification settings (N=6). Other participants mentioned essay help, illustrating options, archiving of contact information, and social media integration.

When asked what they liked best about EASEL, the most common response identified the prompts and structure that EASEL provided regarding reminders for completion of tasks (N=10).

Usability -evaluating the User Interface and User Experience

Six students and eight faculty members participated in the usability phase of the study. Each participant successfully completed all tasks. The facilitator noted no apparent difficulty while observing the participants. When asked to rate the difficulty of each task, in all four post-task questionnaires, every response indicated that every task was either somewhat easy or very easy (Table 1).

Table 1. Total post-task questionnaire responses showing level of difficulty

Task	Very Difficult	Difficult	Somewhat Easy	Very Easy
Schedule/Create an experience			7	7
Write/review pre-experience questions			3	11
Track/review time				14
Write/review reflection questions			3	11

Results of the post-activity questionnaire shown in Table 2, revealed no negative acceptability issues. All but one participant agreed or strongly agreed that they would like to use the system frequently. All participants found the system easy to use and agreed that most people would learn to use the system easily. No one indicated that they needed to learn anything additional in order to use EASEL (Table 2)

Table 2. Responses from faculty (n=8) and students (n=6) to the usability questionnaire

Statements		I think I would like to use this system frequently.	I thought the system was easy to use.	I would imagine that most people would learn to use this system very quickly.	I needed to learn a lot of things before I could get going with this system.
Faculty		Agree	Strongly Agree	Strongly Agree	Strongly Disagree
		Agree	Strongly Agree	Strongly Agree	Strongly Disagree
		Agree	Strongly Agree	Strongly Agree	Strongly Disagree
		Strongly Agree	Agree	Strongly Agree	Strongly Disagree
		Agree	Agree	Agree	Disagree
		Agree	Agree	Agree	Strongly Disagree
		Strongly Disagree	Agree	Strongly Disagree	Disagree
		Agree	Strongly Agree	Strongly Agree	Strongly Disagree
Students		Agree	Strongly Agree	Agree	Strongly Disagree
		Agree	Strongly Agree	Strongly Agree	Strongly Disagree
		Agree	Agree	Strongly Agree	Strongly Disagree
		Strongly Agree	Agree	Strongly Agree	Disagree
		Agree	Strongly Agree	Strongly Agree	Strongly Disagree
		Agree	Strongly Agree	Strongly Agree	Strongly Disagree

We gathered qualitative feedback through open-ended questions and it aligned with the ordinal responses. When students were asked if they thought EASEL would be a useful tool for field activities, responses were consistently positive. Some additional comments included:

- "Yes, I think it would be, because it helps the student to start thinking about what they should ask and gives some guidelines on what to ask and how to think and prepare for the interview. "
- "Yes, if I could set a specific date and/or time on the app by which the task(s) had to be completed."

- "Yes for interviews both outside or for a class"

Faculty members also perceived value in utilizing EASEL. In fact, every faculty participant responded affirmatively when asked if they thought EASEL would be a useful tool for field activities. Additional commentary included:

- "Yes. I'd like to try it for the study abroad course."
- "The app could be integrated with Canvas so one feels that there is only one system to manage the class."
- "Yes! Taking it mobile, in my opinion, makes it much more likely that students will engage with all facets of the assignment"
- "Yes, I think student's would really enjoy using the app."
- "Yes, depending on class needs and the background of students in the course."

Students and faculty also provided constructive feedback when asked to suggest changes. Some responses included:

- "The navigation was not clear - I expected to be able to use the menu icon at the top in addition to the actual links. It might be easier if the links were different colors so they were more obvious."
- "A little more direction on areas to write up questions or tasks."
- "Using more useful graphics."
- "What confused me about the colors is, actually, the shape. I thought they were radio-buttons, but these are more like progress bars just in a different shape."
- "Providing a way to customize the alerts to alert someone earlier (i.e. 1 day) prior to the interview"

Students and faculty also provided verbal commentary by speaking aloud during their interaction with EASEL during the tasks. Some notable comments are shown in Table 3.

Table 3. Talk-Aloud Feedback

Positive Talk-Aloud Feedback	Negative Talk-Aloud Feedback
"It looks very simple. I'm not sure yet what it is for. I think I would just start clicking and figure things out." "The notification thing is awesome" "The notification is helpful because it has something that is helpful because it is a reminder that you need to complete a task"	"When I go in for an interview, my phone is going right in my pocket. I'm not going to check it" "I'm thinking EASEL as some way to draw" "Look is pretty confusing" "At the beginning if you have directions it will make it easier for me"

Discussion and Conclusions

The results of the first informal questionnaire about self-reflection habits indicate that most students do not reflect on things they learn during activities in the absence of prompts. Of those who do reflect, only a small percentage focus on things they learned during the activity. This aligns with findings by Welch (1999) that guided reflection can be employed by an instructor to scaffold the students' learning, especially when the instructor's goal is to achieve specific learning outcomes.

Since we conducted this initial questionnaire near the beginning of the project, our conception of EASEL was not well formed. If we repeated this questionnaire, we would likely assess two groups, one engaging in free-form reflection and the other responding to guided reflection prompts. We could then collect information about each group's perception of the reflection activity as well as qualitative data from the reflections themselves.

While the first informal questionnaire provided a justification for further development, the two subsequent phases of the study were where user perception was investigated based on two levels of interactive fidelity. At one level, in the acceptability needs analysis phase of the study, participants gained a conceptual overview of EASEL by viewing a short animation. At the second level, in the usability phase of the study users were given an opportunity to interact with a low-fidelity prototype. While the needs analysis phase informed the design of this prototype, the outcomes of the evaluation revealed important insights that will be used directly to guide the future development of EASEL.

The results of the questionnaire about acceptability provided justification for our development efforts because it revealed that most faculty members incorporated experiential learning into their courses and used various reflection formats. EASEL was considered to be able to offer a valuable alternative to traditional journaling based on its features because it facilitates reflective processes before, during, and after students engage in experiential activities. Responses from both faculty and students reinforce this assertion, as the majority indicated that they would recommend EASEL after viewing the demonstration animation. While most faculty members seemed open to trying EASEL, some indicated skepticism about adopting new technology. This may be because faculty members sometimes feel that they are asked to integrate technology needlessly. While this concern is valid, Manuguerra and Petocz (2011) found that technology as an integral component of the classroom experience can lead to increased engagement.

The faculty members who indicated that they would use EASEL identified several advantages. The most common responses referenced the high level of engagement that students would experience while they are in the field. Flexibility in scheduling and customization were also highly valued, as were ease of use and efficiency.

Responses from students most often referred to reminders and memory recall. They valued the focus that EASEL might bring to an interaction by reminding the student what they should be learning. This insight is particularly relevant as it indicates that students value support in regulating their learning, which is associated with metacognition, and has been identified by previous studies to occur along with guided reflection (M. Jacobson & Ruddy, 2004).

Two participants identified an important shortcoming. They posited that since EASEL is technology-based, there could potentially be technical problems. When using EASEL, or any networked application, there is always the potential of technical failure. This can occur for several reasons such as an application malfunction, a network outage, poor coverage, or insufficient battery power. One student indicated that he might keep his phone in his pocket during an activity and might miss a prompt. While this is a valid concern, we are unsure how we might address it, as EASEL uses the same notification protocol as every IOS app. Since only one student identified this issue, we will need to conduct further investigation to determine its priority.

When participants were asked to provide recommendations for additional features, the most frequent suggestion was to have the ability to adjust the notification settings. The animation did not depict that the instructor sets the notification timing. Thus, participants may have felt there was no flexibility in adjusting the notification settings, when this feature is actually part of the specification. Including a depiction of the feature in the animation could mitigate this confusion.

The usability testing of the prototype led to several important insights. The first concerns the interface. Since all participants could complete each task and indicated that they could do so easily, we believe that the interface is easy to use and the interaction design is understandable and usable. The type of testing we used promotes iteration and incremental refinement. As we advance the development of EASEL, we will continue to conduct iterative usability testing as advocated by Jakob Nielsen (1994). This is the standard approach in software development because it leads to more usable applications (I. Jacobson et al., 1999).

The second, and perhaps more impactful, conclusion we draw from the second stage of the needs analysis has to do with acceptability and perceived value. Both students and teachers appreciated an application such as EASEL and said they would use it to facilitate reflection. We assumed that this would be the case when we decided to begin this project and results from the acceptability questionnaire reinforced it. Validating this assertion justified our continued efforts.

Finally, usability testing led to a third conclusion: EASEL was perceived to be easy to use. Not only were participants able to complete each task assigned to them, but also their questionnaire responses indicated that they felt most people could use EASEL without having to learn additional information.

Even though participants have yet to use EASEL in an actual experiential learning setting, they have seen examples demonstrating EASEL being used as a reflection tool before, during, and after an experience. Responses to the concept animation and the hypothetical scenarios used in the usability tasks indicate that students and faculty would recommend using an application such as EASEL in these settings. In particular, students identified the time and location-based prompts as a valuable feature to help them structure their reflection. Additionally, the usability phase found no significant interface issues. Therefore, we can conclude that EASEL is an appropriate mobile learning technology for facilitating experiential learning and guiding reflection before, during and after an experience.

Current Development and Future Directions

Feedback from this study guides our current software development. Since both faculty and students indicated a high acceptance rate of the prototype, we continue to follow the prototype design closely. EASEL is currently in the alpha phase of development. Much of the core functionality has been implemented. However, the user interface and user experience still require refinement and testing. The initial results reported in this work have been immensely helpful to guide our efforts. However, we plan to continually and iteratively improve EASEL's design.

The current development version of EASEL runs on IOS only. Confining the development to one operating system simplifies versioning and hardware compatibility. However, if teachers intend to include EASEL as a required tool in their courses, we must develop for the Android operating system as well, to accommodate students using either platform. Future iterations will likely integrate wearable technologies such as smart watches and augmented reality headsets to facilitate a more immersive experience.

EASEL is a stand-alone application. But potentially - and logically - could and should be integrated into learning management systems (LMS). Fortunately, most major LMS platforms implement a compatibility framework called "Learning Technology Integration" (LTI). LTI provides an interface between the LMS and other services, which would facilitate this important feature. The integration of EASEL with an LMS will simplify course organization, grading, and content aggregation. It will also allow instructors to leverage the features already present in their LMS while providing a consistent interface (Dahlstrom et al., 2014).

As we continue to develop EASEL, we plan to evaluate the application in various educational contexts. We anticipate gaining important perspectives by studying how EASEL is used in disciplines that vary widely. We have already begun discussions with faculty members in the sciences, business, entrepreneurship, and dentistry. We look forward to these collaborations and the insights they will yield.

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APPENDIX A. QUESTIONNAIRE 1 – SELF-REFLECTION HABITS

Are you one to personally reflect by journaling on experiences you have had in life?

- Yes
- No

What type of items do you typically journal about?

- Things that you learned
- Emotions you felt during an experience
- Reminders (things to tell other people or yourself)

What method do you prefer for journaling? (check all that apply)

- Pen and paper
- Video Journal
- Audio Journal
- Note-taking application on phone
- Note-taking application on computer

If you utilize a mobile device or computer when journaling, what is that application?

What did you like about the written method of journaling?

What did you dislike about the written method of journaling?

What did you like about the video method of journaling?

What did you dislike about the video method of journaling?

Of the two methods you used to journal during the trip, which did you prefer?

- Written
- Video

Why did you choose this response?

APENDIX B: QUESTIONNAIRE 2 – ACCEPTABILITY OF EASEL

I am a . . .

- Undergraduate student
- Graduate student
- Faculty Member

Would you recommend EASEL be used in courses that have an experiential learning component?

- Yes
- No

How would you describe EASEL in one or more words?

How do you think using EASEL would compare to traditional journaling/reflection exercises?

Is there anything about EASEL that you might find frustrating?

If you could suggest one feature for EASEL, what would it be?

What do you think you would like best about EASEL?

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