

Developing an Adaptive Mobile Platform in Family Medicine Field Experiences: User Perceptions

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Abstract. EASEL (education through application-supported experiential learning) is a platform designed to provide just-in-time content and reflection opportunities to students during field experiences, such as interviews or field labs, conducted as part of the workload in a course. This study was conducted in area of family medicine education at Indiana University-Purdue University Indianapolis. EASEL allows instructors and students flexibility to engage with course content based on the time of day and the location of each student conducting field work by providing access to questions and content before, during, and after a targeted field experience. In this study, three cohorts of family medicine students (N=20) interviewed either a health care professional or a patient and used EASEL to facilitate and support their experience in the field. This study examined the student perceptions of EASEL. The data indicated instructive information on the usability of the EASEL platform and aided developers in considering future technologies to use as a part of the platform.

Keywords: Adaptive Mobile Learning Experiential Learning. Field Experiences. Instructional Design. User Experience. Usability

1 Introduction

1.1 Supporting Just-in-Time Reflection

In the field of educational technology, a variety of tools exist to support experiential learning. Just as experiential learning experiences vary, so too do the tools used to support that - from learning management systems to individual apps. These tools allow instructors to adapt, support, and augment their instruction both in the classroom and outside the classroom. Students benefit as well inside the classroom, in the spaces of online learning, and in field experiences. Experiential learning allows them to ask questions, solve problems, and apply knowledge and abstract understanding to various learning environments such as the classroom, interviews,

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procedures, simulations, and experiments [1]. In this study, family medicine students participated in a field experience that requires them to prepare for an interview with both a patient and a health care professional, conduct the interviews, and debrief and reflect from the interviews. Historically, the preparation, debriefing, and reflection all occur outside of the interview process when the student is working in the learning management system at a computer. However, with the use of EASEL, the student perceptions of shifting to just-in-time content delivery and reflection within the platform were examined.

1.2 A New Tool

EASEL (education through application-supported experiential learning) is designed to be used by both students and instructors to optimize the learning experience. This is done by using both a web-based portal (for the instructor) and a mobile app (for the student). The advantage of utilizing a mobile platform allows for access to phone-specific features such as GPS tracking, camera operation, audio recording, voice-to-text processing, persistent network connectivity, and time. Users interact with the content and reflection prompts based on date, time, activity, and location. EASEL can deliver reflection prompts and content at salient times or when users reach specific locations before, during, and after a learning experience. Instructors can initiate experiences using the web-based portal. Specific content items and tasks completion are assigned under each experience. A task might consist of content to review, reflection questions to complete, an activity to track, or a photo or video that needs to be taken. An instructor can set parameters for when a student can access a specific task, such as when the student arrives at a location or after a specific date and time. The interface is, therefore, *adaptive* based on the location of the student and time of the experience.

A student can open EASEL, select the course and experience, and review the content or assessment items associated with that experience. For example, a student may be asked to watch a video or complete a question before conducting an interview. A student may be asked to audio record an interview or track the time. After all items are completed, the instructor can review them in the web-based portal.

Reflection and content prompts can target specific milestones throughout a learning activity by being triggered via GPS location, time of day, or a combination of the two. This can also be set at an individual level by the student or set by the instructor for a class experience. Students receive notifications to remind them to complete items. This allows students to anticipate content to review and reflection opportunities that can be entered in a variety of modalities including text, photos, audio, and video. Future iterations will likely integrate wearable technologies such as smart watches and augmented reality headsets to facilitate a more ubiquitous experience.

2 Literature Review

Changes in medical education have had significant effects on reflection activities, and a number of methods have been utilized to ensure and improve student reflection [2, 17, 18]. As students spend less time in the classroom and more time gaining valuable practical experiences, a platform that assists with the development of reflective learning through guided, real-world experiences provides the opportunity to gain knowledge through action, reflection and self-monitoring, and understanding the situation and the self so actions can change the next time a similar situation is encountered [3, 4, 18].

2.1 Experiential Learning in Medical Education

The Experiential Learning Theory was originally developed by David Kolb [3]. Kolb's model expanded on the idea of learning through discovery and experiences. The four stages of the model include 1) concrete experience, 2) reflective observation, 3) abstract conceptualization, and 4) active experimentation. The overall goal of the stages listed is for learners to reflect on experiences so they can put theory into practice later.

In the *Theories in Medical Education* series, Yardley stressed the importance of implementing experiential learning theory in medical education [5]. For many years, medical education was considered 'on-the-job' training, but with changing times, the need for learning from prior experience affects how students approach new experiences [5].

Many medical schools across the country incorporate experiential learning into their curricula [2, 6]. In a systematic review of research literature on experiential learning in nursing and medical education, a number of studies were found that discussed areas of medicine in which experiential learning was implemented. In many of those studies, it was understood that experiential learning helps students to share knowledge with an emotional connection to the experience but studies are limited in the contextual influences that hinder the development of reflective learning [7].

2.2 Values of Prompted Reflection

The second stage of Kolb's Experiential Learning Theory is reflective observation where learners reflect on the initial experiences. Reflection occurs often and has been shown to be beneficial in medical education [8, 18, 20].

Several methods of reflection occur including writing assignments, face-to-face feedback (debriefing), and written feedback. Students who complete debriefing following an exercise have a better understanding of their learning experience. Just-in-time adaptive intervention (JITAI) platforms change depending on the needs of the context and needs of the learners [10]. JITAIs have emerged recently in mobile health applications to assist patients with changes in behavior [9-10]. Facilitating just-in-time content reminders and reflection prompts could benefit students with the reflection process by helping them to internalize their learning.

2.3 Mobile Learning and ANS

Tablets, smartphones, and wearable devices can enable on-demand access to learning resources from any time and location and provide notifications and reminders that easily integrate into the lives of the learners. Learners can engage with new opportunities beyond the traditional classroom and can participate more actively in their learning by being engaged in experiential and contextual learning that is embedded in real-life. Mobile learning can also offer real-time access to materials, communication, and exchange of knowledge with peers and experts in their field of study [11].

Adaptable navigation and personalized learning on mobile devices continues to increase because of the ease of mobility and flexible timing [12]. Mobile technology is being recognized as a way to facilitate learning and adapt to individual learner contexts. This has led to interest in the adaptation of content that can provide learning experiences that are tailored to the characteristics of the learner and the situations the learner is in. One example of this use is the *Units of Learning Mobile Player* [11], which supported partially automated adaptation of learning activities. The system helped the learner adapt to the activities (flow of learning) and adapted the educational resources, tools, and services for learning support systems. Gomez, Zervas & Sampson (2014) conducted a study utilizing the player and found that utilizing these methods of adaptation can facilitate student completion of the learning activities [11].

Most learning systems were created for computers and have been modified for mobile devices (rather than being created for mobile devices), which can restrict mobile functionality [13]. Learning management systems (LMS) offer mobile connections to content and communication and offer input such as games, simulations, and even audio/visual recording [14]. Within experiential learning, an LMS can be used to offer reflection opportunities through discussion boards, surveys, or the submission of document files. However, current LMSs fail to take advantage of mobile features that could aide in time-based or location-based prompts or allow students easy access to media use (camera/audio recording) during reflection opportunities. Taking advantage of these mobile features could eliminate the issue of delayed reflection entry and possibly improve student retention and retrieval of salient moments in the learning experience.

2.4 Just-in-Time Interventions

The idea of intervening at critical moments in the learning process is not new. Just-in-time teaching (JiTT) has been used throughout educational contexts and includes web-based, content-related questions for students to answer a few hours before class [15-16]. It has been shown to increase student motivation and learning because instructors can tailor class content using the students' answers. JiTT was originally designed for face-to-face classroom use and has recently evolved to include additional components suitable for new environments able to advantage of JIT elements. One field that has adopted the idea of intervening just in time is that of mobile health and medicine. JITAI is a mobile health technological intervention that changes depending

on the user's needs in a specific environment [18]. JITAIs have been shown to assist individuals with healthy behavioral changes including stress-reduction, smoking cessation, and increased activity [9-10]. However, JITAI has not been widely used in education nor has it been studied in experiential learning contexts as a tool to foster opportunities for metacognitive thinking, and JITAIs are not currently focused on reflection tools. A platform that focuses on facilitating JITAI with relevant content and reflection prompts based on the time and location of the experience and allowing students easy access to mobile reflection tools could, therefore, assist students with retention and retrieval of salient moments in the learning experience. This could enhance opportunities for metacognitive development while reducing the load on working memory, leaving more resources for active learning.

3 Methodology

3.1 Context of the Study

Family medicine education introduces students to the principles and practice of caring for patients by allowing them opportunities to actively work with physicians in a community setting. This study was conducted within a family medicine clerkship at an urban institution. As a requirement of the clerkship experience, students must complete a Family & Community Project. The Family and Community Project serves as a capstone activity that has been designed to bring together what the medical students have learned during their clerkship while emphasizing the mission and values of Family Medicine, essentially applying theory to practice to culminate the experiential learning process. Students must identify a patient or population that faces barriers to health or healthcare, interview both the identified patient (or community resource representative) and a practicing health care professional who works with that patient or community and collaboratively find resources that might help the patient address one or more of those barriers. Students learn how to focus on discrete portions of a patient's medical history and physical concerns within the system of the patient's total health. Students in this clerkship setting meet with patients who present acute medical problems, are chronically ill, need preventive health education, or are seeking the support of their physician to cope with the trials and stresses of everyday life. Most importantly, students see patients interacting with their personal physician and witness the doctor-patient relationship as a learning experience. The goals of the Family and Community Project are for the students to

- Acquire a more comprehensive understanding about the impact of health and illness on a patient's life and family/support systems;
- Use a biopsychosocial approach to consider biological, psychological, and social factors and their complex interactions to better understand health, illness, and health care delivery to improve clinical patient care;
- Describe how the integration of community agencies, organizations, and other healthcare providers into patient care can positively impact health care outcomes;

- Develop strategies to use a team approach to develop a plan to improve health or health care outcomes.

For the assignment, students are asked to include the following elements:

1. The Patient's Story. The students will interview the patient to determine relevant background information and tell the patient's healthcare story in the assignment.
2. Barriers to Care. The students will describe at least one barrier to health or healthcare faced by the patient and his/her family. They will describe how the barrier impacts the patient's health and any strategies already in place to overcome the barrier(s).
3. Improving Health Outcomes. After meeting with the patient and/or his/her family, the students are to discuss how eliminating or mediating one or more of the barrier(s) can improve the patient's health or health outcomes. As such, students must collaborate with at least one other health professional or community resource person that interacts with or could interact with the patient or caregiver (i.e., pharmacist, social worker, nurse, teacher, daycare provider, dentist, etc.). This requires scheduling an appointment and an interview in order to work together with the healthcare professional.
4. Critical Thinking: By the end of the four-week clerkship experience, students will document and reflect upon their interaction with the patient and/or his/her family as well on the collaboration with the other healthcare professional.

Because of the nature and requirements of the clerkship, many students are faced with the challenges of meeting with the patient and healthcare professional at a time most convenient for those being interviewed. This often means squeezing the interview in between patients at the clinic or traveling off site. The information and tools for the students are currently housed as multiple PDF files or longer webpages within the course in a learning management system. Unfortunately, students have, at times, forgotten to download the PDF files prior to the interviews. Additionally, students have misplaced the papers after the interview due to the speed at which the clerkship runs. As well, the PDF documents are considered cumbersome to navigate by both students and instructors, but contain the information necessary for interpretation and interaction within the interview. Many students have not taken specific notes during a patient interview with the belief that they would remember the information later, only to see six new patients after the interview and not recall what exactly their interviewee said; as such, "which patient said that?" is a common thread.

At the completion of both interviews, the students are required to reflect on their experiences by completing a final project for the course. Students must take multiple pieces of information collected over three weeks and, then, during their fourth week, complete a comprehensive, reflective, capstone project. Due to the decentralized nature of the clerkship, the online learning management system (LMS) is heavily relied upon for storing course content and student assignments. The LMS also aims to increase the students' ability to become an active participant in his/her self-directed learning by keeping everything in a centralized course location. However, limitations of the LMS and its mobile app lead to some issues in supporting students as they participate in these important field experiences (for example, in scheduling their

interviews, writing reflections, etc.), as students may not be able to quickly or easily get to a computer once an experience is complete.

The following study evaluated student perceptions of EASEL when used during the interview process. It was hypothesized that by utilizing the EASEL platform, family medicine students in this context would be able to quickly refer to information so they can provide relevant feedback during these interviews and would consider EASEL to be a helpful tool.

3.2 Procedures

The FMC is a required four-week clinical rotation for over 360 third-year medical students. The FMC is decentralized, assigning students to a family medicine physician in clinical locations throughout the state. Four days of each week on the rotation are spent with an assigned family medicine physician in his/her medical office. Each student with the FMC must complete two interviews. One interview is with a patient to understand the barriers to their healthcare. The other interview is with a healthcare professional to understand how to help overcome those barriers. After both interviews the student must complete a final project as a reflection piece based on the interviews.

Utilization of EASEL began in fall 2017. Three cohorts of students (N=20) participated in the study. For one of the interviews students were encouraged (but not required) to review some questions in a document in the LMS before they conducted the interview. Those students who had an iPhone were asked to utilize EASEL for one of the interviews. When utilizing EASEL, the students followed the below procedure:

1. Students will schedule their interview in EASEL (see Fig. 1a) and review tasks (see Fig. 3).
2. Students will receive a notification the day of their interview reminding them to complete two items: to review some questions about the interview and to answer a few pre-reflection questions.
3. Before the interview begins, students will use the time tracker to measure the time length of the interview (see Fig. 1b).
4. After the interview, students will use EASEL to respond to a few questions related to their interview experience (see Fig. 1c).

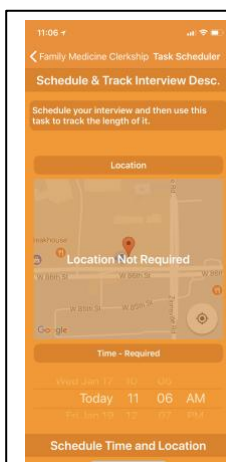


Fig. 1a. Scheduling Interview



Fig. 1b. Tracking Time

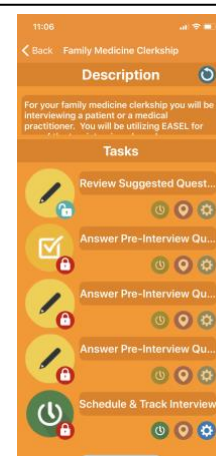


Fig. 1c. Task List

At the completion of each cohort, students who used EASEL (N=20) were asked to complete a short survey including these two questions, which will be discussed in more detail in the *Data Analysis* section:

- What did you find most useful about EASEL? Please be specific.
- What would you suggest to improve EASEL?

Students who did not use EASEL (because EASEL is currently iOS only) were not included in the data results. The perceptions of using EASEL were evaluated to further inform future EASEL development.

4 Data Analysis

Students utilized EASEL for only one of their two interviews. For the interview not utilizing EASEL, students reviewed questions stored within a long document on the Canvas learning management system. They did not have a reflection opportunity for that interview. Future data analysis will include comparing the responses of those two surveys and looking at student final grades. Since course grades will not be completed until later this semester, and because we needed preliminary data to inform design and functionality improvements, the data analyzed here is focused on student perceptions of EASEL and areas that could be improved.

4.1 Most Useful Features

Students were asked to explain what they believed to be most useful about EASEL. Some students utilized words like *reminder*, *guide* or *motivator* to indicate what helped them with their experience. Other students noted specific features such as *the ability to track the time of an interview* or *to reflect on the interview*. See Table 1 for selected qualitative feedback.

Table 1. Student feedback indicating what was most useful about EASEL

Most Useful Item	N	Qualitative Feedback
Reminder	5	<p>“I think the EASEL app can be useful to remind us of when the meeting with the patient is.”</p> <p>“I liked that the app asked what question I would ask first during the interview because it helped me prepare, but more questions like that would be even better.”</p>
Guide/Clarification	7	<p>“It gave a chance for me to organize my thoughts”</p> <p>“It guided my questions and guided me through the process of interviewing.”</p> <p>“It gave specific questions for me to ask and helped me formulate good rapport with my patient as it asked questions from her perspective.”</p>
Reflection/Other Features	2	<p>“I found the post-interview questions spaced out into</p>

		<p>their own boxes and questions the most helpful.”</p> <p>“...timer for the interview, recording the responses of the interview”</p>
Motivator	2	<p>“Motivated me to read more about my patient prior to the interview and to take more time to think about my expectations for the interaction.”</p> <p>“I really liked the sample questions which allowed me to think about things I have not thought about before. It broadened the spectrum of my interviews, I think.”</p>
Ease of Use	2	<p>“Easy to understand the app, Easy to find the resources”</p> <p>“The list of suggested questions was easy to access”</p>

4.2 Areas for Improvement

Students were asked to provide suggestions on how EASEL could be improved. Many of the responses indicated needs for improvement to the user interface. Others indicated a need to adjust the content and content delivery mechanisms within the app. Students also indicated issues with bugs that need to be mitigated and others indicated a general belief that the EASEL app was unnecessary.

Improvements to the User Interface. Students provided feedback on the user interface both in design and functionality. Improvements included accessing the app, structure, navigation of the app, input of content (such as question responses) and understanding the timer. See Table 2 for selected qualitative feedback.

Table 2. Student feedback about EASEL’s user interface

Areas of Improvement	N	Qualitative Feedback
Accessing the app		“I had difficulty with access to the application at the time of interview. I navigated the application interview afterwards. In retrospect, the application most likely would have helped as a reminder of the questions to ask in the interview.”
Structure	1	“I think it needs to have more structure. I was having some difficulty using the app at first.”
Navigation	8	<p>“When I navigated the application after my interview, it was difficult to move on to the next section. Because I came prepared with the same tools the application offered, I am not sure the existing format enhances the experience of the interview.”</p> <p>“It is also inconvenient that each question is on a separate "link" instead of just being able to answer all the pre-interview questions in one "link." I ended up not using the whole app because there were too many steps that were not needed to get the most out of this project.”</p>

Input	5	<p>provide a space for jotting down thoughts/answers to each individual question rather than providing a single space at the end of a list of 10+ questions. Even though it wasn't required to answer each one, it just felt like an enormous amount of typing to be done on a cell phone to sufficiently complete that task.”</p> <p>“Having a text box after each question vs. having just one large box at the bottom. It was harder to stay organized when bouncing from the top of the screen to the bottom.”</p> <p>“I would increase the font size. Some of the questions required long responses and it's not user-friendly to type in such long answers on a phone.”</p>
Timer	1	<p>“The timer was also confusing, since I could not see the seconds (clock displayed as 00:00...). I could not figure out when the timer was started or stopped (unless I were to stare at the screen for a full minute, which I later did in trying to get it to let me move on to the next question) and ended up not recording the time of my interview.”</p>

Content. Students provided feedback on the content of the assignments as well as the delivery mechanisms for those assignments. Students indicated issues with questions (whether it be not understanding Likert scale questions, wanting to input their own questions or the inclusion of questions for the patient). One student also indicated a desire for an audio recorder and three other students stated there were issues with tasks being locked at certain times. See Table 3 for selected qualitative feedback.

Table 3. Student feedback about content

Areas of Improvement	N	Qualitative Feedback
Questions	3	<p>“The "Answer Pre-Interview Question -1" lists how prepared were you for the interview indicating 4 is the highest, but the options are in A-D with not numbers or text beside the options. Just an fyi, so I chose C, but am not sure what that indicated.”</p> <p>“One recommendation to improve the application is to have the questions pertinent to the chief health are barrier accompanied by both quantitative and qualitative response sections so as to ease one's ability to take notes if one were to use the application as the interview unfolds. Another recommendations to improve the application is to possibly have a section in which the patient may provide feedback to one's performance, which may then subsequently be provided to us by the clerkship coordinator at a later date.”</p>
Audio Recording	1	<p>“Feature to record the interview”</p>
Locking Tasks	3	<p>be useful to not lock them until viewed in order, so if other people experience this problem, they would still be able to utilize the other sections, rather than being stuck as I was.”</p>

Bugs/General User Experience Issues. Some students indicated issues with bugs in the app, while other students indicated that there was no need for EASEL. One student did not indicate a need for improvement of the EASEL. See Table 4 for data and selected qualitative feedback.

Table 4. Student feedback about bugs and glitches with using EASEL

Areas of Improvement	N	Qualitative Feedback
Bug - Crashing	4	"The app crashed several times throughout the interview and I ended up not using the app to the full potential. I tried again via telephone call with the patient but again it crashed. I even put the location settings on correctly."
General Glitches	2	"theres [sic] glitches. Sometimes it would go back to a question I just answered and I did not want to type the entire response again. Also I don't think it's appropriate to be using your phone during an interview"
Unnecessary Use	4	"I did not find it useful. Felt like transcribing the interview unnecessarily."
Unclear	1	"Easier to use when timing the interview. It was unclear when to use the app so I filled out all the information post interviews"
No Feedback	1	N/A

5 Discussion and Conclusion

Kolb's theory of experiential learning contains reflection, synthesis, decision making, accountability, and an experience that allows for natural trial and error. For years, experiential learning and reflection have been implemented in medical education, with many studies showing advances that could lead to better patient care. While a small sample size, this study showed that using an adaptive platform for just-in-time content delivery and reflections on experiences in medical education could be beneficial while also providing valuable feedback on an early version of the EASEL platform. While a few participants acknowledged that EASEL was at least somewhat helpful, there was a strong indication to improve both the interface, delivery of content and the need to mitigate bugs

5.1 Positive Features of EASEL

The most noted positive feedback from the study indicated that EASEL can be a helpful reminder tool during an interview process and that EASEL can serve as a guide during the process and can even motivate students to prepare more for their interview. One student indicated "I liked that the app asked what question I would ask first during the interview because it helped me prepare, but more questions like that would be even better." Responses such as this have been validated by early studies (Schnepf & Rogers, 2017.) which examined early perceptions of EASEL with a low fidelity prototype.

5.2 Areas for Improvement

The previous study presented data from the first native version of the EASEL app. Upon completion of the native iOS app, the team knew that there would be issues related to user interface, content delivery, and bugs or glitches. Students specifically noted issues with navigation where after completing a task they were not taken to the previous screen but to a home screen where they would then need to go through the process again. Other students indicated issues with typing large amounts of text onto a small screen. This feedback indicates a possible need for revisions in the interface for phones or potentially to allow students the use of a tablet during the process if content questions require long answers.

It was also noted that students felt they needed to use EASEL during the interview to take notes and they would have to be on their phone which was not the intention of EASEL. Content of assignments was a concern for some students as well, so the EASEL team plans to implement ideas for both instructors and students to help assignment creation, instructions, and completion to optimize EASEL's effectiveness.

Other students indicated issues with bugs such as crashes and general glitches. Four students stated they felt the EASEL app to be unnecessary. Some of this response may have been driven by the frustration with glitches. Others may have stated this due to their struggle with inputting text on a phone while others may have misunderstood the use of the app (i.e. using the app during the actual interview).

Some of the feedback from the students were a function of the environment EASEL was being utilized in. Students were conducting patient interviews and thus they would not have been allowed to record the audio of the interview for privacy reasons (even though an audio recorder is available). These suggestions will be fully utilized in the development of the next iteration of EASEL.

There is limited research related to using just-in-time adaptive reflection through mobile technology in medical education. Of the literature found, most focused on using mobile applications for direct behavior-changing applications. The literature review demonstrates a gap in using just-in-time adaptive reflection for experiential learning reflections in medical education. While this preliminary study offers a potential platform and data indicates a potential for EASEL to fill that gap, it also offers a glimpse of what users found to be useful when using EASEL and some areas of potential improvement for future iterations of the EASEL platform. The information gained from this study can be applied in current medical education through a number of avenues. One example is the use of EASEL to help support student engagement in field experiences with pre-experience, experience, and post-experience contexts. This study opens several areas for additional research. This interdisciplinary team of researchers and developers experienced their own learning through this process, and will continue collaborating on this innovative curricular development and technological intervention project.

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