A CASE STUDY EXPLORING STUDENT ENGAGEMENT with STANFORD MOBILE INQUIRY-BASED LEARNING ENVIRONMENT (SMILE)

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ABSTRACT

This exploratory case study investigates student engagement and the affordances of Stanford Mobile Inquiry-based Learning Environment (SMILE). SMILE is an inquiry-based mobile learning framework designed to promote student-centered inquiry and reflection leveraging mobile media in the classroom setting. The participants were pre-service teachers enrolled in student teaching seminar that met once a week through web-conference.

This study examined how students engaged with course contents, peers, and the instructor by constructing questions using SMILE. The data collection instruments included a survey, analysis of questions created by students in SMILE, observations made by the instructor during seminar class and focused group interview.

Survey questions were developed from the Classroom Survey of Student Engagement (CLASSE) instrument with 15 SMILE related questions based on Universal Design for Learning (UDL) principle guidelines for engagement. The results indicate that using SMILE provides multiple means of engagement as described by UDL principle guidelines.

Student engagement with the course content and peers increased when the inquiry topic was relevant and meaningful to the pre-service teachers. Engagement with the instructor was contingent on how the instructor facilitated the activity.

The discussion explores the implications of the role of the teacher and possible considerations for promoting further student engagement.

Keywords: Mobile Learning, Student Engagement, SMILE

INTRODUCTION

The trend towards mobile learning is steadily increasing with advancements in technology and the affordability of mobile devices. Although there is research that investigates mobile learning, there is still much to be learned about student engagement with mobile devices that could further enhance this body of literature and the connection to desired learning outcomes. Edwards (2013) describes the six key drivers of student engagement as Relevant Learning, Personalized Learning, Collaborative Learning, Connected Learning, Information Literacy, and Dialogical and Dialectical Thinking. He further states that these "learning experiences enhance student engagement, which in turn drives student achievement.

Although these learning experiences were available in a more limited way before the advent of technology, digital conversion has taken them to an entirely new level." (p. 1). Heick (2015) also had a similar idea when he introduced 12 principles of mobile learning which emphasize personalized learning. In the current study, student engagement using SMILE was divided up into three categories: engagement with the learning content, engagement with their learning community, and engagement with the instructor while student teachers integrated SMILE into their seminar course. The research questions that guided this study were;

- ✓ **What are the affordances of SMILE engaging student teachers with content, peers and the instructor?**
- ✓ **How did these affordances foster student engagement?**

LITERATURE REVIEW

Inquiry-based Learning
Inquiry-based learning originally stems from constructivist approach during the discovery learning movement (Lazonder & Harmsen, 2016). Over the years, discovery learning has been promoted within the science disciplines but it has been expanded to become an educational approach rather than just a science discipline approach (Pedaste, et al., 2015). Much research has been conducted on this topic but the most recent meta-analysis of inquiry-based learning by Lazonder and Harmsen (2016) reviewed effects of guidance on learning activities, performance success, and learning outcomes. They found that students who engaged in guided inquiry learning had more proficient use of inquiry skills when compared to students who engaged in unguided inquiry learning.

Further research indicates that specific types of inquiry learning support student engagement. Buckner and Kim (2013) argue that questions are central to inquiry-based learning but that students do not ask enough questions to receive the full educational benefits of this approach. One of the reasons for this may be due to classroom culture involving the relationship between adults and students (Chin & Brown, 2002). However, there is grave need for more research in the area of inquiry-based learning and how students engage in such approach (Looi et al., 2010; Buckner & Kim, 2013).

Table 1.

UDL Principles and Guidelines (CAST, 2008)

I. Provide Multiple Means of Representation	1. Provide options for perception 1.1 Offer ways of customizing the display of information 1.2 Offer alternatives for auditory information 1.3 Offer alternatives for visual information	2. Provide options for language, math expressions, and symbols 2.1 Clarify vocabulary and symbols 2.2 Clarify syntax and structure 2.3 Support decoding of text, math notation, and symbols 2.4 Promote understanding across languages 2.5 Illustrate through multiple media	3. Provide options for comprehension 3.1 Activate or supply background knowledge 3.2. Highlight patterns, critical features, big ideas, and relationships 3.3 Guide information processing, visualization, and manipulation 3.4 Maximize transfer and generalization
II. Provide Multiple Means of Action and Expression	4: Provide options for physical action 4.1 Vary the methods for response and navigation 4.2 Optimize access to tools and assistive technologies	5: Provide options for expression and communication 5.1 Use multiple media for communication 5.2 Use multiple tools for const. and composition 5.3 Build fluencies with graduated levels of support for practice and performance	6: Provide options for executive functions 6.1 Guide appropriate goal-setting 6.2 Support planning and strategy development 6.3 Facilitate managing information and resources 6.4 Enhance capacity for monitoring progress
III. Provide Multiple Means of Engagement	7: Provide options for recruiting interest 7.1 Optimize individual choice and autonomy 7.2 Optimize relevance, value, and authenticity 7.3 Minimize threats and distractions	8: Provide options for sustaining effort and persist 8.1 Heighten salience of goals and objectives 8.2 Vary demands and resources to optimize challenge 8.3 Foster collaboration and community 8.4 Increase mastery-oriented feedback	9: Provide options for self-regulation 9.1 Promote expectations and beliefs that optimize motivation 9.2 Facilitate personal coping skills and strategies 9.3 Develop self-assessment and re ection

Stanford Mobile Inquiry-based Learning Environment (SMILE)

SMILE was designed to promote inquiry-based learning in the classroom. It combines mobile-based application for students to create, share, respond, and rate questions (Seol, Sharp, & Kim, 2011; Buckner & Kim, 2013; Song & Kim, 2015).

SMILE is a cloud (i.g., http://smile.stanford.edu) application that can be integrated into learning management systems through API (Application Program Interface). SMILE allows participants to formulate, share, solve, rate, comment, and reflect on questions of various types.

SMILE also enables facilitators to configure and integrate evaluation rubrics for participants to reference while formulating and evaluating questions.

A prompter feature in SMILE can be configured to challenge participants to incorporate specific keywords or phrases while formulating questions, triggering creative and critical thinking.

This innovation packaged in small form-factor battery-operated computers have been distributed in developing regions where access to the cloud version SMILE application is not possible or reliable electricity is absent.

Universal Design for Learning (UDL)

UDL is a set of principles and guidelines that are based on neuroscience research involving three brain networks to process learning (CAST, 2011). The three brain networks are:

- ✓ Recognition Networks where primary focus is on the WHAT of learning;
- ✓ Strategic Networks where primary focus is on HOW of learning; and
- ✓ Affective Networks where primary focus is on WHY of learning. For each of these networks, three principles were created and then operationalized into

12 Principles of Mobile Learning

The ubiquitous use of mobile technologies is widespread across the world and it is definitely having an impact on the field of education.

This is apparent in higher education by the trends in academic publications, conferences, and professional development related to mobile learning (Traxler, 2009).

Given the inherent nature of mobility, busy students appreciate being able to learn anywhere and anytime.

According to Heick (2015), mobile learning is essentially personalization. These principles provide a framework for the characteristics inherent in mobile learning. The 12 principles of mobile learning are described in Table 2.

Table 2.

12 Principles of Mobile Learning (Heick, 2015)

12 Principles of ML	Description
Access	A mobile learning environment is about access being constant which in turn shifts a unique burden to learn on the students.
Metrics	As mobile learning is a blend of the digital and physical, diverse metrics of understanding and "performance of knowledge will be available.
Cloud	The cloud is the enabler of "smart" mobility. With access to the cloud, all data sources and project materials are constantly available.
Transparent	Transparency is the natural byproduct of connectivity, mobility, and collaboration.
Play	Play is one of the primary characteristics of authentic, progressive learning, both a cause and effect of an engaged mind.
Asynchronous	Among the most powerful principles of mobile learning is asynchronous access.
Self-Actuated	With asynchronous access to content, peers, and experts comes the potential for self-actuation.
Diverse	With mobility comes diversity. Audiences are diverse, as are the environment data is being gleaned from and delivered to.
Curation	By design, these technologies adapt to learners, store files, publish thinking, and connect learners, making curation a matter of process rather than ability.
Blending	A mobile learning environment will always represent a blending of sorts - physical movement, personal communication, and digital interaction.
Always-On	Always-on learning is self-actuated, spontaneous, iterative and recursive.
Authentic	All of the previous 11 principles yield an authenticity to learning that is impossible to reproduce in a classroom.

METHODS

This study was an exploratory case study that focused on how SMILE supported student teacher engagement in learning how to develop integrated curriculum unit.

The participants included seven pre-service teachers enrolled in a once a week student teaching seminar that corresponded with their second semester of student teaching. These student teachers were working towards obtaining either their Montessori Certification, Prekindergarten to Kindergarten (PK-K) licensure, or Prekindergarten to 3rd Grade (PK-3) licensure. The seven pre-service teachers included six graduate level and one undergraduate level students.

The instruments used for this exploratory case study were surveys, a focused group interview, questions and comments posted in SMILE by student teachers, and instructor observations of their seminar sessions recorded through Zoom.

The survey instrument was developed from the Classroom Survey for Student Engagement (CLASSE) in an online format. The survey instrument also included 15 questions directly related to SMILE.

For the purposes of this study, only the question related to SMILE were analyzed. These 15 questions related to SMILE were based on UDL principle guidelines for engagement some of which were open-ended questions. The survey was administered online at the conclusion of the seminar course.

Focus group interview was conducted about a week after the conclusion of the seminar course and after the completion of the survey. Six out of seven student teachers participated in the focus group interview.

Quick analysis of the survey responses provided the foundation for the focus group interview questions in order for focus group participants to provide clarification for those responses.

Each of the participants was new to using SMILE. At the first seminar meeting, the participants were given a tutorial on SMILE along with instructions on registering and using the tool. One of the main activities in the student teaching seminar is for the student teachers to develop their integrated curriculum unit to be implemented during their solo teaching.

As part of their course responsibilities, the participants had to post questions related to integrated curriculum on SMILE. Practicing good inquiry skills was an integral part of their learning activities in the seminar course. The course incorporated a total of 10 learning modules,

From these 10 modules the participants were prompted to post questions and comments to six modules. For each module, student teachers had about a week to post their questions and comments to their peers.

The questions and comments created by the participants in SMILE were analyzed in respect to number of questions and comments posted, ratings of the

questions, timing of when the questions and comments were posted, and in-depth analysis of the questions that received the most number of comments. At the same time, they were also new to using a new Learning Management System (LMS) called Canvas.

The student teaching seminar met on Tuesdays from 4:30 p.m. to 6:30 p.m. Hawai'i Standard Time (HST) through web conferencing tool called Zoom. Zoom allows for student teachers to join virtually using their webcam and audio synchronously and they were recorded so student teachers can review the discussion if needed. Recordings of six meetings with the student teachers were observed and observation notes that relate directly to SMILE were analyzed.

RESULTS

The results from four data sources are summarized below based on the different instruments used. A discussion of the implication of these is provided in next section; specifically how the results demonstrate evidence of student engagement with content, peers, and the instructor.

Seminar Meeting via Web Conferencing Tool (Zoom)

This study started from the second semester of the year long seminar which lasted from January 2016 to June 2016. There were six recorded Zoom meetings and only discussions that related to SMILE were summarized for this study. Most sessions were about two hours long.

During the first Zoom meeting, SMILE was introduced. Zoom allowed the instructor to share screen and demonstrate how to use SMILE but sufficient time was provided for the participants to "play" with the tool.

Student teachers created their accounts and ran into some technical issues when the instructor was trying to share her screen using Zoom. After the participants created their accounts, they created their first questions as dictated by the instructor.

Facial expressions from the video conferencing tool revealed complete engagement with this activity. The instructor observed at the SMILE postings synchronously while participants were posting their first questions.

The instructor assured the participants that with the posting of the first question, that they were only responsible for building comfort with the tool. During this first assignment the students were provided a safe space to "play" and build their understanding with the tool. At the end of the first session, SMILE and other assignments for the following week were explained.

In the second Zoom meeting, the instructor shared her screen to show the questions participants created in SMILE. The instructor reviewed each question and expanded on the question topic each student teacher posted.

Whenever a participant was sharing, the other participants displayed engaged body position and facial expression.

This was apparent by their continued viewing of the screen where the videos of the other student teachers were shown and the occasional nodding or expression of emotion in response to what the speaker was saying. Everyone was eager to share on the different topic when prompted by the instructor.

There were some conversations about inquiry-based learning and references further discussion in the future. For some of the questions in SMILE, the instructor and the participants asked clarifying questions as they discussed the topic.

The question on organizing integrated curriculum prompted how the participants were to organize/develop their integrated curriculum topic. The participants personalized their responses since they were all working on a different topic. This question also forced student teachers to start thinking about how they will develop their integrated curriculum unit.

Many participants opted to make an appointment with the instructor since there were so many questions about their own topic and did not want to take up the whole classroom time.

The instructor continued the discussions with the questions posed by the student teachers in SMILE. When one participant had difficult time understanding, the instructor took advantage of that teachable moment to explain a concept.

SMILE Questions and Comments

Written data from each of the 10 course modules were analyzed quantitatively in order to determine which of the modules received the greatest number of questions and which of the participant questions received the greatest number of comments from fellow participants.

There were total of 47 questions posted by the seven participants; five participants posted seven questions and the remaining two posted six questions within the different modules. The participant question that received six comments was posted in Module 1 and related to integrating different cultures into integrated curriculum. The question that received five comments was posted in Module 2 and related to deeper learning for children. This was also the first question posted in Module 2. Questions posed by the participants were both authentic, drawing directly from the integrated unit plan each student teacher was developing, and open ended. The questions posed by the students were appropriate to the topic because they covered the topic we because they linked the integrated curriculum they developed, and meaningful because they provided the class with opportunities to share their projects. Common characteristics for these questions that received four to six comments were time provided to be playful, topics for the questions were relatable (relative), and the questions were earlier posts, allowing ample time for peer reviews.

Survey

The online survey was administered after the last seminar meeting. Student teachers were given about a week to complete the survey. For this study, only the survey responses from the 15 questions that addressed SMILE were analyzed.

Table 3.
Survey Responses to 15 SMILE Related Questions

Questions	Very Little	Some	Quite a Bit	Very Much
39a. Providing options for recruiting interests such as optimizing my choice and autonomy in this course?	-	1	1	5
39b. Providing options for recruiting interests such as optimizing relevance, value, authenticity in this course?	-	1		6
39c. Providing options for recruiting interests such as minimizing threats and distractions in this course?	-	1	2	4
40a. Providing options for sustaining effort and perseverance such as heightening salience of goals and objectives in this course?	--		2	5
40b. Providing options for sustaining effort and perseverance such as varying demands and resources to optimize challenge in this course?	-		2	5
40c. Providing options for sustaining effort and perseverance such as fostering collaboration and community (i.e. I felt that I belonged to a supportive community of learners) in this course?	-		1	6
40d. Providing options for sustaining effort and perseverance such as mastery-oriented feedback in this course?	-		5	2
41a. Providing options for self-regulation such as promoting expectations and belief that optimize motivation in this course?	-		2	5
41b. Providing options for self-regulation such as facilitating personal coping skills and strategies in this course?	-	1	3	3
41c. Providing options for self-regulation such as developing self-assessment and reflection to grow in skills and knowledge of this course?	-		2	5
42. Do you think using SMILE enhanced your learning in this course?	-	1		6

The results from analysis of the survey data indicated that SMILE provided multiple ways for student teachers to engage in course activities.

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Additionally the majority of the participants reported that SMILE enhances their learning in this course. The analysis of participant responses to the survey questions can be found in Table 3.

Some notable survey results from the analysis of questions specific to the use of SMILE within this course are summarized. On a 4 point likert scale ranging from Very Little to Very Much, Some notable survey results from the analysis of questions specific to the use of SMILE within this course are summarized. On a 4 point likert scale ranging from Very Little to Very Much,

- ✓ **6 out of 7 student teachers indicated using SMILE very much enhanced their learning in this course.**
- ✓ **6 out of 7 student teachers indicated using SMILE very much provided options for recruiting interests by optimizing relevance, value, authenticity in this course.**
- ✓ **5 out of 7 student teachers indicated using SMILE very much provided options for recruiting interest by optimizing their choice and autonomy in this course.**
- ✓ **6 out of 7 student teachers indicated using SMILE very much provided options for sustaining effort and persistence by fostering collaboration and community.**
- ✓ **5 out of 7 student teachers indicated using SMILE very much provided options for sustaining effort and persistence by heightening salience of goals and objectives as well as providing challenges in this course.**
- ✓ **5 out of 7 student teachers indicated using SMILE very much provided options for self-regulation by promoting expectations and belief that optimize motivation as well as developing self-assessment and reflection to grow in skills and knowledge of this course.**

Responses to open-ended questions participant ability to create questions and comments to their peers were features of SMILE that enhanced their engagement. One participant reported there were challenges with viewing the questions initially but that those challenges were quickly resolved. The same participant indicated it would be helpful to integrated SMILE into the LMS (i.e., Canvas) in order to avoid logging in twice. This comment led the SMILE developers to develop and release an API (Application Program Interface) for later integrations. In general, participants provided positive comments about their experience using SMILE. One participant indicated that the questions she created in SMILE helped her frame her essential questions during her solo teaching and another participant felt that all university courses should integrate SMILE into online courses. This particular participant also appreciated that there were minimal restrictions on the type of questions she was able to post.

Focus Group Interview

The focus group interview was conducted a week after the online survey. The focus group interview questions were based on the survey results to confirm the comments made in the survey but also to obtain additional insights as to how and why they were able to engage. Some notable responses during this interview and they are summarized below.

- ✓ **Creating questions in SMILE helped participants think deeper and more critically. Participants made comments such as "It helped us create deeper questions for our unit" or "[Creating] the essential questions…it made me think a lot… more meaning by going in-depth" or "Creating questions gave us a new level of critical thinking that I never thought of before. Like I said before, many teachers at my school who have been teaching for 20 plus years have not thought about things in this deeper level. Their questions were on much shallow level. The questions they usually ask were questions that had right or wrong answers but the questions we asked were topics that could have multiple perspectives or various ways to address it."**
- ✓ **Each Student Teacher Had Different Ideas About How To Rate The Questions Which Was Confusing For Some. Student Teachers Made Comments Such As "The Rating Was A Little Confusing. I Know There [Were] Rating Rubrics But They Were Pretty Generic And Vague So I Think We All Had Different Ideas About How We Interpreted Them." Or "For Me, I Gave Higher Rating If It Was More Open And Relevant To Us." Or "I Thought About Fact Provoking Questions Versus Critical Thinking Questions. I Gave Higher Rating For What I Thought Were More Critical Thinking Questions That Did Not Really Have A Definite Answers.".**
- ✓ **The Number Of Comments From Peers Correlated To The Time When The Question Was Posted. The Focus Group Participants Made Comments Such As "Yes, We Post When We Can And Most Of The Time, We Do Not Go Back To It Until After Our Next Discussion And We Are Ready To Post A New Question For The New Module. That Is Why We Tend To Not Comment On The Questions Posted Later."**
- ✓ **Personalized Questions Optimizing Relevance, Value, And Authenticity Were More Engaging In SMILE. Student Teachers Made Comments Such As "It Mattered To Us Because Integrated Curriculum Was What We Were Working On. It Also Mattered Because We Were Deep Into Researching About The Topic And It Was Relevant To Us." Or "It Mattered To Us Because Integrated Curriculum Was What We Were Working On. It Also Mattered Because We Were Deep Into Researching About The Topic And It Was Relevant To Us."**
- ✓ **Providing Opportunity To Play With SMILE Helped The Participants Engage With Learning. Participants Made Comments Such As " I Was All Confused At First But Playing With It Made Me See How It Works And We Also Talked To Each Other About How To Use The Tool." Or "I Am Still Not 100 Percent Comfortable With Technology But I Felt At Ease After Playing With SMILE For A While. Once I Know How To Work It, I Was Able To Focus On The Questions. That Was Helpful For Me." Or "I Liked That We Had So Much Freedom With This Tool. You Did Not Give A Lot Of Instruction On How And What To Post But Gave Us Time To Just Play With The Tool In The Beginning."**
- ✓ **Effort And Perseverance Were Sustained Through Collaboration And Community Building Opportunity In SMILE. Student Teachers Made Comments Such As "We Are Already A Pretty Tight Community Since We Have Been In This Cohort For The Past Two Years But I Felt That I Really Got To Know These Guys When I Read Their Questions And Learn About Topics That They Were Passionate About. I Felt Comfortable Making**

Comments To The Questions They Created." Or "I Also Felt Really Sincere Support From This Community When I Read Their Comments To The Questions I Created. It Helped Me Go Deeper Into My Research And Provided Resources That I Never Thought About Before."

DISCUSSION AND IMPLICATIONS

There were several themes that arose as this study answered the research questions. In response to the first research question, affordances of SMILE provided multiple means of engagement within the UDL framework especially in relation to contents and peers.

Engagement with Content, Peers and Instructor

The survey results indicated that SMILE provides multiple means of engagement with contents and peers.

Among the UDL principle guidelines, highest rating guidelines reported by the participants were recruiting interest by optimizing relevance, value, and authenticity as well as sustaining effort and persistence by fostering collaboration and community.

The participant responses suggesting the desire for learning that have both meaning and relevance aligns with the 12 principles of mobile learning (Heick, 2015). Heick (2015) explains that the central premise of mobile learning is that it is personalized.

Table 4 provides the alignment between UDL engagement principle and guidelines with 12 principles of mobile learning.

The participants also self reported that by asking questions, they were forced to think critically and move towards deeper understanding.

The quality of the questions and observations from Zoom seminar discussions also support this.

On the other hand, the student engagement with the instructor was established through the discussions during Zoom meetings not within the SMILE environment.

This study intentionally did not involve instructor to comment in SMILE because the instructor wanted the deeper learning to occur through self-discovery and support from peers.

This is an area that can be researched further to identify strategies to optimize the level and types of instructor intervention. Implications for teaching and learning is discussed next.

Table 4.
UDL Principle on Engagement and 12 Principles of Mobile Learning Alignment

Engagement with	UDL Principle on Multiple Means of Engagement	12 Principles of Mobile Learning
Content, Peers, and Instructor	• Provide options for recruiting interest by • optimizing individual choice and autonomy • ooptimizing relevance, value, and authenticity* • minimizing threats and distractions	Play, Transparent, Self-actuated, Authentic
Peers	• Provide options for sustaining effort and persistence by • heightening salience of goals and objectives • varying demands and resources to optimize challenge • fostering collaboration and community* • increasing mastery-oriented feedback	Metrics, Play, Self-actuated, Diverse, Curation, Blending
Peers, and Instructor	• Provide options for self-regulations by • promoting expectations and beliefs that optimize motivation • facilitating personal coping skills and strategies • developing self-assessment and reflection	Metrics, Play, Self-actuated, Authentic

Implication for Teaching and Learning

The evidence from this study supports that affordances of SMILE provides multiples means of engagement but that the role of instructor depends on the type of engagement goals. The instructor should play a facilitator role, use just-in-time intervention, scaffold the skills needed to become comfortable using SMILE but also be aware of when the inquiry learning should be "unguided," "minimally guided," or "guided." (Lazonder & Harmsen, 2016, p. 2).

The level of how inquiry-based learning was used in this particular study was at two levels. First, it facilitated to draw their interest as they developed their integrated curriculum and second, they used it to scaffold deeper understanding through critical thinking process. Observations of how student teachers developed a scaffold of deeper understanding through SMILE revealed some characteristics. Firstly, the participants needed to obtain pre-skills, in order to become comfortable with using SMILE.

These pre-skills were necessary because they could not allocate the sufficient amount of their cognitive energy into critical thinking until they are adequately settled with the tool itself. Secondly, the participants had to persevere through the mental struggles stemming from the novelty of the unique learning model. They were new to instructional model and content in this course, and through perseverance, some of the participants were able to elevate to a deeper understanding. Personalization is the third characteristic of the participant scaffolds. The participants who took on the topics that had personal connection made much deeper level of engagement and curriculum development. The participants who made individual appointments with the instructor to have deeper discussions on their integrated curriculum topic demonstrated a much deeper level of understanding. The fourth characteristic of the scaffolds was that the participants had to make room for playfulness. When some of the participants became frustrated, they had to "play" with the idea, so it could lead to self-discovery. This meant that the instructor had to provide the time and space for the student teachers to "play". The final characteristic that was seen was related to timing. Depending on when the questions were posted, certain participants received more comments from peers. This means that the instructor has to pre-plan the posting schedule so that each question will receive ample and equal attention from peers. Therefore these are the suggested Five "P"s to consider when facilitating inquiry-based learning using SMILE.

CONCLUSION

This case study revealed that SMILE indeed provides multiple means for student engagement through inquiry learning but the facilitation of student engagement will rely heavily on the role of the instructor. SMILE provided options for recruiting interest by personalizing as well as options for sustaining effort and persistence through collaboration and play. Over the semester, the participants also built a scaffold for their learning, taking their learning to deeper level through the practice of critical thinking. In addition, five characteristics emerged that demonstrate how the affordances of SMILE sustained participant engagement in deeper learning. These characteristics are pre-skills, pre-plan, persevere, personalize, and playful, all of which align with the 12 principles of mobile learning (Heick, 2015). Ideally future studies could build upon this pilot study, expanding the method to a larger scale and continuing to explore the role of instructor as the facilitator in order to learn more about engagement in teaching and learning.

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