British Journal of Educational Technology *Vol 47 No 5 2016* 932–944
doi:10.1111/bjet.12327

Effects of reflection type in the here and now mobile learning environment

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Abstract
Here and now mobile learning has the capability to engage learners anytime and anywhere and situate them in their learning context. Mobile devices provide opportunity for learners to participate in reflective activities with experts, peers or self while being situated in the learning context such as being in a museum or gallery and using mobile content to learn about exhibits. This study examined the effects of here and now mobile learning on student achievement and attitude based on different types of reflection (no reflection, self-guided reflection and reflection with virtual expert). Students ($n = 103$) who were enrolled in teacher preparation courses at a public regional university in the United States participated in the here and now mobile learning intervention on art content in one of three reflection groups. The participants completed a posttest and attitude survey. One-way ANOVAs were conducted on data obtained from the achievement pretest and posttest and on the attitude survey results for the Likert-type items. Analysis of achievement data revealed positive significant differences on the reflection type whereas attitude data did not reveal any significant differences. The implications of the findings are discussed for those designing and implementing mobile-based learning.

Introduction

Mobile learning devices have been transformed by the growth of broadband Internet access, data plans and wireless service coverage, such that what was once considered "e-learning"—referring to the digitization of learning content—is now being redefined as "m-learning" (McGreal, 2009). By May 2014, there were 6.9 billion mobile subscription plans globally compared with the 6 billion in 2011 and 4.7 billion in 2009. There has been a growing percentage of users who access the Internet through their mobile devices, particularly in developing countries (International Telecommunication Union, 2014). There were 1 billion shipments in 2013 alone, which was 42.3% more than the sales in 2012 (Gartner, 2014). The substantial growth of mobile devices and data plans provides educators with ever-increasing opportunities to provide learning experiences through mobile devices.

Mobile technology has made it feasible to provide learning and performance support within the field, with the possibility of interaction and communication on a global scale. El-Hussein and Cronje (2010) state that mobile learning takes into account the mobility aspects of technology, learners and learning. Mobile devices have progressively been used to engage learners within the classroom (Sharples, 2006), and more studies are being done positioning mobile devices within different authentic social contexts and informal learning environments (Martin & Ertzberger, 2013; Wu, Hwang, Su & Huang, 2012). In a modern teaching environment, the situational

Practitioner Notes

What is already known about this topic

- Here and now mobile learning increases learning.
- Here and now mobile learning increases student attitude and engagement.
- Here and now mobile learning increases performance support.

What this paper adds

- Reflection via a virtual expert increases student learning in the here and now mobile learning environment.
- Self-guided reflection increases student learning in the here and now mobile learning environment.
- There are no significant differences in the attitude of the participants between the reflection treatments (no reflection, self-guided reflection and reflection with virtual expert) in the here and now mobile learning environment. Overall, the students participating in the here and now mobile learning environment had positive attitudes irrespective of the treatment.

Implications for practice and/or policy

- Mobile learning designers include self-guided reflection.
- Mobile learning designers include opportunity for the participants to reflect with the virtual expert from the learning context.
- Teachers taking students on field trips can try and arrange for students to chat with virtual experts from the context of their learning.

approach to education embodied by here and now learning is given a host of new forms through the use of context-based digital applications. Shih and Mills (2007) found that on using mobile technology, students were highly motivated, demonstrated enhanced interaction and collaboration, and the quality of learning increased. The use of mobile devices for context-based applications also allows students to be involved from wherever they are located (Santos & Ali, 2011; Shrestha, 2011). This participation has the potential to increase student achievement, make student attitudes more positive and lead to authentic learning activities that are indicative of the potential benefits derived from here and now mobile learning.

Here and now mobile learning

While mobile learning broadly refers to learning that occurs via mobile devices, "here and now mobile learning" is a specific aspect of mobile learning where the learners are situated in the context of their learning environment and learn via mobile devices. Martin and Ertzberger (2013) define here and now mobile learning as "learning that occurs when learners have access to information anytime and anywhere via mobile technologies to perform authentic activities in the context of their learning" (p. 77). The principle of this learning is that the learner should be placed inside the context, as learning and performance are specifically influenced by the setting in which they happen (Bransford, 2000). Martin and Ertzberger (2013) listed *Engaging, Authentic and Situated* as the three characteristics of here and now mobile learning.

One of the characteristics of here and now mobile learning is authentic learning. Authentic activities are described as the best way to directly engage learners, by situating them within an interactive environment that supports their learning needs (Brown & Duguid, 2002). Authentic learning environments that use interactive activities have been shown to help learners achieve "deeper content understanding" than more traditional models (Soa & Konga, 2010). As such, mobile-learning environments provide authentic interactive learning experiences by implementing this type of learning and providing scaffolding whenever students need it, whether they are in class or in the field. The here and now mobile learning framework aids "pulling" and "pushing" information as learners have the chance to receive content and additionally generate it. Students can use mobile devices to take note of their observations, document notes from their surroundings, record local sounds and develop content to share with others. Mobile devices have the potential to keep learners engaged in authentic learning activities and assist learners in obtaining information from wherever they are located. Mobile devices assist learners to focus their attention on the context of the learning environment, as well as offer appropriate support when needed. Farrell and Rose (2008) found that being able to access patients' information using a mobile device at the bedside increased learning and health outcomes as well as helped provide better patient care.

Another characteristic of here and now mobile learning is the opportunity for informal learning. Informal learning is defined as "forms of intentional or tacit learning in which we engage either individually or collectively without direct reliance on a teacher or externally organized curriculum" (Livingstone, 2006, p. 204). Clough, Jones, McAndrew and Scanlon (2008) found that mobile devices are used extensively in informal learning contexts. There is still a need for further research and case studies demonstrating how here and now mobile learning can be implemented in informal settings. Reynolds, Walker and Speight (2010) developed a mobile, handheld device that used a web-based application to create various museum trails for design students at the university level. These trails offered various paths for students to engage with the museum content. Student feedback demonstrated that the use of the web-app via these mobile devices enhanced their knowledge and interest in museum artifacts.

Reflection to engage learners in mobile learning environment

Reflective activities have been performed to engage learners and have positive impact on student learning. Johnson (2010) states, "critical reflection is of benefit to adult learners as these methods promote involvement and engagement in the learning process" (p. 1). Dewey (1933) stated that, "We do not learn from experience. We learn from reflecting on experience" (p. 78). Some of the strategies that are used in the classroom to invoke reflection are individual journaling, online discussions, think-pair share activities, creating mind maps, etc. Reflection has long been held as a tool for enhancing retention of learning. Researchers have found that reflection in the form of elaborative interrogation can be a powerful learning procedure (Pressley, Symons, McDaniel, Snyder & Turnure, 1988). Seifert (1993) also found that elaborative interrogation may be an effective strategy for increasing learning and retention. Elaborative interrogation was used in this study, recommending students to ask questions (after viewing the painting) such as: "Why did the artist use such themes?"

Several reflection methods have been examined by researchers. Some of the reflective methods such as reflection with a virtual expert or self-guided reflection can be integrated in mobile learning. Self-guided or individual reflection has been shown to have a positive perception from users (Hanrahan, Pedro & Cerin, 2009). Reflection with an expert can create unique opportunities for deep learning as the learner has the ability to ask questions and get updated information which helps them clarify and retain information. This is done in real time in the context of the situation. We also know from previous studies that true experience-based learning of mobile devices occurs when they are co-present with another person (Ainsa, 2013; Jones, 2015; Parsons & Ryu, 2006). Because individual reflection and expert reflection have been shown to have a positive impact on learning, these methods were selected and then applied in this study and elaborative interrogation was used as the reflective strategy.

The term reflection type is used in this study to describe the different types of reflection that the students were able to engage in while participating in the here and now mobile learning. The two types of reflection that students participated in were self-guided reflection and reflection with the virtual expert. Self-guided reflection refers to the individual reflection that students participate in by responding to the reflection prompts that are provided. Reflection with the virtual expert refers to the opportunity of the user to communicate with the subject matter expert virtually via the mobile device from the context of their learning.

Purpose of the study

The purpose of this study was to examine the effects of different types of reflection (no reflection, self-guided reflection and reflection with virtual expert) during here and now mobile learning on student achievement and attitude. Student attitude refers to student perception regarding the usefulness of here and now mobile learning.

Research questions

1 To what extent do different reflection types (no reflection, self-guided reflection and reflection with virtual expert) during here and now mobile learning significantly improve student achievement?
2 To what extent do different reflection types (no reflection, self-guided reflection and reflection with virtual expert) during here and now mobile learning significantly improve student attitudes?

Method

Participants

Participants for this study were 103 undergraduate students enrolled in preservice teacher preparation courses at a public regional university in the southeastern United States. Most (86%) of the participants were women and 14% were men; 87% were in the 18–22 age range, 8% were in the 20–23 age range and 5% were in the 30–40 age range; 43% were juniors, 35% were sophomores, 13% were freshmen and 9% were seniors. Participants were asked a question if they owned a mobile device and how they used mobile devices (see Figures 1 and 2).

Materials

Using Articulate Storyline, a mobile-enabled online program was developed to be the source of instruction for this study. Three paintings were identified and information about each painting included biographical information about the artist, historical significance of the piece and interpretations.

There were three versions of the instructional material.

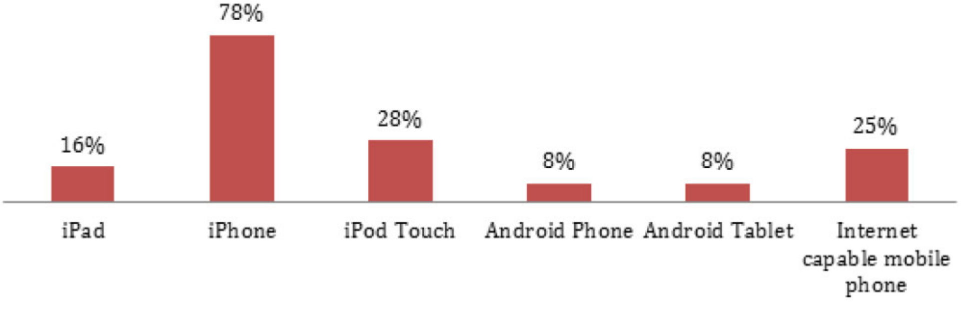

Figure 1: Participant ownership of mobile devices

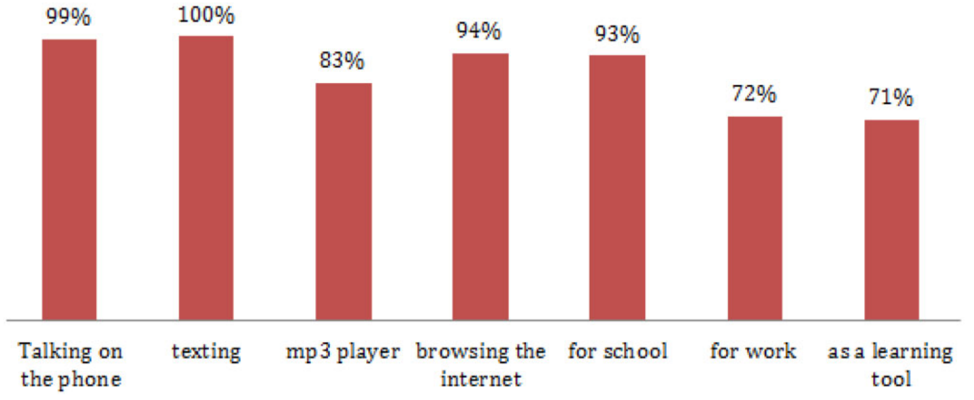

Figure 2: Participant usage of mobile devices

Main screen of the virtual expert reflection version

Content screen

Self-guided reflection screen

Figure 3: (a–c) Sample screens from the instructional material

- No-reflection version—This was the lean version. There was no opportunity to reflect at the end of the mobile instruction. While we understand that we cannot limit internal reflection occurring in a student, this no-reflection treatment refers to not providing any external opportunity to reflect.
- Self-guided reflection version—In this version, at the end of the instruction, they were directed to reflection questions which they could respond to.
- Reflection with virtual expert version—In this version, at the end of the instruction they were directed to talk to the virtual expert via FaceTime on iPad which was mounted on a stand next to the painting. In this study, only one learner interacted at a time with the virtual expert by which the expert was able to scaffold the reflection of the learners.

Figure 3 includes three sample screens from the instructional material.

Procedure

Students from seven different sections ($n = 103$) enrolled in undergraduate preservice teacher education courses were blocked by classes and randomly assigned to the three treatment groups

Figure 4: Student reading about the painting by scanning the QR code

Figure 5: Student talking to a virtual art expert while at the painting

(no reflection, self-guided reflection and reflection with virtual expert). A quasi-experimental design was used in this study to avoid differences in content, attitude or time spent on the program between the students enrolled in the same class. Each of the participating course sections, rather than individuals, was randomly assigned to a reflection type treatment (no reflection, self-guided reflection and reflection with virtual expert).

The pretest with 10 questions was administered first in the classroom and this took approximately 10 minutes to complete. Participants were also given instructions on using their mobile device and installing QR codes or loan out a mobile device which had QR codes installed. A map with the location of the three different paintings marked was given to all the participants.

The participants were then directed to the mobile application to access information for their particular treatment. The participants scanned the QR codes, viewed the painting, read about the paintings while they were in front of the painting. Then they participated in the reflection activity (depending on the treatment they were assigned). Figure 4 depicts a student scanning a QR code on a painting and Figure 5 shows a student talking to a virtual expert.

On returning to the classroom, they completed the posttest and attitude survey. The entire intervention time lasted between 30 and 40 minutes. Participants in the no-reflection treatment took

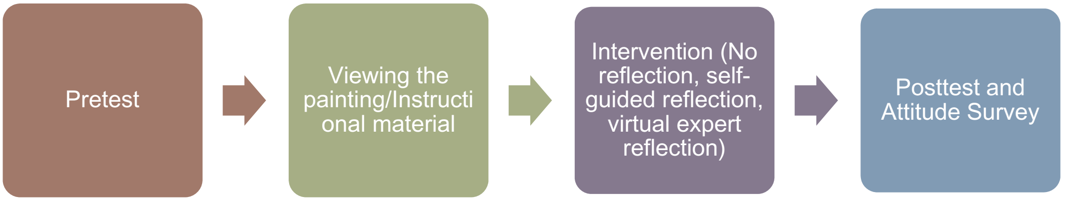

Figure 6: Study procedure

less time compared with the self-guided reflection and reflection with virtual expert treatment participants. (Figure 6 is a visual representation of the procedure of this study.)

Criterion measures

Posttest and a student attitude survey were the criterion measures in this study. In addition, a pretest was administered to evaluate participant's prior knowledge on the instructional content.

Pretest

Ten multiple-choice questions with four response choice items were included on the pretest. The overall mean score on the pretest was 2.80 or 28%, which indicated that the participants had low prior knowledge on the art content.

Posttest

The posttest included the same 10 multiple-choice questions that were on the pretest. The reliability of the posttest was 0.98. A sample question that appeared on both the pretest and posttest is shown below.

The Gathering by Jansem was created to express what emotion?

a. *Joy*
b. *Fear*
c. *Terror*
d. *Pain**

Attitude survey

The attitude survey was used to measure student attitudes toward their mobile learning experience. The attitude survey included 10 Likert-type questions that were rated strongly disagree (scored as 0) to strongly agree (scored as 4). Two open-ended questions on what they liked most and least about the art lesson were also included on the attitude survey. The survey also had a few questions on participant demographics. The reliability of the attitude survey was 0.94.

Data analysis

A one-way analysis of variance (ANOVA) was conducted on the pretest and posttest data. One-way ANOVA was also conducted on the attitude data for the Likert-type items (Items 1–10). A group × occasion repeated measures ANOVA was conducted to check for "interaction" effects. Post hoc Tukey tests were conducted to identify if there were any significant differences between the treatments.

Results

Student achievement

The first research question examined the effects of here and now mobile learning on student achievement. The means and standard deviations for participant achievement on the pretest by reflection type are presented in Table 1. ANOVAs on the pretest revealed no significant differences across the groups $F(2, 100) = 1.66$, $p > .05$, partial $\eta 2 = .032$.

Table 1: Student achievement

	Pretest M (SD)	Posttest M (SD)
No reflection ($n = 31$)	2.61 (1.26)	5.13 (2.22)
Self-guided reflection ($n = 38$)	2.63 (1.44)	6.42 (1.67)
Reflection with virtual expert ($n = 34$)	3.15 (1.39)	7.85 (1.35)
Mean	2.80 (1.38)	6.50 (2.06)

Maximum score on pretest and posttest is 10.

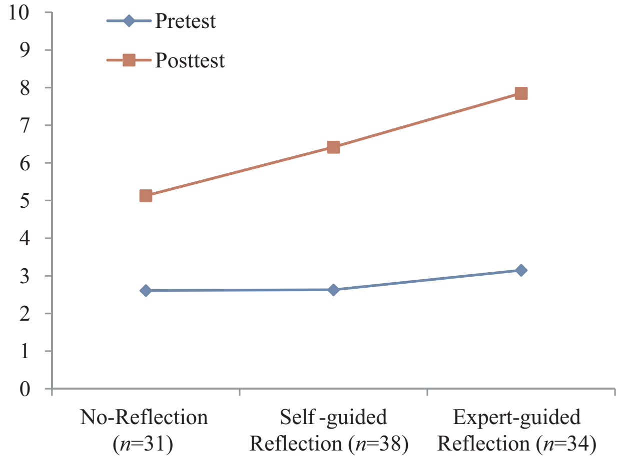

Figure 7: Group × Interaction

The ANOVAs on the posttest for reflection type revealed statistically significant differences between the three groups, $F(2, 100) = 19.41$, $p < .05$, partial $\eta 2 = .28$. Follow-up post hoc Tukey tests revealed significant differences between all the three groups, no-reflection and self-guided reflection ($p = .009$), self-guided reflection and reflection with virtual expert ($p = .02$), and no reflection and reflection with virtual expert ($p = .00$).

Group interaction × occasion repeated measures ANOVA was performed to check for interaction and no interaction effects were found (see Figure 7).

Student attitude

The next research question examined the effects of reflection in here and now mobile learning on student attitude. Means and standard deviations for responses to the 10 Likert-type items on the attitude survey are presented in Table 2. The items were rated on a 4-point Likert scale from *strongly disagree* ($n = 0$) to *strongly agree* ($n = 4$).

ANOVAs were conducted to determine the effects of three reflection type conditions (no reflection, self-guided reflection and reflection with virtual expert) on participant attitude based on the 10 items. No significant differences were found among the three reflection types for any of the items. Overall, the reported attitude was positive across treatment groups. Self-guided treatment had the highest overall mean ($M = 3.35$), with reflection with virtual expert treatment very close ($M = 3.30$).

Table 2: Student attitude

	Items	No reflection	Self-guided reflection	Reflection with virtual expert
1	The content was presented in an easy-to-understand manner.	3.30 (0.95)	3.68 (0.47)	3.50 (0.51)
2	The length of the content was appropriate.	3.33 (0.92)	3.66 (0.53)	3.38 (0.55)
3	The learning content maintained my interest.	2.66 (0.99)	2.97 (0.91)	3.12 (0.68)
4	The learning content provided precise information.	3.17 (1.02)	3.45 (0.55)	3.36 (0.55)
5	I was able to quickly access the learning content.	2.90 (2.09)	3.26 (0.95)	3.38 (0.70)
6	Text was legible without zooming.	3.03 (1.03)	3.42 (0.86)	3.32 (0.73)
7	The clickable navigation was helpful.	2.97 (1.03)	3.50 (0.83)	3.21 (0.81)
8	I enjoyed learning using the mobile device.	2.83 (1.02)	3.24 (0.88)	3.24 (0.70)
9	I view this type of mobile learning as effective.	2.80 (1.00)	3.21 (0.87)	3.24 (0.79)
10	I would be interested to learn using this method in the future.	2.69 (1.10)	3.08 (0.94)	3.22 (0.66)
	Mean	2.97 (0.28)	3.35 (0.23)	3.30 (0.11)

Likert scale: *strongly agree* ($n = 4$) to *strongly disagree* ($n = 1$).

Table 3: Open-ended attitude items

Treatments	*What did you like the most?*	*What did you like the least?*
No reflection	Getting to use the phone for learning (11 students) Leaving the class to go learn about art (7 students)	Technology difficulty (8 students) Not interested in art (5 students)
Self-guided reflection	Using technology and scanning QR codes to learn (13 students) Going outside the classroom and learn (9 students) Learning about art (4 students)	Technology difficulty (7 students) Was not interested in art (4 students)
Reflection with virtual expert	Talking to the expert (11 students) Using the mobile device (8 students) Learning about the art (5 students)	Technology challenges (8 students) Not sure what to ask the expert (5 students) Not interested in art (3 students)

There were two open-ended questions on the attitude survey that asked the participants what they liked the most and least about the program. Table 3 includes a summary of student responses to the open-ended questions.

Discussion

This study examined different types of reflection in a here and now mobile learning environment following a mobile lesson on art content. The no-reflection treatment participants reviewed the content and then came back to the classroom, the self-guided reflection treatment participants were given reflection questions to respond to, and the reflection with virtual expert participant's treatment had the opportunity to reflect with a virtual expert after their mobile lesson.

Achievement

There were significant differences between the treatments (no reflection, reflection with virtual expert and self-guided reflection) for achievement. Results showed that the group that reflected with the expert scored the highest on the posttest. High posttest scores are indicative of deep learning. The high posttest scores could have occurred because of the interactions with an expert in the community (Lave & Wenger, 1991). The type of learning that occurs between learner and learners, learners and tutors, between a learning community and its learning resource is also described as networked learning (Goodyear & Carvalho, 2014; Goodyear, Jones, Asensio, Hodgson & Steeples, 2005). Jones (2015) explains that the key aspect of networked learning is the "use of information and communications technology to promote connections" (p. 5) and in this case the mobile instruction served as the information and communication technology (ICT) to connect the expert and the learners. These results also showed the importance of a virtual expert in here and now mobile learning environment. Having access to an expert while the participants were in the field benefitted the students by being able to clarify any questions they had about the painting. The virtual experts also supported making sense of what the students learned and helped them interpret the subject matter (Säljö, 1979) which supported deep learning. This could have implications of including access to a virtual expert via their mobile device when students go on field trips though it includes challenges with data signal availability and the expense to guarantee students instant access to an expert.

The self-guided reflection group scored higher than the no-reflection group. The self-guided reflection group was given questions to reflect on before they completed the posttest. In a mobile learning environment where information is given in chunks, providing reflection questions for the individual to reflect on makes a difference. Overall, the need to scaffold reflection was confirmed in this study. The results of this study were consistent with those studies that showed improved learning outcomes using devices (Wu *et al*, 2012). The results of this study were consistent with the findings of Pressley *et al* (1988) and Seifert (1993) who found that that elaborative interrogation as part of reflection may be an effective strategy for enhancing learning and retention.

Attitude

There were no significant differences in the attitude between the three treatments (no reflection, self-guided reflection and reflection with virtual expert). All the participants had similar attitudes for participating in mobile learning based on the Likert Scale items. Based on the open-ended items, talking to the expert was the most liked reason from the reflection with the virtual expert group, whereas using the mobile phone to learn was the most liked reasons from the guided self-reflection and no-reflection treatment participants. Some students in all three treatments had technology difficulty in learning to scan the QR code and accessing the website correctly on their smartphone. Students were allowed to use their own mobile phones and each phone had to be used slightly differently. Some of the students had not used a smartphone to scan QR codes and pull up websites before and had to learn how to do it. Overall, the participants in this study were excited to be out of the classroom to participate in the context of their learning and scan QR codes to access information about the paintings using mobile devices. Though the attitudes between the treatments were not significantly different, overall their attitudes were positive on the attitude survey which included items on usability of mobile learning, enjoying learning using a mobile device, considering mobile learning to be effective and being interested in participating in mobile learning in the future.

Limitations

Key limitations to the study are the use of a quasi-experimental design, the limited treatment period and the exposure to the pretest before the posttest. A quasi-experimental design with a convenience sample was used in this study to avoid differences in content, attitude or time spent on the program between the students enrolled in the same class. Each of the participating course sections, rather than individuals, was randomly assigned to a reflection-type treatment (no reflection, self-guided reflection, reflection with virtual expert). The lack of random assignment at the individual level in this design leads to additional potential vulnerabilities to internal validity.

However, participants completed the treatment individually and were unaware of other treatment groups. Further, selection bias was addressed through the selection of demographically similar course populations at a single institution. External validity was threatened by the limited convenience sample. The items on the posttest were measuring information recall rather than the deeper learning that might have occurred from reflection. Future studies should consider this during the design of the test items. The sheer novelty of connecting with the virtual expert could have also influenced the learners' performance in this study. Students who also lacked the knowledge and skills to ask good questions to maximize interaction with the virtual expert may need prior scaffolding to benefit the most out the virtual interaction and this was a limitation in this study as students were not provided any scaffolding on questions to ask prior to interacting with the expert. While there are several advantages of here and now mobile learning, there are limitations such as potential of situated distractions from within the device and the surroundings and consequent detraction from learning.

Implications for future research and the improvement of practice

There are a number of implications for the design of here and now mobile-based instruction based on the results of this study. The study findings suggest that students may benefit from the inclusion of reflection activities that can be delivered to the student via the mobile medium. The study revealed that when mobile learners had the opportunity to reflect on the content with the experts from the context of their learning, they performed better. This study recommends making time for virtual interaction with an expert teacher or scientist when students are outside the classroom on field trips. Further supporting this implication are the open-ended responses of students in the reflection with virtual expert treatment group where a majority of the participants responded that "Talking to the Expert" was the most liked aspect of that treatment.

Recommendations for future research based on the current study are derived from both the study findings and the technological capabilities of the mobile platform. Future studies should be conducted in museums where the learners are motivated and in the context of the learning. Also, collaborative aspects of interaction should be examined in the here and now mobile learning environment. With the technology capabilities of the device, location-aware data should also be collected along with the analytics data on time spent and pages that a mobile learner visited from the context of his/her learning. The transition of the assessment within the mobile environment would be also a factor of interest that could further inform the design of instruction for mobile learning environments.

Conclusion

As mobile technology usage increases, it is important for research to explore on both usage of the device in the context of students' learning and also determine the impact the ubiquity afforded by mobile technologies will have on current instructional design practices. Mobile learning offers the potential of situated learning (Dede, 2011; Quinn, 2012) and networked learning (Jones, 2015; Goodyear & Carvalho, 2014), and supports authentic tasks in informal learning settings (Mann & Reimann, 2007; Shih, Chuang & Hwang, 2010). However, more research needs to be conducted on using here and now mobile learning in various instructional contexts using a variety of instructional applications.

Statements on open data, ethics and conflict of interest

a. The data is with the researcher and can be accessed by emailing the researcher.
b. Institutional Review Board approval was obtained at the University where this study was carried out. All identifiers were removed once data was collected and pre and posttests were matched.
c. There is no conflict of interest.

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