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Expressive Interactions: Tablet Usability for Young Mobile Learners

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ABSTRACT

In this paper we examine the usability of tablets for students in middle school in the context of mobile environmental education. Our study focuses on the expressive qualities of three input methods – text, audio and drawing – and the extent to which these methods support on-task behaviour. In our study 28 small groups of children were given iPads and asked to record ecological observations from a round their schoolyard. The effectiveness of the devices and their core utility for expressive, on-task data capture is assessed.

Author Keywords

Mobile learning, design, educational technology.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): User interfaces.

INTRODUCTION

With tablet computers becoming increasingly ubiquitous, it is worth assessing what role this class of device can play in school-based education. Investigation of its potential values starts with some of its fundamental distinguishing attributes – a larger multi-touch display balanced with inherent mobility. This paper reports on a study designed to examine the relationship between tablet input modes and children's interactions. Twenty-eight small groups aged 11 to 13 years used Apple iPads to collect data during an outdoor science activity. For this study, we assess three interaction modes – touch-screen typing, drawing and audio recording – in the context of simplified scientific data collection. Our research aims to understand each interaction mode in terms of:

- *Usability* as effectiveness in enabling children to achieve goals, and learnability created by ease of use;
- Capacity to support *on-task behaviour* as defined by the extent to which records created by children related to the task at hand; and
- *Expressiveness*, shown by depth of communication.

Our findings indicate that children find audio the most effective and easy to use mode. We also found that while typing provided the most reliable and 'on-task' data capture, both audio and drawing provided more expressive interaction.

BACKGROUND

Education for environmental sustainability (EES) is an area of the curriculum that is well suited for incorporating new and interactive mobile technologies, particularly those that can be used in groups and have the capacity to encapsulate multiple key learning areas such as data capture and manipulation (Smith et al., 2005), scientific classification techniques (Chen et al., 2003) and the use of multimedia resources to relay context and processes (Gay et al., 2002). In examining the relationship between children and mobile technology we focus on the importance of context in the mobile learning experience. The outdoor data collection dictated by our study area of EES provides a rich context to examine mobile device use situated within a school context. The study focuses on the interactions offered by mobility within a physical space (Sharples et al., 2007) as children move through the school playground to record ecological observations.

The use of mobile devices within a learning context creates a complex relationship between children, activities, the environment and the technology (Wyeth and MacColl, 2010). Personal tools and cultural artefacts are important educational resources; they allow children to make ideas tangible, to share them, to negotiate meaning, and to communicate (Ackerman, 1996). In this context, we look to assess the effectiveness of tablet devices for expressive interaction, as children capture data through text, audio and drawing. We look at how the quality of being "ready-to-hand" (Dourish, 2001) allows children to work through the tablet interface to perform data collection activities. Our interest lies in how this kind of seamless interaction and subsequent immersion promotes expressive interaction and supports on-task behaviour. By studying how children create persistent artefacts using tablets, we broaden our understanding of the dynamic and evolving nature of their use as mediators within learning experiences (Henning, 2004).

STUDY APPROACH

We conducted our study on 'science day' at a suburban state primary school. The study participants were four classes of approximately 20 to 25 students each. The students were all between the ages of 11 and 13, and of mixed gender. Students were divided into groups of between two and four (most commonly three) and given an iPad with which to conduct the ecological observation and data collection activity. Twenty-eight groups participated in the study and each was given an iPad with the following apps on the main (iOS 3.2.1) home page:

- iBooks (Apple Inc.): a PDF viewer pre-loaded with a five-page reference guide;

- Adobe Ideas (Adobe Systems Inc.): a touch-based drawing app pre-loaded with an editable school map;
- Notes (Apple Inc.): for the capture of text notations using a digital keyboard;
- AudioMemos (Imesart): for environmental sounds and voice recordings; and
- Maps (Apple Inc.): GPS-enabled map app preset to a satellite view of the school.

At the start of each session students were assembled and given an overview of their objective in the field – to capture observations of interesting environmental attributes they encountered, including plants, trees, birds, insects, spiders, reptiles and mammals. In this introductory session, students were also given a brief tutorial on how to use each iPad application. Each session was comprised of 10 to 15 minutes introduction, 20-25 minutes exploring the school and a 10-minute wrap-up.

Study Instruments and Analysis Methods

Study data was captured through analysis of the records created on the iPads during the sessions. This data included audio records, written notes and drawings. A record was categorized as an individual observation. Some groups created one file per observation, while others recorded multiple observations in one file (e.g., multiple observations on separate lines within a Notes file). Records that were “blank” (e.g. silent audio recordings of less than 2 seconds and blank drawing canvases) were not included in the analysis. Each record was rated on the ‘on-task’ scale outlined in Table 1. Assessing the level of detail, looking for examples of creative input and examining the extent of personalisation were used to evaluate expressiveness.

On-task	Description	Example
Fully	Rich descriptive detail	Very tiny dark green spider and a black spider with yellow spots.
Mostly	Some detail	Black and yellow ladybird.
Partly	Brief description	We saw a butterfly.
Most off	Loosely related	We met with lots of people.
Off-task	No meaningful data	Tech guy has cool sunnies.

Table 1: The 'on-task' rating scale used to classify records.

In the wrap-up, students filled out a brief questionnaire designed to assess the usability of iPads generally, and of typing, drawing and audio recording more specifically, using a simple three point scale to express levels of agreement with statements (yes, not sure, no). The difficulty of surveys for measuring children’s perceptions (Read and McFarlane, 2006) is acknowledged and survey data is carefully considered with the other data.

FINDINGS

In total, 78 drawings, 147 audio records and 77 note records were produced. Seventeen groups used all three input methods, nine used two methods and one used only one method. There were significant variations in the number of observations produced, with one group only creating three observations while another produced 20.

Usability

Observational data indicated the students embraced iPad use, taking responsibility for overcoming any usability issues themselves. Only two student groups out of 28 were seen taking their iPad to facilitators for assistance, one for help creating a new audio memo and the other due to GPS failure in Maps.

Survey results indicated that the function students rated as having the greatest ease of use was recording audio, with only one negative response and almost 90% agreeing use was ‘easy’. Ease of use of audio input is supported by the large number (147) of valid audio records produced by children. The longest recording was almost 8 minutes and an example of a single entry appended multiple times. Several groups took this approach rather than creating a new entry for each observation.

Typing text received double the number of negative and ‘not sure’ responses, with about 80% agreeing it was ‘easy’. Captured records also support the survey data with respect to typed input. Notes represented the smallest pool of captured records with 77 text records created using the digital keyboard. Many of the notes were very brief; 78% of typed records were less than 10 words.

Drawing had the poorest usability rating with just over half of valid responses agreeing that it was ‘easy to use’, and the greatest negative and unsure response of a category at almost 10 and 30 percent respectively. Data captured supports this finding as drawing had the highest portion of blank records. While there were 78 valid drawing records generated, there were also 32 saved drawing files containing no data. Drawing activities involved participants overlaying information on the school map (19 records), constructing a habitat profile using a template (5 records) or producing a drawing on a blank page (54 records). The variation in record numbers indicates children preferred working without the overlays.

Task Oriented Behaviour

Notes had the highest ‘on-task’ rating with 84% of records at least partly on-task (see Figure 1). Two off-task records represented mistakes likely due to interface or other distractions. Only one text record was identified as completely off-task. An additional nine records were categorized as mostly off-task.

Drawing produced the lowest levels of ‘on-task’ behaviour, with only 55% of drawings categorized as partly on-task or more. Thirty-seven percent of drawings were classified as ‘off-task’. Five groups produced only on-task drawings and six produced only off-task.

A majority of “off-task” drawings were doodles completed on blank pages (20 of the 29 off-task records). Thirty-four of the blank page drawings were attempts to capture some element of the environment in a drawing. All but four of these drawings were considered to be at least partly on-task, but only one included the detail necessary to be categorized as fully on-task. Of the 19 map files containing data, 11 were categorized as at least partly on-task. Only two of the five altered habitat profiles were considered to be partly on-task with the three categorized as off-task.

Sixty-nine percent of audio records were categorized as partly on-task or better. Audio records rated ‘fully on-task’ varied in length from 17 seconds to just over a minute, indicating the time for a record to be most effective falls in this window (brief, well structured and to the point). There were 25 audio records rated as off-task; four represented problems with the interface or device (e.g. “*should I press record?*” and “*woh, it’s pretty heavy!*”). Twenty-one others (approximately 14%) could be regarded as intentionally off-task.

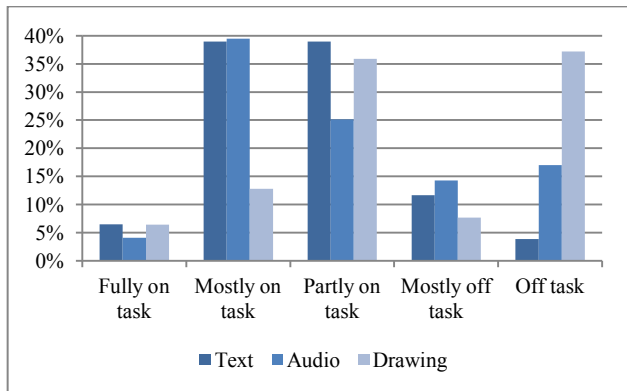


Figure 1: Level of on-task across text, audio and drawing.

Expressive Interaction

We analysed the records created during data collection to establish the extent to which tablet text, audio and drawing facilitates expressive interactions. Table 2 provides an example of the quality of ‘on-task’ data produced through each medium. A majority of the notes contained a brief description of flora or fauna that had been observed in the playground. Notes were generally succinct and to the point. Even those records that were categorized as mostly off-task were short pieces of information. These records generally described the people that were encountered, a location (e.g. “*oasis*”, “*outside toilet next to shed*”) or were a comment on the process (e.g. “*having great difficulty finding any animals*”). There were only three examples of personalization or interesting self-expression within notes:

- *We found a FEATHER!!!!!!! Luv George*
- *Butterfly it was beautiful with yellow and black wings It was flying near the yellow flowers (agipanthus) it was fluttering round in circle we almost caught it! Hehe lol.*
- *Ant Small, black, 6 legs, looking for food, three section of body wow really huh?!*

Audio recording clearly offered opportunities for self-expression and creative behaviour. Sixty-two percent of audio records contained more than one sentence with the average recording lasting 35 seconds. When on-task, these records included rich descriptions (see Table 2), personal reflections (e.g. “*We heard some Myna birds singing near the basketball court. They sounded very lovely*”) and evolving detail (e.g. (boy) “*We have just discovered a lorikeet, rainbow lorikeet*”. (girl) “*Three!*” (boy) “*Three lorikeets?*” (girl) “*Yeah!*” (boy) “*Very interesting. And it is up in the tree in front of us right now*”). Collaborative entry was quite common, with students finishing each other’s sentences or helping if the main speaker was lost for words. In other groups,

however, iPad ownership was taken quite seriously and the ‘reporter’ would repeat or rephrase all observations made by group members in the field. A few groups also conducted an interview style of questioning to encourage the flow of observations. One of the most interesting aspects of the recordings was the narrative play adopted by five groups, with students of both sexes putting on a voice to make their observations. Out of the ten ‘dramatic’ records, six related to the task in some way, indicating narrative play motivated some groups to engage with the activity.


Text Record	Audio Recording	Drawing Record
<i>There is a small black spider near the grade fours and it has small dot on it. It is moving around its web.</i>	(girl1) <i>We saw a spider web, a very small one and a really tiny spider on it (girl2) it’s a very circular web, it’s a very small spider, it’s almost invisible – very good hiding spot for the spider</i>	

Table 2: ‘On-task’ example with text, audio and drawing.

While many of the audio records produced were focused and on-task, the expressiveness of the medium also resulted in behaviour that might be seen as undesirable within a ne educational context. For example there were records that included swearing and name calling, that discussed genitalia (e.g. (boy1) “*they’re really fat and ugly*” (boy2) “*oh, look at the size of those penises*”) and that demonstrated silly behaviour (e.g. *putting on voice and gasp, gasp* “*I am Darth Vader, come to the dark side!*”). With over 30% of audio records categorized as off-task to some extent, there were many examples of records that contained irrelevant (and potentially offensive) material. Even within ‘on-task’ records there were many examples of off-topic utterances.

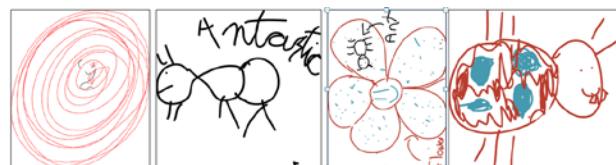


Figure 2: Drawings created by study participants.

Even though drawing produced the most ‘off-task’ behaviour, it clearly provided opportunities for creative and explorative interactions. Doodles ranged from practice drawings created early in the session to graffiti of names (‘tags’) and random swirls. Two groups used doodling as a prelude to data capture, while eight groups interleaved doodling with on-task data capture. For six other groups all drawings were ‘off-task’ doodles that largely included a range of single words, lines, shapes and scribbles. There were some interesting and artistically valuable contributions across the array of drawings, capitalizing on the capacity of this medium for personalization and self-expression (see Figure 2).

CONCLUSION

Our study focused on children working through a tablet interface to perform data collection activities. Table 3

provides a summary of our findings. Of particular interest was the extent to which data entry became ‘seamless’, allowing expressive use by children. Seamlessness has been judged, in part, by participant feedback on ease of use. The data analysis demonstrates that the children found the process of audio recording relatively seamless, as they were able to record extended audio entries without focusing on the tablet interface. Participants could start a recording and then immerse themselves in the task of being an eco-detective. Of the other two input methods, participants found drawing the most difficult. In considering the degree to which typing, audio and drawing input could be said to be “ready-to-hand”, while the current generation of tablets have improved usability dramatically through heightened direct manipulation, extreme portability and larger, more immersive screens, it is easier to talk about what we see than it is to work with a screen to record our observations.

	Usability	‘On-task’	Expressiveness
Typing	Medium	High	Low
Audio	High	Medium	High
Drawing	Low	Low	High

Table 3: Assessment of tablet-based input methods.

Assessment of ‘on-task’ behaviors shows that typing produces the best results. In part, this result may be seen as an attribute of its interface – since typing out in the field may be a little cumbersome, fewer entries are created yet they are also more focused. While many audio entries contained rich detail and were on-task, there were also a significant number that were off topic, irrelevant and potentially offensive. Drawing performed poorly within this category and many of the drawings produced were not directly linked to data capture tasks. It was clear that participants spent time experimenting as they scribbled, wrote their names and created shapes and lines.

While participants indicated that drawing was more difficult than typing, the number of drawings and notes produced were roughly equivalent. Analysis of drawings demonstrates that participants found it to be a more expressive and creative medium than typing. Given the age group, this result may not be too surprising; while children of this age are generally fluent writers, they are in the early stages of becoming skilled at creative and expressive writing. The data analysis demonstrates that audio recording offered the greatest opportunity for expressive interaction. The ease with which children created detailed records, the collaborative engagement supported and the role-play opportunities provided all contributed to this interaction quality. Exploration facilitated through a modality that is more “ready-to-hand” supports the expressive personalization observed in audio recordings. Seamless immersion is enabled through simple controls that are not, at present, replicated by the screen-based interface.

One area that we have not explored in this study is the degree to which the novelty of the technology itself was an issue. While our participants are, almost by definition,

“digital natives”, tablets are still not commonplace. We plan on repeating and expanding this study with a similarly aged group who each have an iPad to explore appropriation with longer-term use.

In conclusion, typing is clearly the best means to ensure data capture that is on-task and reliable. Drawing offers the capacity for users to form unique interpretations of data and customize records according to preference and context. This personalization can help facilitate a sense of device ownership, but drawing remains a challenging mobile interaction mode with questionable usability and data reliability. With the level of engagement generated by audio recording, it seems to offer the greatest potential as an in-the-field notation tool. With further refinements to entry structure, audio could prove to be a valuable data capture medium, allowing more freedom to observe and interact with findings.

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