The digital reading path: researching modes and multidirectionality with iPads[†]

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Abstract

This paper reports a study that examines the integration of tablet technologies such as iPads into literacy lessons to investigate how reading and meaning-making occur within this digital medium. Specifically in this paper, we discuss the concept of reading paths as applied to physical and cognitive planes of meaning-making. The paper reports on data collected as part of a Social Sciences and Humanities Research Council (SSHRC) funded project involving researchers from Canada, the United States and Australia. The study is currently under way in schools in the three different countries where the researchers are observing students in classrooms in primary and secondary schools. The research is designed with a mixed methods approach coding video footage of dyads to enable close study of their interaction during literacy tasks incorporating iPads. Our findings show that the affordances of touch technology allow for multimodal, multidirectional reading paths. By tracking students' interactions with the digital platform through touch, it is possible to see navigation as evidence of the relationship between material and cognitive processes, which fosters metatextual awareness. These aspects of modes and new literacies construct a dynamic materiality for students' reading and writing. As a result, we propose that current awareness of the mode of gesture needs to be expanded to take into account haptic ways of learning.

Key words: digital literacy/ies, multimodality, reading, research methods, new literacies, iPads

Introduction

In our ongoing research on young students' use of tablet technologies such as iPads (Rowsell et al., 2013; Walsh and Simpson, in press) we have observed many instances of reading for information on this digital platform. There is a typical activity sequence that they follow, and it is important to note that the interactions occur on both a physical and cognitive plane of meaning-making during the reading process. That is, when students type a key word to prompt a browser to complete a search on the Internet; select a page to read from the list offered by tapping on a hyperlink; read the text on screen and then (depending on the text

or site relevant to their need) select, copy and paste information or a web link into a note-keeping document they have created; they have interacted with the semantic plane through touch to accomplish some act of meaning-making. The researchers propose that the reading paths down which the students travel are not only non-linear and multimodal but multidirectional, where the term multidirectional is taken to refer to interaction across interrelated textual dimensions and platforms. As we will demonstrate through a close analysis of student dyads working with iPads, the multidirectional nature of their reading pathways is a result of the facilities of the digital technology. The use of touch is read as a signal of student awareness of both the medium and the message they were trying to create. We explore two methods of coding touch-based meaning-making processes as a means of providing evidence of students' developing metatextual awareness (Simpson and Walsh, in press).

Background and contexts

This article reports on data from two of three international sites that are a part of a Social Science and Humanities Research Council of Canada Insight Development Grant. The three sites involved in the research are located in Oakville, Canada, San Diego, USA and Sydney, Australia. The Canadian government created Insight Development Grants for the purpose of building knowledge and understanding about new methodological approaches to emerging research topics and ways of mobilising such knowledge in practice. Noting the burgeoning use and adoption of iPads across schooling contexts, the researchers came together as an international group of scholars to examine tablet pedagogy, assumptions, epistemologies and their implications for reading policy and practice.

The stated aim of the project is to theorise the properties, processes and practices involved in 'reading' with tablets. The lofty goals at the beginning of the research were to:

"advance current research in reading specifically and literacy broadly, by comparing and contrasting reading processes across geographic sites and by creating frameworks for teaching methodologies for multimodal (i.e. image, sound, interactive) texts increasingly used and

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[†]The commercial name iPad is referenced as those were the tablets used in the project.

understood inside and outside of the schoolhouse. Conducted by international scholars in three diverse settings, the research holds the promise of offering academic as well as wider general audiences innovative ways of thinking about reading beyond a sole focus on the written word and print-based texts." (Rowsell et al., 2011).

As with much research, what we set out to find and what we have actually identified has shifted. Although there are many implications for pedagogy that will be published in the near future, we are particularly interested in the impact of touch on students' use of tablets for literacy tasks. Thus, we are focusing here on the mode of touch and reading paths.

Review of research

The study of reading paths is a line of inquiry, which this research follows while situated within theoretical frameworks of new literacies and multimodality. Previous research (e.g. Bearne et al., 2007) has examined the non-linear aspects of reading on screen, but there is little research on how the use of touch with tablets influences meaning making through physical action. Although not all schools provide one-on-one access, the structure of classrooms where every student has individual access to iPads fosters their constant interaction with the screen through quick finger movements such as touching, tapping and sliding. Over a decade ago Snyder (1997) showed that the electronic links of hypertexts offer non-linear pathways for both reading and writing. Snyder's description of hyperlinks and hypertext deals with the purposeful connection of information conceptualised as "a network of links between words, ideas and sources, one that has neither a centre nor end" (Snyder, 1997, p. 127). In this study we are examining students' metatextual awareness by tracing the multidirectional links that they make in their reading paths through their choices of physical action and semantic chaining incorporating but going beyond hypertext.

Because of the increased use of touch in digital platforms, the concept of reading pathways resonates even more as the interface between sites, programs and apps is more fluidly accessible. Lawless and Schrader's (2008) extensive review of research on navigation across technologies and several disciplines shows an established relationship between physical movement and cognitive processes (pp. 268–269). They refer to various attempts that have been made to track navigational paths or to set up audit trails, showing that further research is needed to capture navigation in authentic use. Lawless and Schrader consider navigation as a spatial metaphor and apply the perspective of schema theory, which allows for consideration of the relationship between the external, material environment and the background and internal cognitive processes of the

learner. The effect of the reader making links to background experience and knowledge of other texts through intertexual referencing is important within this focus as we consider the logical connections students chose to make as they forged their digital reading paths. A further issue is how the increased use of touch for navigation of hyperlinks, hypertexts and screens within multimodal contexts means that the mode of gesture has become more prominent and also operates at a heightened level of delicacy in students' meaning-making processes (Kendon, 2004). A question that arises from such an inquiry is how does touch play a role in the way that students come to understand texts? For this reason, our paper examines the materiality of student interactions with iPads as evidence of their reading paths.

When so much contemporary learning relies on active touch versus more passive touch, we agree with Minogue and Jones who called for "more research into how students perceive, process, store, and use haptic information in a variety of educational contexts and settings" (2006, p. 343). Because of the growing uptake of tablets by schools and the lack of research in the area, the proposed relationship between the materiality of touch technologies, reading paths and cognitive processes needs detailed examination. The term 'haptic' refers to the sense of touch and learning that happens through touch (Lowenfeld and Brittain, 1982, p. 326). Touch-based learning involves the feel of objects (e.g., soft, hard, cold, etc.) combined with the immaterial sense of working within interface and three-dimensional software. In an interesting study Mangen (2008) explored the idea of a haptic modality within the reading of hypertext fiction. She contrasted the multi-sensory, tactile experience of holding and flipping through the pages of a print book with an e-book, which she argued is 'intangible' because of the virtual nature of digital texts. Mangen thus argues for the importance of the material, tactile even graspable benefits of touch for digital reading contexts. Although her study was principally focused on the effect of reading hypertext fiction compared with print book fiction, it adds to our consideration of how the tangibility and haptic affordances of tablets intensify the relationship between material and cognitive processes compared with reading on screen without a touch facility. In their meta-analysis of research on touch, Minogue and Jones (2006) noted the increasing role of haptics in education yet also commented on the undertheorisation of touch in multimodal research. A key question that arose from their work provides further impetus for our study; does the bidirectional exchange of information between a user and a haptic device (stimulated by the sense of touch) enhance a learning experience?

The multi-sensory nature of modes and multimodality for reading have been acknowledged for some time (Jewitt and Kress, 2003; Kress, 2010; Pahl and Rowsell, 2010; Rowsell, 2006, 2012; Walsh, 2010). However research into touch in literacy learning is in the early phases of conceptualisation with no systematic

description yet for that mode of communication. Gesture has been acknowledged as a mode (Jewitt, 2006; Kendon, 2004; Kress, 2010), but it is more often studied within the disciplines of film, dance, theatre and external spaces (e.g. Jaworski and Thurlow, 2010). Given the development of touch screen technologies, we need to expand the conceptualisation of gesture and movement as modes to take account of the sensory nature of touch by considering new 'metaforms' (Kress, personal communication, 2012). Kress suggests that an analogy to field and focus in photography may be used to consider the level of detail needed to describe a student's actions as part of meaning-making processes in a classroom context. For example, a wide screen shot of a classroom would show the whole class working with the iPads individually and in small groups, while the teacher moves amongst them offering advice and support. To trace the interactions of individuals within the class we need to narrow the focus to include only one or two students. The resulting depth of field enables us to observe the students' movements, gestures and touch as they select their actions contingent to the meaning they intend to make or experiment with. We acknowledge that each act of communication is a response made to the multiple possible interpretations of shifting contexts. However, because our goal is to explore how the use of touch fits into acts of meaning-making at a social, pedagogic and cognitive level, we have chosen a close-up focus on pairs of students for our analysis in this paper.

Methods

For our 2-year study of iPad use, with a focus on reading and reading processes, we took a mixed methods approach to data collection (with a focus on qualitative research methods). A large portion of our corpus of data has been observational fieldwork filming Grades 3 and 5 students using iPads in the midst of literacy work. Filming tablets, by using angles that capture how students touch, scroll, navigate apps and touch iPad texts, and front views of readers, the research team has managed to capture sustained reading path moments. There has been significant filming within each context and we have collected artefacts of some students' work.

The cycle of teaching/learning/assessment is observable in a classroom episode, but multiple perspectives on the data are necessary including the researcher, the teacher and the students to cross-correlate complementary views of the same context (Reid et al., 1996). Therefore, in addition to the data listed previously, the teachers involved in the study have kept reflective journal entries as blogs or written diaries. This material provides the researchers with further insight into the pedagogic decisions that shape the teachers' actions in class that we record. We have also recorded students' reflections on their learning in vocalised 'think alouds'. These data provide researchers with the student perspective on their learning in the immediate context of their learning. Both of these additional data sources

are important to the study as they record the 'voice' of these participants and acknowledge the roles they play in the ecology of the learning environment.

Findings

We are currently trialling two forms of reporting to illustrate our findings: the first is in prose and the second is diagrammatic. The former sets out the roles in which touch was employed in collaborative and independent meaning-making episodes as a table of related themes and sub-themes. The latter provides a navigational trail of multimodal action at a finer level of focus. An example of both coding schema is given in the later text after each episode of interaction is described to show the complementary benefits each reporting approach delivers. We have found both tools useful as ways of conceptualising the role of touch in revealing reading pathways.

Example one: Canada

In the first example the focus is on two students, Brian and Cassandra (pseudonyms), from the Canadian data. The two Grade 3 students (seven-and eight-year-olds) are working side by side at a literacy centre while their teacher is working with a Guided Reading Group. Each student has his/her own iPad to work on for the guided reading session. Cassandra is a high-fluency reader and when she moved to the school from England was placed a year ahead of her age group. Brian is a fluent reader and a confident user of technology. Both students have been asked to go to the Teach Kids News website, choose an article to read and be prepared to share with the class what they have learned at the end of the session. The first task is to get to the website. Brian gets there quickly and then looks over to see that Cassandra is watching what he has performed. She taps, types and scrolls through the news item and he does the same, then he points and clicks on her screen. Brian reaches over to Cassandra's screen and taps onto another site. He chooses an article for her about a man who parachuted from near space to the ground. Then, Brian selects the same article on his tablet and Cassandra keeps glancing at Brian's iPad to see what he is doing.

When students like Brian and Cassandra work together in pairs the Canadian researchers note that there are substantial collaborative practices and participatory work. For example, as described previously, one student taps, the other expands the text, then the other jumps in to tap a menu and then the other follows suit to tap on an item in the menu, moving back and forth between tablets to fulfil these actions. Here we see several reading pathways materialised by a student tapping on a hyperlink, expanding the text to display information to another then the other

student tapping on another item on the menu to share. The use of touch and tapping reveals the semantic chains of information that students are gathering together. In contrast when students worked independently with their iPads they were more inclined to create reading paths of their own between hybrid texts (i.e. move from a prose text, to a blog, and to photographs). For instance, Figures 1 and 2 show moments during a lesson when a student uses touch to navigate between sites showing content material on indigenous communities relevant to his literacy task and a related game site he discovered. The reading path shows the student shifting between epistemic frames – reading, processing and thinking about content in a written text – then problem-solving in a spatial game – then moving back to written text – then moving into a different prob-
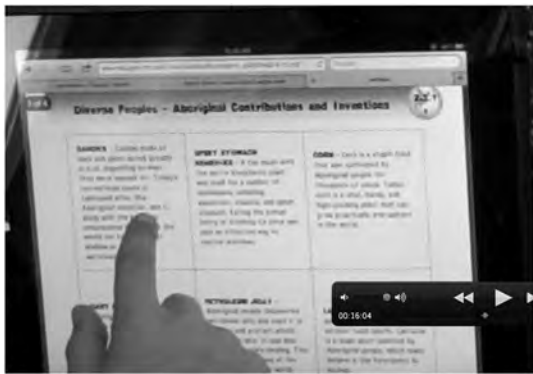

Figure 1: Reading government text on aboriginal communities

Figure 2: Playing a game on National Geographic for Kids website

lem-solving space in an adventure game. Again, this highlights the multidirectional aspects of students' reading paths both when they are collaborating and working independently, and demonstrates that touch is the active practice that bridges all of these processes.

In Table 1, the types of touch the students used for learning observed in the Canadian data are set out. At a level of general purpose, there is collaborative touch work where both Brian and Cassandra touch, tap or type to show a peer aspects of text and there is individual touch where readers touch, tap or type to complete independent learning tasks. Returning to our framing of touch and haptic learning, this kind of touch is more active and driving the information gathering. Initially what struck the Canadian team as pure 'goofing around' where students were shrinking and enlarging text turned out with closer observation to reveal instances where students honed in on specific content that they found particularly interesting and compelling. These practices are layered under the general purpose of touch. More specifically, there were particular touch practices and strategies for managing reading such as making font larger to comprehend text; or elucidating practices where one reader touches and widens part of the text to clarify information for another reader to see. Both kinds of practices demand dynamic engagement with the iPad as a material interface within which students manipulate their thinking processes.

Table 1 sets out an analytical approach that highlights how touch was used for general purposes, for example, reading and haptic play as well as emerging patterns of navigation and comprehension of textual features through specific actions of touch. Speech and gaze could be included in the table, but given our focus on touch, we have not included it in this form of data analysis. There are different varieties of touch-based learning invoked in the small sample of video data, which we have coded as follows: touch to seek information; purposive touch to play a game; perfunctory touch to move from one menu to another menu; visual–spatial touch expanding and shrinking text and other visual components; haptically driven touch when texts rely on touch to make meaning. These sub-elements enable us to expand our argument

Table 1: Touch for learning

Interaction	General purpose of touch	Sub-elements
Student to student learning	Explanatory (accompanied by talk)	
	Demonstrative	Showing
	Haptic play	Goofing around and/purposeful
Student as independent learner	Reading	Following words
		Expanding text
		Highlighting text
		Using app support tools

about the relationship between touch technologies and haptic learning in relation to reading paths.

Example two: Australia

In the second example, the field of attention is restricted to a 20-second video clip of two 10-year-old boys from a Grade 5 classroom in the Australian site who are collaboratively seeking information but recording it individually on their own iPad. In the video, the boys, Aaron and Barry, (pseudonyms coded as boy left = BL and boy right = BR) are seated at a shared desk. They both have iPads and both can see each other's screens. They are both operating at similar levels of reading ability. The teacher has set the class the task of looking for five useful websites that provide students with reliable information about the life cycle of a star and given them a research process to follow that includes recording their findings in Corkulous (a note-taking) app. The sequence of four images extracted from the video shows two students collaborating over their discovery of useful sites and over their technological skills. Figures 3–6 show some of the steps along the reading paths the students create as they deal with the semantics and the physicality of their meaning-making processes.

For this data extract from the Australian site we have trialled another way of viewing the data. Where the analysis of the Canadian site focused on touch only and was coded in prose, here the dynamism of the students' reading and writing paths is represented visually. This has the advantage of not only showing

Figure 3: Boy on left (BL) types on the iPad keyboard belonging to boy on right (BR) while looking at his own screen. BR watches on his screen

Figure 4: Boy on left (BL) types on boy on right's (BR) touch iPad keyboard while looking at BR screen. BR looks at BL screen

Figure 5: Boy on right (BR) taps on drop down menu on his screen to select text. Boy on left (BL) watches BR screen

Figure 6: Both boys have turned their screens towards themselves. Boy on left (BL) swipes to reveal Corkulous app already open. Boy on right (BR) taps icon to go to Corkulous app to paste information copied earlier in Figure 5

the interactions as a sequence of complicated steps where meaning-making choices are enacted but also demonstrates the simultaneous layering of modes and multidirectional moves that make up the processes that the dyad incorporate into their reading and writing. The boys use gaze, movement, gesture (incorporating touch) and a minimal amount of speech to negotiate their way to a successful outcome of being able to search for, evaluate, copy and paste a website address onto their note-keeping page. Figure 7 illustrates the sequence of physical actions as a schema of interrelated moves where the boys interact with the iPads. As with the Canadian example, each physical action of touch forges another potential link in the semantic chains of meaning the students are in the process of creating. The sequence of numbers and letters in the diagram correlates with the
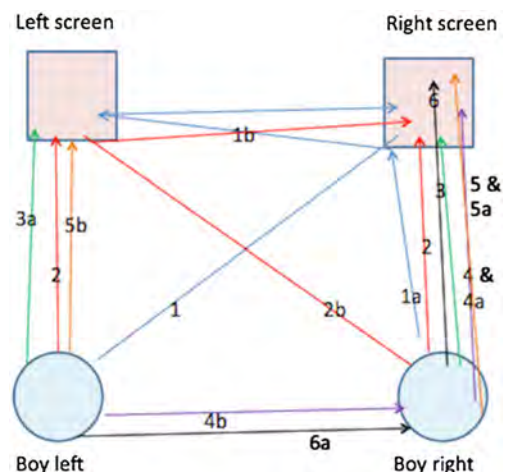

Figure 7: Touch for learning diagram

annotated record of the episode shown in Table 2. Column one provides the time count. Column two describes the corresponding image on the screen. In column three, the moment-by-moment action of the dyad in the video is coded.

The examples given previously represent common actions and interactions frequently observed in both research sites. Considering the findings from the Canadian and Australian team, it is becoming clear that there are some patterns across our data sets. When both coding schema are considered together, the findings show that there is a close relationship between material and cognitive processes. Tracing digital reading paths has allowed us to code the potentiality of modes and multidirectionality, as the students we focused on demonstrate different levels of metatextual awareness. We make the case for the concept of emerging metatextual awareness as each student was making his or her own cohesive connections between unrelated pieces of information found in different locations including print texts and the Internet following research processes that directed them to create a new text. We also note the high level of interaction in both dyads, which demonstrates the importance of collaboration to these students as they worked to achieve their independent literacy tasks.

Discussion

Although in both instances, each student was set the same task at the beginning of the lesson, because of the additional dynamism in the learning context prompted through the use of the digital pathways and facilitated through touch, each student had the potential to explore the task in different ways. Our data show that students tend to share ideas when working with tablets by modelling their actions to each other. Both the Canadian and the Australian example provide evidence of interaction, collaborative and participatory learning when the students read and write on the tablets. An important finding highlighted in the analysis from both research sites shows that different levels of readers (struggling and high fluency) would

Table 2: Coded dynamic action of Aaron and Barry dyad

Film timing	Screen	Action
0.00	L screen shows results of a Google search; R screen shows search in progress on Google	1 BL is typing on BR's keyboard to show him how to find useful site he found on his computer
0.01	L screen shows results of a Google search; R screen shows search in progress on Google	1a BR looks over his shoulder; 1b BL is checking details from his page as he begins to type
0.02 to 0.07	L screen shows results of a Google search; R screen shows search in progress on Google	2 BR and BL collaboratively type in web address to find the same list of entries; 2a As BL types in letters BR looks at the screen on the left to double check he is right; 2b BL tells BR to type in 'then star'
0.8 – 0.14	R screen fills with new list of websites as result of search	3 BR points at one web address a voice (BR?) says "this is a good website"; 3a BL points at another web address and a voice (BL?) says "this is the best, it's got everything you need"
0.15 – 0.16	L screen shows results of a Google search; R screen shows list of sites and a menu	4 BR taps screen to bring up menu list; 4a and chooses option to copy web address; 4b BL watches him
0.17– 0.18	L screen shows results of a Google search; R screen shows list Google page moving up the screen and a list of apps at the bottom;	5 BR turns his iPad away from BL and uses four finger swipe to move the browser page vertically out of the way to reveal his app list below; and 5a taps on the Corkulous app to select it; 5b BL uses four finger swipe to move the browser page out of the way horizontally to reveal the Corkulous app already open
0.19	L&R screen show Corkulous app	
0.20	L screen shows Corkulous app; R screen shows Corkulous app and keyboard appearing at the bottom	6 BR taps his Corkulous note in preparation to paste the address he has just copied over 6a BL looks over to BR check if he is successful

L, left; R, right; BR, boy on right; BL, boy on left.

equally partake in touch practices together. As a result, students with mixed reading abilities were more inclined to work together with the tablets than with printed texts. There is still more analysis to do to find out if this is a pattern across all the research sites.

What emerges strongly from the two examples discussed is the role of haptic learning. In the 20-second clip, most of the actions demand typing, tapping, scrolling, and expanding texts and text components without explicitly emphasising the visual. More importantly from the perspective of sensory awareness, each touch needed to be employed at a specific velocity and appropriate level of pressure in order for the tablets to respond appropriately. Therefore, moments in the video when touch is enacted record meaning-making choices for both students made at physical and cognitive levels of awareness.

In both data samples, dynamic multidirectional reading practices are visible. However, varying degrees of collaborative modelling and independent decision-making create differentiations between the two samples. In the Australian example there is a tacit interplay between the two students where one initiates the search (BL) and then the other (BR) follows suit and takes over the reading moment. One does not broker or control the reading event over the other, but instead there is a steady negotiation of the search and then they set to work independently on the task. BL and BR work on fairly equal terms as they navigate and make meaning from the tablets working side by side. It does appear that one learner is more advanced or more adept, but together they figure out a process to create a text of their own. Touch ignites all reading processes in the clip and catalyses the thinking that takes place through navigation and manipulation of text (e.g. when BR initialises a drop-down menu to appear and taps the right feature). The negotiated learning moment serves as a telling example of the interaction between material, spatial dimensions and more immaterial thinking processes that occur as a result of the joint negotiation of text. It is significant to observe the level of collaboration and participatory structures in play through touch and then fluid movement into independent work. For this dyad, insight into the cognitive work being achieved is interpreted by tracking the reading paths indicated mostly by touch and the resulting text creation at the end of the task.

The Canadian example shows similar patterns of interaction and negotiation of skills though one child, Brian, appears to be more dominant in his control of the interaction and the students speak to each other. In this case, there is evidence that Brian is more adept with the technology than Cassandra, which may be why he finds and reads the information more quickly than Cassandra who we know is an advanced reader. Brian appears to be skimming the text jumping around and telling Cassandra what he has learned. He tells Cassandra details from the articles that she had not seen;

that the man would have died if his suit broke. When Cassandra gives a sceptical verbal response and asks Brian where he found the information, Brian expands the text with his fingers and points out the place in the text where he found it. As with the Australian example, the students negotiate their meaning-making through the multiple modes of gesture (incorporating touch) and gaze. However, this dyad use talk far more than the Australian dyad so it is easier to trace how their reading paths are mediated.

With Lowenfeld's work on creativity and haptic expression informing our research, the lens through which we view the data has altered how we privilege touch and learning through touch. This has challenged our traditional notions of the reading process to take into account not only the cognitive demands of the design of a text but also the physical interaction of the reader with the text. Our findings demonstrate that we can observe reading paths and touch learning, but we do not yet have a strong understanding of the impact of touch on the reading process or where touch sits in explanations of socially meaningful actions (Lemke, 2005, p. 16). For example, in the short video coded in Table 2 the shy glance one student makes turning his head to look over his shoulder is related to the social context of the hovering researcher. Yet, his action has no relevance to the pedagogic drive of the reading task or the specificity of his reading processes. We see those actions operating more clearly when the two boys select a specific hyperlink from a list after they have reviewed its suitability to their purpose and then post it on their note-taking screen. There we see them interact with the physical interface of their tablets through the mode of touch to record the result of their mental hyperlinking. This provides the researchers with a partial view into the students' learning processes. We need to interrogate the data further by asking students to review and explain recordings of their interactions to more closely track the students' cognitive development through the use of tablets.

Conclusion

In this paper, we have provided a close analysis of the dynamic interactions of pairs of students reading with their iPads. Our analysis of the dyads from two sites has enabled us to examine how tracing the reading paths of students through the mode of touch gives us additional insights into the ways meta-awareness of task and technology play out. We have identified the complexity of multiple and multidirectional reading paths that are possible with digital texts and in digital environments. Moreover, we have demonstrated the need for multiple levels of analysis and made some small inroads to provide some suggestions for analytic approaches that need further development. We have raised the profile of touch in reading by investigating material action and cognitive processing as students

read with tablets. Our conclusion is that further conceptual development is needed to take account of the role of touch in meaning-making processes through digital reading paths.

Acknowledgements

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