Educational Affordances of Tablet-Mediated Collaboration to Support Distributed Leadership in Small Group Outdoor Activities

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Abstract: This paper investigates how distributed leadership emerges during tablet-mediated collaboration in an outdoor learning environment. We posit that one of the affordances of mobile technology is to mediate the distributed leadership that emerges among group members during small group activities. A collective case study was conducted to observe how children assume different types of leadership during collaborative tasks. The findings show evidence that supports the mediating role of tablet computers on the emergence of distributed leadership during a collaborative group task.

Introduction

Leadership is not a singular role that is held by one person during a collaborative task; rather, leadership is distributed and assumed by multiple group members across time and space. Different attributes of collaborative tasks require different leadership roles for their success, and, by doing so, this leads to diverse engagement (Gressick & Derry, 2010; Li et al., 2007; Mercier, Higgins, & da Costa, 2014). Our study focuses on how different dimensions of leadership are distributed among group members during a collaborative science learning experience. By analyzing peer interactions while using tablet computers, we explore how tablets afford capabilities for learners to assume leadership during observational inquiry activities.

Theoretical background: Distributed leadership and role taking

During a collaborative learning experience, leadership is a "a reciprocal social process, instead of the property of an individual (Li et al., 2007). Leadership emerges from social interactions, when a leader initiates an action and his or her followers respond to the initiated action (Li et al., 2007). Because leadership emerges from social interactions, leadership does not usually stay with one person; instead, different types of leadership emerge from different group members. Li et al. presents five dimensions of emergent leadership: Turn Management, Argument Development, Planning and Organizing, Topic Control, and Acknowledgment. Mercier et al. (2014) developed these dimensions further by synthesizing them into two categories: Intellectual and Organizational. The *intellectual* category is comprised of topic control and idea management and development; it is related to the content of the learners' discussion. The *organizational* category is related to managing and organizing discussions. Mercier et al. suggest that the nature and content of tasks may influence the distribution of emergent leadership among group members.

Discovering different types of emergent leadership can be interpreted as a person acquiring a role. Rowell (2002) illustrates how peers take on roles in a group activity during shared technological activities. For instance, if one assumes the role of manager, the others take on a supportive assistant role. Also, a student with the assistant role may choose to work in a different domain than the manager in order to assume more responsibility. By taking different roles, children assume different leadership for the success of a learning activity. Some studies on emergent leadership assign roles to engage learners in a collaborative learning environment. For example, Gu et al. (2015) assigned different roles, consisting of Starter, Supporter, Arguer, Questioner, Challenger, and Timer, to undergraduate students in order to engage them in the process of constructing knowledge collaboratively.

Educational affordances

Another concept related to tablet-mediated collaboration is educational affordances. From the varying definitions, we adopt Norman's (1988) definition: "The term affordance refers to the perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could possibly be used. A chair affords ('is for') support and, therefore, affords sitting" (p. 9). It is important to identify educational affordances of the technologies because, in many cases, technologies that are used for education are not necessarily designed with such purpose in mind. Hence, understanding the concept of affordance and analyzing which affordances are inherent within the device could help educators to effectively use the technology (John & Sutherland, 2005; Mishra & Koehler, 2006). In our study, we explored how a mobile tablet device mediates distributed leadership.

We presupposed that the tablet would play a role in helping distributed leadership to emerge among learners in a summer camp.

Methodology

A collective case study was conducted to see how young children (ages 9-12) collaborate and assume leadership during an informal learning experience. The study comprised four sessions in 2015 during iteration six of a larger DBR study (Zimmerman et al., 2015). In iteration six, each workshop session contained multiple groups. This study examines the interactions that took place among two groups of learners, resulting in total of four groups for observation. Group interaction was video-recorded using a standard video camera. We also asked some group members to wear GoPros on the head to collect additional videos. Video recording was our main data source to analyze peer interactions within each group and to identify how distributed leadership emerged during the task.

Study setting

The setting of the study was at an environmental center run by a land grant public university located in northeastern region of the United States. The center runs summer camp for hundreds of young children each year to help them learn about nature. The study was a one-hour session of a six-week camp program where children used tablets to experience and learn about trees. Children were led by a Naturalist on a guided tour during the study. One iPad Mini tablet was given to each group. For the first part of the tour, which lasted about 45 minutes, the Naturalist led children through the forest to learn about the life cycle of the trees. Five different stages of life cycles (seed, seedling, sapling, mature tree, and snag/dead tree) were explained during the Naturalist-led part of the session, with the assistance of a mobile app called *Tree Investigators*. The Naturalist prompted learners to observe the trees and read from the app containing a conceptual diagram of the tree life cycle and pictures and descriptions of each stage. *Tree Investigators* was designed with the theory of distributed cognition/intelligence in mind where we intended for students to use it to augment and interact with the nature around them as part of their cognitive activities (Hollan, Hutchins, & Kirsh, 2000; Hutchins, 1995; Pea, 1993). The second part of the tour was student-led activity where learners were prompted to use the app to take the photos of trees they identified in each life cycle stage. The children in groups freely explored the designated area to observe and take photos. Then they were prompted to create a personalized photo collage of the tree life cycle using their own photos. No restrictions were given in terms of iPad usage and turn-taking within each group.

Data collection and analysis

A total of 25 upper elementary learners were video recorded after obtaining informed consent and assent. There was a total of four sessions, and two groups were chosen for this preliminary data analysis. The focus of the study was observing how learners assumed leadership during the collaborative task, so only the second part of the camp experience was analyzed. The analysis focused on how and when learners took turns using the iPad and how they assumed roles and performed tasks in observational activities such as navigating and photo-taking.

Findings

Our analyses showed that the tablet device appeared to play some role in mediating leadership among group members. Since children were grouped in pairs, one child would typically assume the role of holding the tablet while the other did not use a device. Often, the child without the device would initiate the first move. To illustrate this finding, Michael and Nathan were looking for a tree's seed. Nathan held the tablet, and as such, had a specific role of holding the tablet. The tablet is important because it held all the information about the tree life cycle stages as well as a photo capture tool and checklist to verify the evidence for each identification. Hence, it was impossible to complete the task without the tablet. Because of the tablet, Nathan's role was clear: taking photos, organizing the next tree stage to identify, and checking the criteria for each life cycle. However, Michael's role and task were not as clear since he was not holding the tablet. Michael consistently showed leadership by searching the forest to find a tree specimen to photograph. Then, Nathan would take a photo of the specimen while Michael gave advice on how to maneuver the tablet. To illustrate, after taking the photo, Nathan (holding the tablet), read the app content to find the next tree life cycle stage while Michael led them through the forest.

Michael:	((gasps)) Look! A small pine cone. ((approaches the ground to pick it up)) We could make a picture of this. ((but leaves it on the ground)). It's really small just like lean down on it.
Nathan:	((bends a bit and takes a picture))
Michael:	Plus check on there, check on there, and then.

Nathan:	Oh that's perfect ((gets up) Okay.
Michael:	Okay.
Nathan:	((reads)) "Has a root, stem, and at least one needle"
Michael:	((whispers)) stem… ((looks around))

Nathan assumed the role of a photo-taker and content reviewer while Michael assumed the role of a navigator. Across the groups, often the child who was not holding the tablet would go ahead and look for the tree specimen while the one with the tablet focused on verification of the tree based on app content and creating the photo artifacts using the tablet. Using Mercier et al.'s (2014) term, Michael focused on organizational leadership while Nathan focused on intellectual leadership with app content.

Similarly, another group displayed consistent leadership distribution. In this case, Jason and Matilda (holding the tablet) are looking for seedling:

Jason:	Seedling now, seedling…Here, over here, right there. Can the camera see it?
Matilda:	((Bends down and sits to take photo as Jason monitors it))
Jason:	Right there, yeah got it ((Matilda seems to struggle and Jason helps)).
Jason:	All right, what's next?
Matilda:	Sapling ((points)).
Jason:	Let's see. That's a sapling ((as other group member points)). Do you want to use that sapling? Do you want to use this one?
Jason:	All right, I will try to find a…
Matilda:	Mature.
Jason:	Mature Tree.
Jason:	Here's one. Found one right here.
Matilda:	((Takes photo)). This tree has thick tuck thicker than around both of your hands.
Jason:	I will check ((goes over to the tree and tests it out using his own arms).

Similar to Michael and Nathan, Jason, who was not holding the tablet, took charge of navigating and looking for the appropriate tree specimen. Jason also initiated the task by asking Matilda to confirm which stage they are looking to identify next. Jason also assisted Matilda while she took the photo. Also, we found that the children collaborated by verifying the photo target in a different manner. When they located a mature tree, Matilda provided the criteria to verify whether the tree was indeed a mature tree. Then, Jason went over to the tree to physically verify what Matilda had just read. Both children were taking initiatives but in a different way to successfully complete a task.

Overall, these two excerpts provided evidence that the device and mobile app played a role in helping different types of leadership to emerge within a group. Learners voluntarily appropriated themselves to take roles that were different yet complementary. This is in line with Rowell's (2002) study where peers would strategize themselves to assume leadership roles for the success of the group. This study adds to Rowell's study and the studies on emergent leadership (Gressick & Derry, 2010; Li et al., 2007; Mercier et al, 2014) by suggesting that the device can afford to mediate emergence of distributed leadership in an outdoor learning environment. We were able to observe that turn taking and utlization of tablets elicited group members to assume different leadership roles. Having a personal device to share seems to be different from sharing a large device where children can interact together simultaneously. This shows that, instead of waiting for distributed leadership to emerge naturally, we could integrate personal devices into learning designs in order to promote and mediate distributed leadership skills which could enrich learner experiences.

Future study implications

Our investigation suggests that tablet devices can play a role in eliciting leadership among group members. Based on this result, we posit that different technologies and their uses could possibly afford elicitation of diverse leadership. We would like to expand this notion further by assigning different devices and/or technology-mediated learning methods to each member to investigate how different technological affordances influence the emergence

of distributed leadership. We suggest assigning roles by handing out different types of devices. For instance, a smart watch could be associated with the role of time-keeping and planning, a tablet could be associated with app content processing, and GoPros/cameras could be associated with artifact creation.

There were some limitations to this study. First, rather than observing student groups in a longitudinal manner, these data were collected during a single session. Having a "one-shot" study has its limitations since it cannot fully entail the group dynamics during the collaborative learning process. Second, since dimensions of distributed leadership were based on group discussions, there were not enough dialogue to code the data with the Li et al. (2007)'s coding scheme, suggesting a need to modify the coding scheme to fit an informal, summer-camp context. Lastly, we implemented GoPros to see if the GoPros played a role in mediating leadership roles. However, it seems that GoPros were too ambient for learners to appropriate any leadership roles. This shows that pedagogical consideration associated with educational affordances of a technology is essential in promoting leadership. Future research can focus on clearly delineating tasks or instructional methods associated with the devices to investigate their role on learning and emergent leadership.

With these limitations in mind, next steps in the work include analyzing and more cases for more valid findings and designing and conducting a new study which diversifies devices and assigns them to children in order to mediate emergent leadership. Through future study, we hope to investigate whether different educational affordances instantiated by different personal devices could mediate children to assume different types of leadership.

References

Gressick, J., & Derry, S. J. (2010). Distributed leadership in online groups. *International Journal of Computer-Supported Collaborative Learning*, *5*(March), 211–236.

Gu, X., Shao, Y., Guo, X., & Lim, C. P. (2015). Designing a role structure to engage students in computer-supported collaborative learning. *The Internet and Higher Education*, *24*, 13–20.

Hollan, J., Hutchins, E., & Kirsh, D. (2000). Distributed cognition: Toward a new foundation for human-computer interaction research. *ACM Transactions on Computer-Human Interaction*, *7*(2), 174–196.

Hutchins, E. (1995). How a cockpit remembers its speed. *Cognitive Science*, *19*, 265–288.

John, P., & Sutherland, R. (2005). Affordance, opportunity and the pedagogical implications of ICT. *Educational Review*, *57*(4), 405–413.

Li, Y., Anderson, R. C., Nguyen-Jahiel, K., Dong, T., Archodidou, A., Kim, I.-H., … Miller, B. (2007). Emergent leadership in children's discussion groups. *Cognition and Instruction*, *25*(1), 75–111.

Mercier, E. M., Higgins, S. E., & da Costa, L. (2014). Different leaders: Emergent organizational and intellectual leadership in children's collaborative learning groups. *International Journal of Computer-Supported Collaborative Learning*, *9*(4), 397–432.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.

Norman, D. (1988). *The psychology of everyday things*. New York: Basic Books.

Pea, R. (1993). Practices of distributed intelligence and designs for education. In G. Salomon (Ed.), *Distributed cognition: Psychological and educational considerations* (pp. 47–87). New York: Cambridge University Press.

Rowell, P. M. (2002). Peer interactions in shared technological activity: A study of participation. *International Journal of Technology and Design Education*, *12*(1), 1–22.

Zimmerman, H. T., Land, S. M., Mohney, M. R., Choi, G. W., Maggiore, C., Kim, S. H., ... & Dudek, J. (2015, June). Using augmented reality to support observations about trees during summer camp. *Proceedings of the 14th International Conference on Interaction Design and Children* (pp. 395-398). ACM.

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