Executive Summary LBD-2012-1:

Processes of design and tool use in the development phase of the CoCo Design Day

Kate Thompson, David Ashe, Philippa Yeoman, Dewa Wardak and Martin Parisio

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Executive summary

This working paper reports on the results of research carried out between June and October 2012, based on the ‘Water in the Landscape’ project, funded by WSROC (Western Sydney Regional Organisation of Councils). As a result of this research, two papers have been submitted for further publication.

Enabling school students to understand complex systems is challenging and providing engaging tasks, through technology enhanced learning, that support collaboration can be beneficial. One method of learning, ‘Learning by design’, has a long association with learning about complex, environmental systems. However, there is still much debate over how best practices for this type of learning can be identified. There is still a need to examine and understand the processes of learning, that students go through, when engaged in a ‘learning by design’ activity. Students use many different tools while completing a ‘learning by design’ activity; to help design better tasks, it is important that the complex interactions of both physical and digital tools is better understood. As the tools become more sophisticated and specialized they are playing a greater role in face-to-face collaborative learning situations. This working paper focuses on two aspects of one group of students as they undertook a collaborative design activity:

1. A look at the way in which the students were using tools (tablet computer and whiteboard) including an analysis of group’s sketching activities.
2. The process of design, the role of idea development, and the facilitator’s impact on the processes.

Three groups of four to five students were asked to undertake a design challenge to create an online educational resource about a waterway of local significance. The groups were recorded during the ideate phase of a design process. They carried out this design work in a multimedia design space, using a whiteboard wall as well as a tablet computer (projected onto the wall). In these papers, we studied one group during a forty-minute session. Their task was to develop their ideas about the design. After a break they were expected to present their ideas to the other groups.

From the video and audio data collected, ideas important to the progression of the design were identified, and represented visually, as they developed over time. It was found that the roles of all members of the group were important to this development, as was the role of the facilitator. The conversations between members of the group and with the facilitator were analysed using the CPACS coding scheme. Four phases of the group’s work were identified, and Markov-transition diagrams of the content were created. The overall patterns of tool use, for all members of the group, were plotted and the relationships between tool use and idea development were investigated. Two cases of different patterns of tool use were identified and these were analysed according to the practice of sketching identified in other fields of design.

Overview of findings:

Learning by design:

By tracking the development of ideas as they related to the final design, and visualizing this development over time, we found that students’ interactions, both with each other and with design tools, were essential to their progression through the design process. This led to the identification of naturally occurring phases in the group’s collaborative design work, as well as indicators of movement into and out of these phases. This identification provided valuable information on the management of time and materials which, as identified in other projects, can be a challenge.

The facilitator was an important element in this system; in particular the way he used goal-oriented questions. He was able to connect the students’ activity to the task at hand. Over the course of the collaboration (40 minutes) students developed expertise, and adopted specific (and self-assigned) roles within the group. Once these roles had been established, they were adhered to and all students played important parts in the development of ideas; they demonstrated this by their collaborative actions at the white-wall. The ownership of ideas was important, as was the requirement for a permanent record of those ideas to be made.
Learning outcomes

Identifying measures of learning outcomes in these design situations can be challenging; however, the students were observed to be able to articulate an understanding of some (and often challenging) ideas about systems. One measure of the success of this group was the organic nature of its ‘designerly’ behaviour. Individual members of the group were able to return to ideas raised earlier in the design work; the group was then able to revisit these ideas and build new ideas on a new, common understanding of the design.

Implicit knowledge about the inputs and outputs from the ecosystem (under consideration in the design activity), likely impacts, and links between elements of the ecosystem was present in the development of the group’s ideas. Knowledge about the ecosystem was present in their discourse, and also in their drawings, throughout the collaborative task. This one finding reinforces the importance of analysing the data set as a whole rather than regarding separate individual elements (such as analysing audio conversations disconnected from visual imagery).

Students were all in agreement that the ecosystem in question needed to be managed in terms of the human impact on this system, and that there should be shared use, mostly in terms of urbanization (most familiar to these students) rather than in terms of agriculture or industry. They put themselves in the pictures that they drew of the creek and a strong personal connection between the creek and the group members was observed. However, there was no demonstration of an understanding of the global/local relationship in the ecosystem, nor specific reference to possible impacts of decreased water quality.

Tool use

The students, in this group, were able to use the tools in complex patterns and, within the group, they were able to specialize the tool use in terms of the roles they were playing. The importance of the multiple tools use became apparent during data analysis. While it appeared, when the data was first analysed, as if there were only minimal discussions about the creek, it became clear that all the information about the creek was being written on the wall and recorded on the tablet computer. Keeping track of multiple tools being used simultaneously by a group of students can be a challenge. We used multiple recording techniques to gain an understanding of the tool use and the tool/student interactions. During their collaborative design task, the students were effectively supported by the tools and the use of those tools was key to the students’ idea development and record keeping. The tools allowed collaboration to occur as individual ideas were articulated on the white-wall and combined in the more permanent record keeping of the tablet computer. Despite the fact that the students, for most of the session, worked collaboratively (and on-task) the social interactions appeared to interrupt the regular pattern of idea development.

Methods for analysing the processes of learning

By visualizing the overall patterns of collaboration, we were able to identify phases in the design work that corresponded to recognizable patterns in the discourse. This led to multimodal analysis, which provided insights into relationships between the patterns of the content of discussion, the generation of ideas, and the phases of design work.

Conclusions

This paper represents our initial analysis of a large data set, collected over several meetings. Although the analysis of the entire data set is still in its early stages, we have already been able to gain a better understanding of how, when faced with a design task, students, teachers, and tools (both physical and digital) interact. Learning by design has been shown to be effective; promoting higher order skills such as collaboration, problem solving and creativity. Understanding the intersections of the social interactions of students, the physical and digital tools, and the development of ideas as part of a design process, is vital to the on-going design of learning by design projects. Future work will include analysing the interactions of the other groups present in the room, and tracking the development of all ideas to the final brief given to the multimedia design team.