Pearls of Wisdom: A Computational Scaffold for Design and Diffusion of Cognitive Artifacts

Robbin Chapman, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building 7-231, Cambridge, MA 02139, rchapman@mit.edu

Abstract: Critical learning involves relating old and new knowledge, and problem solving within unfamiliar domains. Learning through articulation of learning experiences within a social context improves our ability to navigate complex, ill-structured situations. Pearls of Wisdom software is used to facilitate learner engagement in critical learning through the design and sharing of cognitive artifacts called Pearls. An empirical study details how designing and sharing Pearls facilitated critical learning at individual and community levels.

Overview

Designing is authentic and ill-structured, and involves working with a variety of materials, tools, and ideas. Learning by design is analogous to learning embedded within the design process as design activities engage learners in a cycle of designing, evaluating, and redesigning (Perkins 1986). Just as Dewey (1933) theorized reflection to be important to learning, reflection embedded with the design process becomes a dialogue between the learner, her or his reflective process, and the world (Chapman, 2009). Designing affords opportunities for reflection but those episodes are transient and generally focus on performance enhancement. Learners rarely revisit their work to reflect on design and learning processes, and may not intuitively know how to engage in critical reflection. Most learners will require scaffolds for reflection. I introduce the Pearls of Wisdom software toolkit, a computational scaffold for designing and sharing of cognitive artifacts called Pearls, which capture learners' reflections within concrete, artifacts that may be refined and shared. Pearls capture learners' problem-solving, design, and meta-learning strategies as they critical reflect on their project design processes.

The Pearls of Wisdom Toolkit

The Pearls of Wisdom software was designed to help learners create a reflective artifact called a Pearl. Critical reflection is facilitated by scaffolding learner reasoning and decision making about *how* and *what* to share about their project design and learning experiences. The majority of the Pearl interface is organized in three sections that function as a design canvases. Pearl content may include text, graphics, video, source files, links to other Pearls, and various other media. Learners are prompted to think about meta-cognitive and functional aspects of their project. During these activities, they also make decisions about Pearl content creation and organization, layout design, and relevant media to include. The canvas appearance and prompts may be altered by the learner as they gain fluency with the process of articulating their reflective and design processes.

Methodology

Research question included: *how do cognitive artifacts enhance critical reflection on learning experiences* and *how do these artifacts diffuse throughout a learning community?* Examinations focused on how learners negotiated the Pearl design process, the characteristics of the resultant Pearl corpus, and how Pearls propagated throughout the learning community. We utilized a design-experiment methodology as proposed by Brown (1992). The study took place at the Computer Clubhouse (http://computerclubhouse.org), an after-school technology center for underserved 10 to 18-year-olds, located at the Boston Museum of Science, in Boston, MA. Clubhouse members work on self-motivated projects utilizing expressive technologies, including graphic and multimedia software, video technology, and music studio equipment (Kafai, Peppler, & Chapman, 2009). 305 Computer Clubhouse members participated in the study. Cases studies were conducted and data collected, including observational field notes, artifacts (member projects, Pearls, and emails), surveys, interviews, and Pearls of Wisdom system analytics. Quantitative data included scored Pearls and Clubhouse projects, surveys, and system usage analytics. Pearls were scored using a rubric grounded in constructionist project and portfolio evaluation research (Barab and Kirscher, 2001). Projects were scored using a rubric developed specifically for evaluation of Computer Clubhouse projects by the Center for Children and Technology (2002). Surveys, designed to evaluate the learning and meta-learning experiences of study participants, were grounded in the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1992). Qualitative data included observational field notes and interviews. Field note validation was accomplished via participant checking (Stake, 1995).

Data Analysis and Results

Study variables of interest to evaluation of learning environments were identified with a focus on salient characteristics of learner reflective activity, reasoning about learning strategies, effects of cognitive

apprenticeship, and persistent learning strategies. The Pearl corpus was populated with 78 Pearls and with 2,764 Pearl page views over the course of the study. 63% of the Pearl corpus included some dimension of critical reflection. 15% of the corpus was comprised solely of critical reflection content. Critical thinking attributes included problem solving, design opinions, incorporation of other perspectives, meta-cognition, making connections between old and new knowledge. Articulation of project problem-solving strategies was seen in 14 (18%) of Pearls. Statements regarding Pearl or project inspiration or design esthetic decisions were incorporated in 19 (24%) Pearls. Members discussed others' points of view within Pearl narratives in 7 (9%) Pearls. They described problem solving processes in 23 (29%) Pearls. Learners articulated how they made connections between old and new knowledge in 13 (17%) Pearls.

Discussion

A pedagogical goal for Pearl construction was to induce learner reflection by posing a design challenge that required critical reflection to resolve. Integration of Pearl construction and project design situated critical reflection directly into the heart of Clubhouse activities. Members were engaged in an ever-deepening process of explicitly thinking about their learning. That process was provoked by a desire to resolve Pearl design challenges and obstacles, where learners used cognitive and meta-cognitive strategies to resolve incongruities. They became immersed in a protracted project review process that slowed them down, creating a space to think critically about their learning. They also began to give more consideration to the esthetics, content, and complexity of their Pearls, and reported changes frequently motivated by feedback from Pearl users.

Conclusion

Using Pearls of Wisdom learners engaged in critical reflection in ways that made sense for their individual learning styles, and how they learned and made design decisions. They gained fluency in articulating those reflections. I argue that the construction of *concrete representations* of critical reflection serves to motivate learning and reflective interactions between learners, their reflective artifacts, and their learning environment (Chapman, 2009; Chapman, 2004).

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