Building the Narrative Cloud: Reflection and Distributed Cognition in a Design Studio Classroom

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Abstract: *Education in Human-Computer Interaction Design (HCI/d) aims to instill a human-centered perspective among its students, encouraging a designerly way of thinking that allows them to develop creative solutions that consider the implications and consequences of people interacting with technology. It has been known that a practicum (Schön, 1987) environment contributes to developing this way of thinking by means of reflection (Schön, 1987). We present in this paper a pedagogical approach based on narratives to be employed in studio-based courses for HCI/d. We discuss how oral and multimedia narratives support in conveying content-independent concepts that affect the learning experience. We propose a set of components to help the elaboration of these stories. Additionally, we introduce a conceptual space called the narrative cloud, which helps us to elaborate on the ideas regarding this approach and closely ties to the concept of distributed cognition (Hutchins, 2000). Therefore, the goal of this paper is establish a base for discussing a further development of this approach, or any framework or methods where narratives constitute a fundamental element that supports reflection in HCI/d education.*

Keywords: Human-Computer Interaction, Design Pedagogy, Design Studio, Narrative Cloud, HCI, Reflection, Distributed Cognition, Storytelling, Narrative.

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Introduction

Human-Computer Interaction Design (HCI/d) focuses on interaction flows and the interfaces of a system so as to enable its users to accomplish certain tasks and have an aesthetic experience at the same time. The nature of this discipline results in a challenge for its pedagogy: HCI/d students adopt as their primary goal the generation of solutions that are not only human-centered but also creative and feasible. HCI/d pedagogy, therefore, must cultivate competent, confident students capable of achieving such solutions. This is no simple task.

For this type of student, a creative and feasible solution implies the understanding of technology that benefits humans. This suggests the importance of the development of a *computer imagination*, which focuses on the "exploiting of the medium for some purpose that couldn't be done easily in any other medium, and it speaks to needs of users that they didn't even realize they had, but once they 'see' it, they want it all" (Siegel & Stolterman, 2008).

HCI/d involves *designing experiences* (Buxton, 2007). These experiences equate to *stories* about how people integrate technology into their everyday lives. In other words, *talking about interactions is akin to telling people's stories.* Stories also constitute part of the designer's *repertoire* (Schön, 1990), which can be disseminated during the learning process. Thus, stories have the potential of being considered as *cognitive units* (Hutchins, 2000) that would be distributed during the learning process.

With these ideas in mind, we introduce in this paper a narrative-based approach for HCI/d pedagogy. In particular, this approach is considered for a *practicum* (Schön, 1987) or *design-based course* –hereafter referred to as the *studio*. We inquire into the use of stories during the lecture stage in a studio whose intention is to initiate the *metamorphosis* (Siegel & Stolterman, 2008) of non-designer into designer.

In this approach, the teacher selects one concept as an intellectual foundation for a story. The aim is to engage students into *reflection* (Schön, 1987) upon themselves as learners, team members, and ultimately, as agents of positive change through and by HCI/d. We call these foundational concepts *Content Independent Concepts* (CIC). For conveying these concepts we suggest oral and multimedia stories (e.g. video clips or musical pieces). We introduce in this paper a set of components for composing or selecting stories to convey CICs.

Additionally, we look to sensitize students to stories, such that they develop designerly thinking (Siegel & Stolterman, 2008) and a consciousness that focuses on people's stories rather than designing digital artifacts *per se*. As a result of this sensitizing process, the students start building their own stories. These stories and all the other elements of the studio –people, infrastructure, and materials– function as units for distributing cognition and conform to a bigger story, a conceptual space we call *The Narrative Cloud*.

Some considerations for HCI/d pedagogy

Nelson & Stolterman (2012) present a theory where the result of any design process is an *ultimate particular*. These particulars are always contextualized. They depend on certain variables, including the judgments from the designer, the *desiderata* from the client, among other factors (Nelson & Stolterman, 2012). They also emphasize the responsibility of the designer at the moment of introducing the *artificial* (Simon, 1996) into the world. Taken together, these ideas illustrate that HCI/d pedagogy should seek

to creating consciousness among the students about the *why* and *how* of introducing *ultimate particulars* in certain contexts.

Hence, design pedagogy has the responsibility of providing an environment that supports the development of what Nelson & Stolterman (2012) call the sets of design competency: *mindset, knowledge set, skill set*, and *tool set*. By developing these competencies the students may create, enhance, increase or refine their *artistry* (Schön, 1987) as part of their design education before they engage with the *real world* and its *ill-structured problems* (Rittel, 1972). We take the *studio* as the environment *par excellence* for *learning by doing*; the ideal pedagogical space for the approach presented in this paper.

When referring to the design of interactive systems, a pedagogical approach based on a (design) studio retains the same characteristics as in any other design discipline, which implies: the inclusion a design problem, lectures related with the design problem or foundations, independent work, and the crucial factor of elaborating and giving critiques of the design proposal (Cennamo, Douglas *et al.,* 2011). The studio can help students understand that design is not about programming, website creation, or graphics, but rather it is an iterative process that requires understanding design challenges, generating multiple ideas, and finding ways of communicating solutions that encourage feedback for future iterations (Reimer, Cennamo & Douglas*,* 2012).

The studio and the act of reflection are inseparable (Schön, 1987). Well-developed reflective thinking results in efficient shaping of a creative design ability (Löwgren & Stolterman, 2004). According to Tracy & Baaki (in press), "when a designer is presented with a complex problem situation, the designer shows a series of questioning, making a decision, reflecting on the consequences of the decision then making another move." And also as Löwgren & Stolterman (2004) point out, "a practitioner has to reflect in her actions by separating herself from the actions and judging the outcomes of the actions." In fact, reflection is an activity that occurs in design due to the nature of the *design problems* or *situations* (Tracy & Baaki, in press), which share certain characteristics that define them as *"wicked," or ill-structured problems* (Rittel, 1972).

Two types of reflection stand out in this context. The first type takes place *during the action* and is known as *reflection-in-action* (Schön, 1987). The second type, *reflection-on-action* (Schön, 1987), is formulated in a more conscious fashion once the activity has been completed, providing the opportunity for recording and archiving. "Reflection-in-action helps designers deal well with situations of uncertainty, instability, uniqueness and conflicted values, which are inherent in ill-structured problems" (Schön, cited in Tracy & Baaki, in press) while reflection-on-action allows designers to "focus reflectively on the process of [their] design behavior in general" (Nelson & Stolterman, 2012). Due to the relevance of reflection for design, reflective frameworks are familiar in studio-based courses for design disciplines (Koschmann, Myers *et al.*, 1994; Ellmers, 2006; Ellmers, Brown & Bennett, 2009). Thus, the approach presented in this paper exposes students to stories with the intention of engaging them into reflection as a primary outcome in a studio.

When a student experience a studio, a *transformation process* occurs, whose consummation is the achievement of designerly thinking (Siegel & Stolterman, 2008). This transformation is expected to be *transactional,* implying that the learning experience results from "unfolding interaction and co-creation over time of all participants and environment" (Parrish, Wilson, & Dunlap, 2011). In addition, the theory of distributed cognition "extends the reach of what is considered cognitive beyond the individual to encompass interactions between people and with resources

and materials in the environment" (Hollan, Hutchins & Kirsh, 2000). According to Hollan et al. (2000), three kinds of distribution of cognitive processes may be observed in human activity:

- "Cognitive processes may be distributed across the members of a social group."
- "Cognitive processes may involve coordination between internal and external (material or environmental) structure."
- "Processes may be distributed through time in such a way that the products of earlier events can transform the nature of later events."

Distributed cognition takes into account what is inside humans' minds and considers people as active participants of the cognitive process. The theory also includes the use of external material artifacts to support these types of processes (Hutchins, 2000). All of this allows for establishing a relation between students (as agents) and those elements that constitute a studio. Thus, in our approach we consider that everyone and everything are distributed cognitive units: people (instructor, students, guest speakers), infrastructure (the room, tables, chairs, projectors, screens, boards), materials (sketchbooks, markers, pen and pencils, cameras, mobile devices), deliverables (presentations, printed documents, photographs), communication objects (email, drawings, social networks and blog posts), among others.

A narrative-based approach for hci/d pedagogy

We start from the idea that HCI/d pedagogy entails guiding students in their development as creators of *ultimate particulars* (Nelson & Stolterman, 2012). The studio allows HCI/d students to develop and/or refine their *sets of design competency* (Nelson & Stolterman, 2012), in order to assemble a *repertoire* (Schön, 1987) to face HCI/d challenges. As we discussed, the act of reflecting is a crucial activity that occurs in a studio (Schön, 1987; Löwgren & Stolterman, 2004; Tracey & Baaki, in press), and all of its elements constitute units for distributing cognition (Hutchins, 2000).

Stories are elements of distributed cognition. Some of those stories will come directly from the instructor, and other stories will come from the students. Experiences from the studio will become stories themselves. These stories may be exchanged among students, or recalled in future design challenges. The latter implies that stories are attached to the learning experience and the *repertoire*, which is useful for sharing knowledge among designers (Schön, 1990). Ultimately, experiencing the studio as a whole becomes a story as well. For this reason, the studio should be *experience-centered* (Parrish, Wilson, & Dunlap, 2011).

Our approach considers stories as *tools* for HCI/d pedagogy to be taken into account in the studio. The reason for using this tool is to immerse students into constant reflection during the design process and also to develop human-centered designerly thinking, sensitive to people who live stories everyday. With our narrative-based approach, founded on aims for reflection and distributed cognition, we support the maturation of *design judgments* (Nelson & Stolterman, 2012) among our students.

Content-Independent Concepts

This narrative-based approach makes use of what we called *Content Independent Concept* (CIC). A CIC gives design students in a studio a sense of agency (as a designer). A CIC encourages students to reflect and to generate answers to the question, "How do you see yourself (as a designer)?" A real-world example will prove illustrative.

During our semester-long observation in an HCI/d graduate-level studio, the instructor screened a segment from the documentary *Maya Lin: A Strong Clear Vision*. The segment told the story of the start of what would become Lin's illustrious design career: her winning entry into the national design competition for the Vietnam Veteran's War Memorial in Washington, D.C., U.S.A. The video segment provides glimpses of Lin, a then undergraduate design student at Yale, sketching, visiting the proposed site for the memorial, and sitting at press conferences as her entry was subjected to scrutiny from the design community and vicious attacks by war veterans themselves. Furthermore, the video compares and contrasts her entry with the other entries in the competition and paints her narrative as a David vs. Goliath(s) tale, of sorts. Lin was up against the most prestigious design firms, and her design was simple; almost too simple by comparison. In spite of the scrutiny and attacks, the young designer held true to her vision, not in spite of, but because of its purity; its simplicity.

Immediately after this class session, the instructor engaged in a casual conversation with one of the students and asked for his thoughts on the video. The student responded, "You know, I couldn't help but think that, she was so young and early in her career, inexperienced, really. A student still. And yet she still had the *courage* to believe in her design. It was so simple! You have to be *courageous* to believe in such a simple design. I wonder if I could do that." This example illustrates both reflection on action and a student orbiting around the content-independent concept. In this example, the CIC would be the answer to the question, *"How courageous are you?"* This student may not have had the answer yet and that is acceptable. The point is not that the student has the answer immediately, although some students may have the answers immediately. The point is that students think about *their own courage*. They try to ascertain a sense of it. They grapple not with explicit issues of design but with issues of identity as a designer; issues of agency as a designer, which are independent of any concept we might teach them about design. Understanding of a CIC manifests itself in moments of self-realization; moments when the design student asserts, *"I am courageous," "I am confident," "I can transform the world,"* and other statements of a similar ilk. Students achieve this understanding through two types of reflection: reflection-in-action or reflection-on-action.

The aforementioned student was thinking to himself during the Maya Lin video. The object(s) of his thoughts at this stage, we cannot know with certainty. Nevertheless, if even some of his thoughts related to the video segment or any of its concomitant content, then this student was engaged in reflection-in-action, or, what we call *reflection-in-narrative*. Reflection-in-narrative describes the thoughts a student has about a story during its telling. These thoughts about the story need not pertain to design or design concepts under investigation in the studio. It is more desirable and appropriate if these thoughts pertain to the student's own self (as designer). Figure 1 illustrates how reflection-in-narrative might look during an instructor's delivery of an oral narrative.
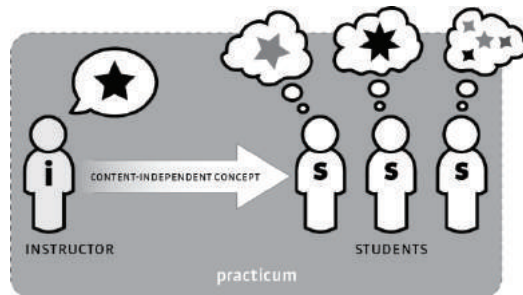
Figure 1. Reflection-in-narrative.

Even though each of the students in this illustration are thinking along similar lines, there are idiosyncrasies to their thought processes. This is to be expected and perhaps even acknowledged explicitly by the instructor. Each student is unique and, hence, brings unique personal experiences to bear on any narrative. Two students may arrive at two distinct CICs in a given narrative. For example, another student may have thought of the Maya Lin video, "I'm not as imaginative as she is," a reflection on creativity as opposed to courage. As we will discuss in a subsequent section, such differences emphasize the responsibility of the instructor to select appropriate narratives in order to communicate particular CIC's. But we must acknowledge that even the instructor's careful selection process cannot protect against different interpretations, and so we look elsewhere for a solution: *reflection-on-narrative*.

Returning once again to the Maya Lin example, when the instructor asked the student for his thoughts on the video after class, he was prompting the student to *reflect-on-narrative*: to reflect on the story *after* its telling. Like its precursor, reflections at this stage need not pertain to design or a particular design concept. It is more desirable for these reflections to yield insights about the self (as designer). Figure 2 illustrates how reflection-on-narrative might look after an instructor's delivery of an oral narrative.
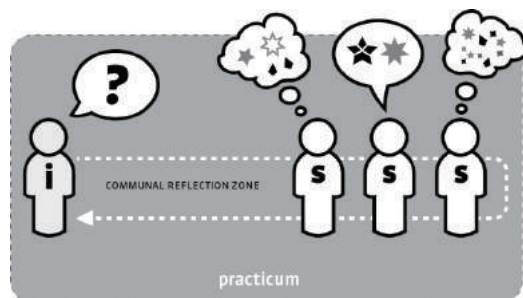
Figure 2. Reflection-on-narrative.

One major difference between reflection-in-narrative and reflection-on-narrative is the point at which they occur. Reflection-in-narrative occurs *during* the story. Reflection-on-narrative occurs *after* the story. Another key difference, illustrated in figure 2, is the nature of the reflection. Reflection-in-narrative is akin to an internal monologue whereas reflection-on-narrative is a dialogue or discourse with instructors, peers, or both. It is at this stage that different perspectives and, thus, potentially different insights regarding the CIC come to the fore. As students give voice to these

different perspectives, we observe a third key difference between reflection-in-narrative and reflection-on-narrative: reflection-on-narrative encompasses new instances of reflection-in-narrative.

For example, if the instructor/student interaction we described in the Maya Lin case had taken place *in* class instead of after class, then all the students in class would have been listening as the first student talked-aloud his reactions to the video. This talk-aloud is, in essence, a personal narrative -- a mini-journey of self-discovery; a narrative that would naturally cause all those students listening to reflect-in-narrative on a deeper level. If this reflection happens in a formal environment (e.g., in the classroom) then the instructor must engage students with guided questions to (1) reaffirm the CIC for those students who may have understood it in the first place, and (2) guide those students who may have had different interpretations toward the intended interpretation. If this reflection happens in a less formal environment (e.g., casual social gatherings) then the instructor may not have the opportunity to proffer guidance. Hence, it is imperative that she or he selects a meaningful, impactful story. We discuss three types of stories and the components for creating or selecting them.

Stories: type and composition

There are at least three types of stories an instructor might bring into the studio in order to teach content-independent concepts: oral narratives, video narratives, and musical narratives.

Oral narratives are spoken-word stories. In a studio setting, the instructor is usually responsible for telling oral stories unless he or she provides students with an opportunity to participate in formal storytelling. Oral narratives are especially effective when they are personal. The telling of personal stories often puts the instructor in a vulnerable position because they reveal aspects of life to which few gain access. For example, during our semester-long observation of a graduate-level studio, the instructor told the students a story about the days he spent at his dying mother's bedside, struck at the contrast between her countenance and the bustling shoppers at the mall across the street from her care facility. The death of a friend or loved one –let alone a parent– is a deeply personal matter, and, as such, these stories can be difficult to tell in front of a student audience. However, to tell such a story with sincerity, fully acknowledging the concomitant vulnerability has the potential to put students in touch with their own humanity.

Video narratives are video-based stories. Video narratives are cheap, efficient ways to build meaningful stories capable of communicating CICs. Unlike oral narratives, video narratives can break from the limitations of reality. Video narratives can transport a student-audience through space. They can slow down or speed up time. They can force students to confront death or new life. But video narratives have limitations, too. Chief among those limitations is novelty. Video has been a relatively common tool in the instructor's toolbox for quite some time, and so the instructor bears the responsibility of carefully selecting a meaningful, impactful video in order to counteract the potential lukewarm reception to "showing a video in class."

Musical narratives present a unique set of challenges in that their meaning can be more ambiguous than their oral and video counterparts. Musical narratives rely on the instructor to guide students thinking with a thoughtful observation or rhetorical question posed immediately after the piece. During our observation, we noted that students articulated visceral reactions to music more so than video or oral stories. That is, they spoke of how the music made them "feel" rather than what it made them think

about. Only when the instructor pointed to a particular line or musical technique did their intellects kindle.

Although there's no general formula to compose a story in order to convey a CIC, this approach considers the following components for accomplishing that task:

- Characters
- Setting
- Actions
- Time Pins
- Objects
- Emotions
- Intentions
- Values

This set of components is non-exhaustive and it can be modified depending on the needs and abilities of the storyteller and/or the type of story. Even when these components are suitable for oral stories, they can also work for selecting stories on other formats (e.g. video clips).

CHARACTERS

In this approach, HCI/d is understanding people's stories around interactions with other people and technology. To sensitize students to this idea, we exploit the use of stories that are people-centered. The characters' experiences will establish the medium through which the CIC will be transmitted.

It's advisable to keep the number of characters to a minimum. Every character represents a *voice* inside the story. Consequently, it is important for those voices not to conflict with each other. Consider having only one main character. Keep the main character's voice *strong* and *active*. When participation of other characters is required, keep the rhythm of the story by providing the appropriate timing for this participation.

In HCI/d, Personas (Cooper, Reimann, and Cronin, 2007) are an effective tool for developing and refining a particular design. A story conveys a CIC that is not particular to design or design processes. However, it might be beneficial to think about characters as Personas in the sense that the storyteller must have intimate knowledge of the character(s) for her narrative. Rich, well-developed characters reach students just as rich, well-developed personas reach design teams and stakeholders.

SETTING

The story takes place in an imaginary world. An effective story should detach the audience from reality and transport them into the *diegesis*. To achieve this, it is necessary to find what constitutes the set of descriptions that will create an appropriate *atmosphere* for the story. The students should be engaged in such a manner that they can *sense* or *imagine* the weather, landscape, odors, texture, spatial distributions, and other details. The storyteller's mastery rests on creating the setting without overloading the audience cognitively.

ACTIONS

Action refers to any relationship of *cause and effect* between one, two or more characters. With this in mind, we identify three types of action:

- Interaction with the self.

- Two or more characters interacting.
- Characters interacting with objects.

We invoke the first type of action when we want to externalize a character's thoughts or reflections. The consequences of this type of action reveal insights about the CIC. It is important to point to the *why* and the *what* in a character's reflection. If a story has multiple characters, their interactions *thread* the story. Similarly to the first type of action, there might be consequences of these interactions that may direct the transmission of the CIC. The latter doesn't necessarily happen when one or more character interact with objects. Interaction with objects serves the purpose of clarifying or enriching the context of the story. The actions allow the students to understand part of the current state of the story –the *where* and the *what*. The form in which it is said these interactions occurred –the *how*– will affect the students' ability for *threading* the story in their minds.

TIME PINS

Time pins exist in order to bolster this narrative threading. Time pins occur naturally in any narrative. At a high-level, we can think about time pins as signifiers of transitions between ideas. In other words, time pins are transition points. They mark the transition from one scene to another. They mark the transition from one idea to another. In multimedia narratives, which we will discuss shortly, they may even mark the transition from one shot to another. Time pins contribute to students' ability to engage with stories by breaking them into manageable chunks.

OBJECTS

Descriptions of objects in the narrative should be as concise as possible. Props are objects that contribute to the story's atmosphere and they might also be things with which the characters interact. Although it has been remarked that the story should be people-centered, there may be exceptions to this rule. This is not a suggestion for anthropomorphizing an object, but using an object and its characteristics as a medium to convey a CIC.

EMOTIONS

In order to complement the story's atmosphere, any emotion in an oral narrative must be transmitted through verbal or nonverbal communication during the telling. For example, the storyteller can describe explicitly a character's internal emotional state: "He was overwhelmed with melancholy." "Happiness washed over her like a steam bath." "They looked at the horizon, feeling young at the prospect of adventure." Alternatively, the narrator can exhibit the emotions him or herself through body language, facial expressions, gestures, or tone of voice. The inclusion of emotions in the story nuances the various participating voices thus making the story that much more real.

INTENTIONS

Any interaction among characters or between character(s) and object(s) will be triggered by some *motive* or *intention:* the *why*. Students might distinguish the intentions that come from a character's reflections. The storyteller should revise the intentions contribute positively in conveying the CIC.

VALUES

Values are those additional layers of meaning extrapolated across the story lending it a normative stance. For the storyteller it is important to keep in mind when and how

to embed value-laden elements in a story. Values are expected to motivate students to adopt a stance throughout a story.

The expansion or modification of these components will depend on the *expertise* (Nelson & Stolterman, 2012) and *repertoire* (Schön, 1987) of the storyteller. In the studio, this role is initially played by the instructor. But later, it's expected that students start to employ stories as a form of communication.

Stories: social and emotional development

Beyond our belief in the stories as powerful tools to engage students into reflection during the lecturing stage of a studio-based course, we hold that stories augment students' social and emotional development (Pedersen, 1995). Students listen to stories in the studio *as a group*. Consequently, they become sensitized to the same CIC. Following the act of listening, the students reflect on and grapple with issues raised in the narrative. And this reflection is emotionally driven. The narratives themselves manifest emotion. The storyteller brings emotions to life through the performative act of telling. And the students' reactions to the narrative are emotionally charged.

We define emotionally-charged stories as those that resonate with an audience even when the audience does not know why. In a studio, emotionally-charged stories motivate students to create their own stories as part of the learning process. Students share these stories in the studio and through other outlets, such as a sanctioned blog. Sharing is the primary means by which students attain their understanding of the CIC. It is also the means by which students shape stories out of their learning experiences. We have observed that students' sharing of stories extends beyond the end of a studio. Emotion is one reason for this extension; it tends to transcend time. However, there is a practical reason, too. As a storyteller, the instructor models the structure and elements of storytelling.

The instructor models how and when to think about and apply stories during the design process. Stories are tools, after all. The instructor uses them to convey CICs, and students use them to attain mastery of CICs. Knowing when to inject a narrative into a studio and when to prompt students to reflect on a narrative is for the instructor to decide; it is context-dependent. The same principle is true for students, however the decision of when to discuss a story and, consequently, to create their own narrative is less strict.

It is less important for students to pick an *opportune* time to discuss and create stories. In a studio, the act of discussing and creating narratives is fruitful in and of itself because as students create narratives of their learning experience, at least two things happen: (1) They approach understanding of CICs, and (2) they create internal separations of thoughts or experiences (Murch, 2001). Regarding the latter, the act of story-creation divides the larger narrative of students' learning experience into manageable chunks. In other words, the students' own stories serve as *time pins* in the larger narrative of their learning experience.

The narrative cloud

As students externalize and exchange stories during the design process, they contribute to a conceptual space we call the *narrative cloud.* We envision the *narrative cloud* as the highest level on which we can model the learning experience as a narrative (see Figure 3). In the narrative cloud, the instructor abdicates sole authorship. In the narrative cloud, stories act on, are acted upon, and complement each other. The

instructor, students, additional active agents, and other objects construct the *narrative cloud* together; storytelling and meaning-making are thus "socially distributed across members of a group" (Hollan et al, 2000).
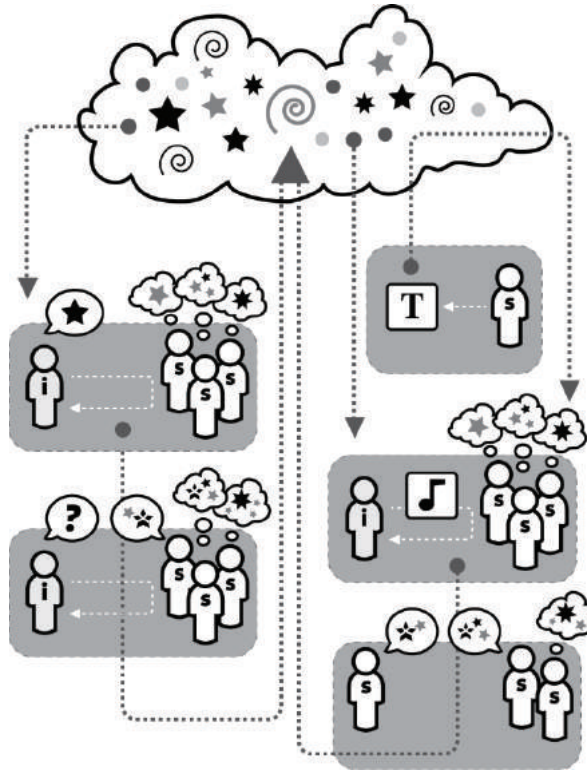

Figure 3. Schematic representation of some scenarios about the construction and retrieval of stories from the narrative cloud.

As illustrated in figure 3, multifarious stories within the cloud coexist, overlap, and intersect. The points of overlap and intersection have the potential to yield insights about aspects of pedagogy, such as: applicability and efficacy. Narratives must be applicable to students. Inapplicable narratives are unlikely to yield meaningful student engagement. If a narrative overlaps or intersects with others infrequently (or not at all) then the instructor might consider whether that narrative is applicable to his or her students. Narratives must also be effective. That is, they must be told such that they encourage students to engage with the narrative. An ineffective story is likely to overlap and intersect infrequently with other narratives. Seemingly inapplicable and/or ineffective narratives must be evaluated for revision or exclusion from the studio. We do not expect that this evaluation can be conducted from memory. Instead, we advocate for the preservation of these stories and (at least part) of the student responses to them.

Preservation is a means to several ends. First and foremost, it provides rich qualitative data for the instructor to analyze and interpret regarding stories used in a studio. In addition, depending on the mode of preservation, it provides a platform for

student engagement and interaction. Finally, again, depending on the mode of preservation, stories may be transmitted across time between student cohorts thus enriching the narrative cloud for a different group of students.

Effective preservation requires finding the appropriate means to lend materiality to these narratives. Whether the means of preservation is analog or digital does not matter. However, there are at least three qualities which any means preservation should possess: accessibility, durability, and ease of communication. These qualities skew in favor of digital preservation, however there is a particular analog method that we have observed to be useful: an iterative exercise of *drawing the whole game* (Perkins, 2010) whereby students draw and re-draw their conception of the "whole game" of HCI/d. At the end of the semester-long studio, students were left with a tangible record of their evolution as design thinkers. They can trace the transformation of their understanding of design. The *game* is sketched and, as such, is accessible to all students. In the digital realm, we have observed that blogs can be particularly successful methods of preservation. Blogs are familiar and intuitive (and therefore accessible) to most students. Blogs are durable. Unless someone deactivates a blog or cleans out all of its posts, its content will remain intact for a long time. Finally, blogs allow for multiple modes of communication (text, image, video, audio, etc.). In sum, blogs can be ubiquitously accessed and extended.

Armed with these materialized reflections, an instructor can use them as tools for analysis and reflection-on-action. What worked well? What failed? Which stories were effective? Which weren't? Which CICs were understood quickly? Which ones took more time to understand? Which ones are still processing? The students' materialized reflections are units of distributed cognition at the pedagogical level; they are an essential component of an instructor's thinking about his or her course. Taken over time, these reflections are fodder for the instructor's own learning: has the storytelling improved such that more students are engaging, grappling with, and attaining CIC understanding? Through this lens, the narrative cloud is so much more than just a repository of stories. It is an evolving component of distributed cognition across space and time. It is an integral nexus of foundational aspects of design, including: reflection (Schön, 1987), experience (Wong & Pugh, 2001) and distributed cognition (Hutchins, 2000).

Conclusions and future work

We introduced an HCI/d pedagogical approach to be applied in a *practicum* or studio-based course (Schön, 1987). This approach employs stories as a means to convey *content-independent concepts*. These stories gather in a conceptual space we call the narrative cloud, and they serve to engage students into self-reflection. This self-reflection motivates achievement of two student goals: (1) empowerment of the individual as designer, and (2) cultivation of consciousness about the nature of being a designer: a transformative agent of the (natural) world through the introduction of ultimate particulars based on design competences and judgements (Nelson & Stolterman, 2012).

We now discuss some of the limitations of our approach. Students may have difficulty comprehending a narrative-based approach in a studio. It defamiliarizes more traditional means of lecture-based instruction in which the lecture content links directly to course content. We see this space as an opportunity. The naturally exploratory studio context favors extending the learning process beyond the communication of

theory, principles, or technical skills. It represents a space where learning as an *aesthetic experience* (Parrish, Wilson & Dunlap, 2011) is feasible.

Instructors may perceive a limitation of this approach in that it does not instruct design principles *per se*. We are not advocating the narrative-based approach as a replacement to the instruction of design principles. Rather, we are advocating it as an augmentation to teaching design principles. According to Nelson and Stolterman (2012), "facts and skills are only valuable in the context of the confidence to take action or do things." Our approach aims to instill a sense of agency in design students; it aims to bolster their confidence. And so there may not be a place for this approach in every HCI/d studio.

Just as the approach does not fit with every curriculum, neither does it fit every instructor. Instructors interested in adopting a narrative-based approach to HCI/d pedagogy must be committed and sincere. Students at this level have a keen sense for insincerity and superficiality. If the instructor does not buy into the method, then the approach will fail. If the instructor does buy in, then he or she must acknowledge that telling stories is not the same as lecturing. An instructor who expects success using this technique interchangeably with traditional lecture will inevitably fail. Unless the instructor is a seasoned storyteller, it will require committed practice in order to hone the storytelling craft. The components we outlined in this paper constitute a good starting point. They can be used as criteria to evaluate stories for use in a narrative-based approach.

Future work

As we move forward with our research, we aim to develop a framework for practical use. When should an instructor think about using the narrative cloud approach to HCI/d pedagogy? What are the implications of use? How should an instructor prepare to integrate the narrative cloud into his or her curriculum? How might it change the way we think about instructor/student interaction? How might it change the in-class dynamic between student and instructor, or between student and student? What happens when the narrative cloud exists in a non-HCI/d studio (e.g., architecture or industrial design)? What implications does the narrative cloud have for pedagogy in general?

The narrative cloud is about people. The instructor and students create it through the telling of stories. But its reach extends beyond the boundaries of the academic institution. The purpose of HCI/d pedagogy, after all, is to train the next generation of designers. The narrative cloud aims to grow a workforce of designers who prioritize their users above themselves. We believe that one effective way to do that is to imbue designers with a strong sense of agency; to enable them with the courage to go out into the world and act and to build for them a socially-minded collegial community of designers who think about people first, not technology.

Through the process of exchanging stories and inquiring into the meaning of those stories, a natural shift occurs whereby students no longer speak of the stories themselves. The students begin to speak of themselves in relation to the stories. They begin speaking about stories in terms of their personal experiences. They seek meaning in themselves. They strengthen and refine their sense of agency by composing their own life narratives. In the end, the students are the story.

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