

**Social Context in the
Design of Online Learning Environments to
Support Critique: A Study of Studio Zone**

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Abstract

A common practice in design education settings is participation in “crits,” or design critiques, in which critical feedback is given about students' creative works in progress. This paper suggests that web-based technology might offer advantages for students to learn through critiques by introducing Studio Zone, an online learning environment that allows students to interact in design critiques asynchronously. This study asked how students perceive design critiques, and documents how Studio Zone was used in a graduate-level educational software design course. Results revealed that critique was a valued activity and that participation in critiques was shaped by social factors such as rapport and perceptions of shared concepts of critique, as well as the constraints of the technology. Students' perceived strengths and weaknesses of the software are described. A discussion of the implications for future iterations of Studio Zone and its use is also given.

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“Ultimately, the care with which we treat one another within our organization is the source of empowerment, and provides the foundation for good design.” (De Young, 1996, p. 255)

In design education settings such as architecture studios, participation in "design critiques," or reviews of creative works, is considered essential to learning how to design (Shaffer, 1999). De Young's statement above highlights the importance of the social interaction in a design environment; being able to communicate and support others is just as important as knowing design principles and having design skills. In this study, I adopt this view and suggest that understanding the social aspects of critique is important for creating effective learning environments for design education. Further, given the social risks involved in presenting work for critical review in live settings, this research also explores the potential advantages of participation in design critiques in web-based learning environments. In particular, this study focuses on the social context of design critiques as a way to inform the design of a web-based learning environment called Studio Zone.

Studio Zone allows students to present digital images of their designs and to post comments asynchronously. The two main pedagogical goals of the software are (a) to foster students' ability to reflect on their designs and (b) to enhance opportunities for students to support and learn from each other through design critiques. In this paper, I present a rationale for Studio Zone as well as a study that documents how it was used in a particular design education context, a graduate-level educational software design course. Primarily addressing the second goal of providing a supportive learning environment, this study set out to describe and analyze how users perceived Studio Zone as a place to give and receive design critiques. Hence, this research also represents a reflective study of Studio Zone itself that has implications for future iterations of its design and use. Specifically, I sought to answer the following research questions:

- (a) How did class participants use Studio Zone for design critiques?
- (b) What were class participants' perceptions of design critiques?
- (c) How did class participants view Studio Zone as a tool for learning?

I needed to answer these questions to determine if Studio Zone was used and perceived in the ways it was intended. Asking students about their experiences using the software and about their participation in critiques helped paint a picture of the social context in which Studio Zone was a part. Researching the effectiveness of Studio Zone's cognitive guidance is also important; however, I leave detailed examination of that issue for later study. The final section of this paper discusses the implications of the results of this research for future iterations of Studio Zone and its use.

Research Rationale

This study contributes to research in educational technology in two main ways. First, it draws from previous work on scaffolded computer-based learning environments in science education and extends that work into an application for design education by presenting a design and rationale for a new computer-based learning environment, Studio Zone. Second, it contributes to research on social aspects of learning in asynchronous, computer-based learning environments by focusing on how

students make sense of critiques in online situations. This work reveals important social dynamics that need to be considered in the design of educational settings in which students respond to each other's creative work, whether a technology-based component is used or not.

Scaffolded Computer-Based Learning Environments

The learning technologies that are most relevant to the study reported here are computer-based learning environments that have mostly been used in science education such as Computer Supported Intentional Learning Environments (CSILE) (Scardamalia & Bereiter, 1991), the Knowledge Integration Environment (KIE) (Linn, 1995), and the Progress Portfolio (Loh, et. al., 1998). In general, they aim to promote deep concept understanding and to develop scientific inquiry skills by providing procedural and cognitive scaffolding. Scaffolding (Collins, Brown & Newman, 1989) is a form of guidance that helps students carry out tasks that might ordinarily be too difficult. For example, CSILE provides cognitive scaffolding by prompting students' thinking as they participate in asynchronous discussions with sentence starters such as, "My theory is...". Similarly, in the Knowledge Integration Environment (KIE), students' science investigations are guided with procedural prompts, as well as cognitive guidance in the form of prompts and hints (Bell, Davis & Linn, 1995). The scaffolding is designed to help students conceptualize scientific investigation in the way that experts do. The Progress Portfolio scaffolds the process of scientific inquiry by providing a "workspace in which to document, manage, and communicate about the [scientific] investigation" (Loh, et. al., 1998, p. 2).

While these computer-based environments aim to help students become reflective *inquirers* in various ways, this research explores how the same ideas can be applied toward developing students as reflective *designers*. The research on computer-based learning environments for science education suggests a promising avenue for similar work in other domains such as design. Hence, this research represents a step towards exploring that potential.

Computer-based Learning Environments for Design

Researchers have also highlighted the importance of reflection in design-oriented domains (e.g., Kafai, 1995; Shaffer, 1999; Gal, 1996). For example, the use of "design diaries" (Puntambekar & Kolodner, 1998) and role-plays (Rowland, Fixl & Yung, 1992) have been offered as ways to promote reflection in design learning contexts.

There is also some research that examines the potential of technologies to support design learning. For example, Kydd, Dyke & Jenkins (1999) have created a web-based design journal for engineers, though this tool is used as a way to keep records of design rather than as a tool to discuss and review designs within that online space. Perhaps the most prominent research in this area is underway at the Georgia Institute of Technology (Hübscher, Puntambekar & Guzdial, 1997; Kolodner & Nagel, 1998; Puntambekar & Kolodner, 1998; Shabo, Guzdial & Stasko, 1999). Researchers have been engaged in the development of a Supportive Multi-User Interactive Learning Environment (SMILE), a suite of technology tools to support "collaboration and reflection during problem-based learning, project-based learning, and learning from design" (Nagel & Kolodner, 2000). Like the computer-based learning environments described in the previous section, SMILE scaffolds students in a variety of tasks, such as proposing solutions and explaining test results. One of the SMILE tools, the Design Discussion Area (DDA), is designed to support students' presentation and discussion of

design plans and results. Their work acknowledges social aspects of facilitating collaborative learning and highlights classroom practices that work effectively with the technology they have designed. Research on the DDA has paid attention to the feasibility of the DDA tool, patterns of use, and effects of use (Kolodner & Nagel, 1999). One way the research reported in this paper connects research on the DDA tool is the common focus on supporting students' presentation and response to design. Kolodner and Nagel's (1999) research found that the ways in which the DDA tool was integrated into the classroom activities influenced the quality of participation (i.e., number of comments and quality of comments) in discussions. Thus, while there is some research that explores how technology can support design critiques, more work is needed in designing technology to work within the social context of the learning environment.

In the area of design education, little is known about social interaction in asynchronous, online environments. However, adopting the notion that social and cognitive processes are inextricably linked (Rogoff, 1995), this research assumes that the social context of a technology tool is related to cognition and hence the learning potential that can be achieved with the tool. For example, Hewitt and Scardamalia's (1999) research of a computer-based learning tool (CSILE) that allows students to participate in asynchronous discussions emphasizes that providing a supportive social environment is important for addressing the fear of criticism and students' lack of experience in making constructive responses to peers' work. The extent to which students can benefit from their interactions online is partly influenced by the nature of the learning environment outside of the technology tool.

Bruckman's (1998) research on students' use of Moose Crossing, a particular online environment in which students learn programming skills, reveals important social aspects within a computer-based environment. One important finding indicates that participants provided each other with emotional and technical support, an appreciative audience for their designs, and role models. Again, these studies exemplify how social context and cognition are linked.

Understanding how and why students interact in online environments provides firmer ground on which to build new tools for design education. Especially since critiques involve sensitive issues such as giving feedback kindly and learning to accept criticism, this research is essential to the refinement of Studio Zone and to the development of curricula in which critiques are used.

Theoretical Basis of Studio Zone

In the previous section, I offered a rationale for a technology tool for design critiques and for an inquiry of its social context. Next, I will elaborate on the theoretical grounding on which the design of the proposed software rests.

Reflection in Social Context

A basic theoretical idea underlying the design of Studio Zone is social constructivist pedagogy, which values reflection and articulation of thinking in a social context. Collins, Brown and Newman (1989) highlight the importance of reflection in their theory of "cognitive apprenticeship." In their model, reflection "enables students to compare their own problem-solving processes with those of an expert, another student, and ultimately, an internal cognitive model of expertise" (p. 482-483). The sociology of the classroom is equally important in supporting reflection. Interaction with other learners is critical for providing students with "calibrations of their own

progress, helping them to identify their strengths and weaknesses and thus to focus their efforts for improvement” (p. 486). By articulating thinking, students clarify their understandings as well as make their thinking accessible to others.

Language as a Tool for Reflection in Social Context

The theoretical basis of this research is also informed by the work of Schön (1983, 1985) and Shaffer (1999). Their work describes aspects of reflection that are essential to learning in architecture studios. Specifically, Schön and Shaffer identify the “desk crit,” or design critique between “master” architect and student, as an interaction in which the student learns to adopt expert design practices. Shaffer emphasizes the “expressive” nature of design critiques, describing that expression as “the process by which thoughts, emotions, or sensations (internal mental states, or incepts) are reflected in words, gestures, or physical creations (external states, or incepts).” This model of social interaction between student and instructor involves a critical conversation about the student’s design, and usually involves both people working towards solving a problem. The evaluation in these interactions is generative rather than summative; criticisms are given so that the discussion can contribute to the improvement of the student’s design.

Connected to this notion of design critiques is Vygotsky’s idea of the “zone of proximal development,” or ZPD (Vygotsky, 1979). In his view, the use of speech is considered a tool for connecting people and for achieving goals. To develop what he terms “higher psychological functions,” speech and social interaction are instrumental in internalizing what was at first external, social activity. For a learner to develop skills that she could not ordinarily perform on her own, the internalization of socialized speech depends on interaction with a more skilled person. From this premise comes the “zone of proximal development,” which can be defined as:

the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. (Vygotsky, p. 86).

This study views learning in design critiques as a ZPD, assuming one participant is more knowledgeable in some respect compared to another. As people with different levels of experience and skills interact with each other, zones of proximal development are dynamically created. Thus, zones of learning potential are not only created by interactions between student and instructor. Depending on the task at hand, a particular student can theoretically be located in a “higher” or “lower” point in the zone. Assuming that students have various individual strengths and weaknesses, peer interaction can create valuable opportunities for learning.

Through critiques, participants articulate their design goals in relation to their designed artifacts. By responding to others’ designs in the critique, participants make thinking that is ordinarily tacit “visible” for themselves and for other participants. The issues and approaches that become explicit in the conversation may be the same processes that the student will eventually come to learn to apply on her own. For example, in a critique of educational software, the designer may learn ways of handling screen layout issues from a person who has dealt with a similar problem. Or, a person with teaching experience might bring up a pedagogical issue that the designer might not have considered.

Use of Tools in the ZPD

It is useful to view design critiques as exemplars of interaction within zones of proximal development because we can apply Vygotsky's idea of *tools*. His theory holds that cognition also interacts with "technical tools" (such as computers or pencils) and "psychological tools" (such as language or mnemonic techniques) that are available in a particular cultural and historical context.

Similarly, in his studies of an architecture studio, Schön (1983) shows how design critiques are mediated by language as well as the physical materials of the situation. Language and physical materials are tools that in effect "talk back" as the participants in a design review engage in a "reflective conversation with the materials." That is, as participants interact with each other and with the tools available to them (for example, specialized vocabulary or a drawing pad), they also react to feedback from the tools, sometimes in unexpected ways. Thus, the *tools* of language and physical materials play important roles in the social interaction.

Social Role of Language

Both Schön and Vygotsky acknowledge the important role of language in enculturating the learner into the ways of expert practice. For example, Schön talks about language for this purpose in an interaction he observed:

The language of designing is a language for doing architecture, a language game which [the professor] models for [the student], displaying for her the competencies he would like her to acquire. But [the professor's] discourse is also punctuated by parentheses in which he talks *about designing*. (emphasis added) (Schön, p. 81).

Hence, language not only serves the function of explicitly communicating about design, but also of providing a model of how designers use speech as a tool for practice. This idea suggests that students must have access to others with expertise in order to learn their skills and ways of designing.

Goals and Features of Studio Zone

Studio Zone serves as a "virtual critique space" that structures and guides students' thinking as they present and respond to work at various points during the course of a design project. By saving students' representations of designs over time (and the discussions of those designs), Studio Zone also captures the design process itself. This can be valuable not only as a reflective tool for students while they are designing, but also for keeping a store of case studies. The software can be used for instruction in a variety of design oriented domains such as graphic design or even studio art. In the study reported here, students were studying educational software design.

In general, the goal of this research is to develop students' ability to create, reflect on, and critique design. Specifically, there are two closely knit learning goals for students using the Studio Zone software; one is primarily social and the other cognitive. Acknowledging that presenting work and accepting criticism can at times be daunting to students, Studio Zone aims to create opportunities for students to share experiences and provide general social support in the way of encouragement, suggestions, and/or technical advice. An important cognitive objective is to help students become more adept at making critical responses to designs. It is expected that fostering the ability to reflect on and respond to design will be valuable for developing design skills.

On a practical level, the accessibility of the web provides students a forum in which they can interact outside of normal class meetings. Hence, Studio Zone is designed to extend opportunities for social interaction. Providing a way for students to communicate asynchronously with each other and with the instructor can be important for a typical design-oriented class such as the one featured in this study since face-to-face time is often needed for group meetings and learning specific skills. Instructors often need to spend time meeting with students individually to review work. The accessibility of a web-based environment also allows for enhanced access to participation in design critiques.

Two main features of the Studio Zone software that are designed to support the learning goals are the *assignment discussion space* and the *guiding questions and prompts*. As students work on their design projects, they can participate in design critiques online in the assignment discussion space. To present work to the rest of the class in Studio Zone, students can post images and text that describe the current state of their work. Students can then make comments in response to the posted designs. This activity structure allows students to create records of their design work at each step of a project. It allows students to create a visual record of a project from initial ideas, through revisions, to final product. By making these steps explicit and accessible by all participants, Studio Zone aims to make the iterative process of design visible. Thus, by making aspects of design explicit and accessible, these representations can then become tools for thinking. In effect, they can become part of the reflective conversation among students.

The *guiding questions and prompts* is the other main feature of Studio Zone which addresses the cognitive goal of developing the ability to reflect on and critique design. By providing cognitive supports in the form of guiding questions and prompts, Studio Zone encourages students to articulate their thinking at various points of the design process. These guides can be customized by the instructor and appear as students post to the site. These provide strategies for assessing their own work and responding to the work of others. For example, as a student composes her post to present a design, she might see the guiding questions, "What is your rationale for your choice of layout in this design?" or, "What was your target user group?" Prompts in the form of sentence starters might also appear. For example, when a student is responding to peers' work, he might see the text, "The first thing I notice about the layout is..." or "An alternative way of handling the issue might be..."

In addition to these main features, Studio Zone allows students to view "portfolios" of their work collected online. A set of administration functions also allows the instructor to create new assignments, manage usernames and passwords, and monitor online activity.

Research Design

Theoretical Framework

In accordance with sociocultural theories of learning described above, I adopt a sociocultural framework (Jacob, 1992) to inform the research design. This framework comes out of the psychology of Vygotsky (1979) and emphasizes that cognition is mediated by social and cultural interactions. Specifically, my research approach incorporates Barbara Rogoff's conception of sociocultural activity (Rogoff, 1995). She identifies three planes of analysis: "apprenticeship," "guided participation," and

“participatory appropriation.” These correspond to personal, interpersonal, and community processes. Rogoff emphasizes that the study and observation of learning environments cannot treat cognition, culture, and social context separately. Instead, these three “planes” of sociocultural activity can only be alternatively foregrounded or backgrounded.

The plane I foreground in this study is “guided participation,” or the interpersonal processes involved in critique. Specifically, this refers to:

the processes and systems of involvement between people as they communicate and coordinate efforts while participating in culturally valued activity. This includes not only the face-to-face interactions, which has been the subject of much research, but also the side-by-side joint participation that is frequent in everyday life and the more distal arrangements of people’s activities that do not require copresence (e.g., choices of where and with whom and with what materials and activities a person is involved). The “guidance” referred to in guided participation involves the direction offered by cultural and social values, as well as social partners, the “participation” in guided participation refers to observation, as well as hands-on involvement in an activity. (Rogoff, p. 142).

My research questions fit within this framework of “guided participation,” since they focus on describing and analyzing interpersonal interaction and activity involved in critiques (what are the patterns of “participation”?). At the same time, I am paying attention to cultural and social factors that may shape that activity (what “guides” the nature of participation?). Although intrapersonal cognitive processes involved in critiquing design is equally important (the plane Rogoff calls “apprenticeship”), I reserve detailed examination of those processes for future study.

Methods

My research approach combines qualitative and quantitative methods and the specific educational goal of creating a technology tool to foster students’ ability to reflect on and critique design. As the designer of this tool, the interventionist aspect of my study allowed me to interact with participants (in particular, the instructor of the course) towards achieving this goal.

To investigate my research questions, I employed an interpretivist perspective (Erickson, 1986) which acknowledges that humans make subjective meanings based on objects and behaviors around them and create multiple realities that shape their behavior. This ontological perspective is consistent with the sociocultural theories that guide this study. Taking this approach allowed me to use a variety of qualitative data collection and analytic techniques to understand the plane of “guided participation” in the design course context.

Site, Participants, and Time Frame

The setting for the study was a Master’s level course on educational software design that lasted for 14 weeks. The class met for three hours once per week. There were 13 students in the course (9 females and 4 males). These students were all students in an Educational Technology program and had different levels of design experience. In the semester before the one studied here, the same students took a related course (taught by the same instructor) that focused on learning basic principles and theories of educational software design. The course studied here required groups of students to design and build educational software applications for clients.

Role of the Researcher

Consistent with my interpretivist/interventionist approach, my role shifted between participant and observer. Since I have experience designing educational software, I often worked with the instructor and students as a resource for technical and design help. Students sometimes communicated to me problems or suggestions related to the use of Studio Zone as well. I was able to quickly implement changes in Studio Zone that students found to be helpful. Students in the class knew that I was the designer of Studio Zone, and that I was studying their use of it. As an observer, I sat in on design critiques, without interacting with participants.

It is important to note that my familiarity with the instructor and the students was a key aspect of my relationship with the participants. My connection to them was likely a benefit in allowing us to interact easily; however, our rapport may have biased their expressed opinions of Studio Zone and the class, as well as my own interpretations in general.

Data sources

I employed a variety of data collection techniques that are consistent with the sociocultural framework described above. These methods provided me multiple perspectives for understanding how participants defined and expressed their experience of design critiques.

Primary data sources included student and instructor interviews, posted writing and images on the Studio Zone web site, and survey data. After about five weeks into the course, I conducted one semi-structured interview with six students, and one with the instructor. These interviews were audio taped and transcribed. The protocols were designed to gain information about (a) the participant's background and experiences related to design, (b) his or her experiences learning design in the course, and (c) his or her experiences in Studio Zone and in critiques in class. In the instructor's interview, I included questions about her goals for the class, as well as her approaches to teaching design of educational software (see Appendix A for complete protocols). I collected all postings on Studio Zone, including (a) presentations of project groups' storyboard images and their written explanations of those images (n=25), and (b) students' posted responses to the presentations (n=41).

A survey was administered at the beginning and end of the 14-week course. This was a self-perception questionnaire (Lee, Kerner & Berger, 1998) that asked students to assess their levels of knowledge, experience, and confidence related to software design skills which the instructor had previously identified as learning goals (see Appendix B for complete survey). For example, students would indicate on a scale from 1 to 5 their level of knowledge, experience, and confidence in *designing user interfaces, working with clients on design projects, and critiquing the learning goals of an education unit or program*. The survey asked students to assess themselves on 18 such items.

Other data sources included observations of the class as well as informal contacts with participants. During the class time, I observed the instructor as she reviewed students' designs. These were either reviews of paper prototypes of software or electronic working versions in progress. Consistent with sociocultural theory, observations of these interactions focused on the participants' use of language, materials, and space to understand processes of critique in face-to-face situations. I also observed the classroom with the goal of understanding the feel of the classroom culture,

its activities, and physical environment in general. I made four formal observations during times when class activities focused on critiques of student work.

Organization of the Studio Zone activity

During the first few weeks of the design course, students were asked to create “storyboards,” or visual representations of the computer interface. Storyboards are used to start working out the overall concepts and possible activity paths a user might take when using the software. Students presented these storyboards to the instructor in critiques during class. In addition, I worked with the instructor to craft an assignment that would ask students to critique the storyboards asynchronously using Studio Zone. Students working in their project groups were to post digital images of at least four screens from their storyboards along with a “rationale that connects to [their] functional specifications” (Instructor’s interview transcript). Then, students logged in to Studio Zone individually and were asked to critique at least one storyboard from another group. The students had approximately one week to complete this task. The instructor created a set of guiding questions that were visible as students wrote comments about the storyboards. For example, two of the guiding questions asked, “What objective was the designer trying to achieve?” and “What design decisions did the designer make?” See Appendix C for complete list of guiding questions created by the instructor.

Data analysis procedures

Data sources were analyzed without a particular theory to test; instead, I looked for themes and patterns as they emerged from my coding processes and memo writing with reference to my research questions.

The interview transcripts and observation notes were analyzed by using open, selective, and axial coding techniques (Strauss, 1987). As I reviewed the data, I identified key words and emergent themes that seemed significant. I reviewed the data again and identified particular codes. These codes were described and analyzed in memos that I wrote after coding each piece of data. As the data analysis proceeded, I reused or collapsed codes, or created new ones. After reviewing previous memos, I wrote additional theoretical memos that attempted to synthesize themes.

To analyze project groups’ postings of their storyboards and posted critiques, I read through all of them and began to identify themes. I then reviewed the postings and coded sentences according to some codes I generated from the initial analysis. For each critical comment posted in response to groups’ postings, I identified its *type*, *content*, and *modality* (expressed degree of certainty that the proposition is true). Each sentence (or clause, if appropriate) was coded. Frequencies of the occurrence of these codes were created. I also used descriptive statistical techniques to examine these data in relation to survey data collected about students’ perceptions of their knowledge, experience, and confidence in accomplishing design-related tasks.

Findings

This research set out to understand (a) how Studio Zone was used by class participants for critiques, (b) how they perceived design critiques, and (c) how they viewed Studio Zone as a tool for learning. I will describe the findings for each of the questions in turn.

How did participants use Studio Zone for critique?

Overview of use patterns

Although the instructor did not use Studio Zone to hold online critiques throughout the design process, she did use it for one critique in the early part of the course. The four project groups were asked to post their drawings or computer-based mock-ups of the software designs along with written descriptions each image. Students were also directed to post individual critiques of the designs using the instructor's guiding questions. These questions attempted to focus students' critical responses on educational design aspects of the software. For example, as students composed their comments online, two of the questions that appeared were "What are the learning or performance objectives?" and "Will the user learn anything?"

Each project group posted at least 4 images and textual descriptions to present their designs. As expected, project groups' posts about their own work tended to focus on describing basic features and giving rationales for the overall tasks and activities of the software.

Almost all students in the class commented on their peers' projects (10 of 12 students), though the number of comments students posted varied. The instructor did not post comments. Overall, 41 comments were posted in response to group designs. The average number of comments posted per student was 3.33, with one person posting as high as eight comments and two people not posting at all.

Although almost all students in the class gave comments online, each project only received feedback from a few students. Two groups got comments from four individuals, and the others had two and three people respond to their work. Project groups also received few comments per "page" (which includes an image and a written description) posted. These findings are summarized in Table 1.

Table 1. Distribution of Postings in Studio Zone

	Project Group A	Project Group B	Project Group C	Project Group D
Number of Pages Posted By the Project Group	4	5	7	4
Total Number of Comments Posted about their Design	4	9	16	12
Average Number of Comments Per Page	1.0	1.8	2.3	3.0
Number of Students who Posted Feedback to this Group	3	4	2	4

Posted Comments in Response to Project Designs

The comments that students posted in response to projects' designs varied in terms of their *type*, *content*, and *modality*. To get a sense of what kinds of responses students gave to their peers, comments were categorized into five *types*: *makes suggestion*, *identifies a source of confusion/problem*, *praises/affirms*, *gives rationale*, and *poses question*. Comments were also analyzed for their *content* and categorized as addressing *interface design*, *pedagogical*, or *technical* issues. In addition, it was expected that studying *the way* students expressed their feedback might be an important factor to consider.

Thus, each comment was categorized as expressing a low, medium, or high *modality*, or relative level of expressed certainty. A comment classified as *low modality* often contained phrases like, “You might want to consider...,” “I wonder if...,” and “I think it may be...” *High modality* comments were more assertive, using phrases such as, “I believe that...,” and “Please change that element.” Comments categorized as having *medium modality* were more neutral. Examples of comments in these categories are included in Table 2, and distributions of comments in these categories are reported in Table 3. See Appendix D for representative comments and analysis.

A frequency analysis found that the comments fell almost evenly into five *type* categories, with comments offering praise, questions, and suggestions being most commonly posted. It is interesting that while project groups did not focus on justifying interface designs in their project presentations online, 45% of critical comments referred to aspects of interface design. And, even though the instructor’s guiding questions attempted to focus students critique on the more pedagogical aspects such as learning goals and the activity design, only 45% of comments focused on pedagogical issues. Most comments were of medium modality (62%). There were slightly more comments of low modality than high modality (22% were classified as *low*, and 16% had relatively *high* modality).

Table 2. Categories used to analyze comments posted in Studio Zone and representative examples.

Categories	Examples
TYPE	
Makes suggestion	“I was thinking you might want to consider using a fun looking map...”
Identifies a source of confusion/problem	“The enter/edit data heading doesn’t really seem to go with the theme of this screen...”
Praises/affirms	“I really like the way you have created a child friendly shell for a data base.” “Well done.”
Gives rationale – explains reasoning for response	“For the purposes of scaffolding and explaining what these things are, ...”
Poses question	“What age group are you considering...?”
CONTENT	
Pedagogy	“We want to empower students and let them decide when they need help.”
User Interface/Design	“The design of your screen shots is visually appealing.”
Technical	“What happens if there are too many records to appear on screen?”
MODALITY	
Low	“It might be helpful to have some guiding questions on the side.”
Medium	“What group are you considering to read these?”
High	“Moreover, I believe there is no motivation to go here.”

Table 3. Distributions of comments (analyzed at the sentence level) by *type*, *content*, and *modality* of response.

Code	Percentage of Comments	Number of Comments
Type of Comment		
Praises/affirms	28%	43
Poses question	23%	35
Makes suggestion	22%	33
Gives rationale	17%	26
Raises confusion	10%	16
Content of Comment^a		
Interface Design	45%	59
Pedagogical	45%	60
Technical	10%	13
Modality of Comment		
Low	22%	34
Medium	62%	94
High	16%	25

^aNot all comments were coded for *content*. Thus, this percentage refers to total comments that were coded for *content*, not total comments posted.

Relationships between online participation and self-perceptions of knowledge, experience, and confidence

It was expected that individual differences in students' self-perceptions of knowledge, experience, and confidence in various tasks involved in designing educational software would be related to students' participation in online critique. Therefore, comments posted in Studio Zone were also analyzed in relation to pre-survey data of self-reported assessments of knowledge, experience, and confidence. One subset of self-assessments asked students to rate themselves on knowledge, experience, and confidence relative to (a) critiquing learning goals, (b) critiquing user interface, and (c) critiquing overall effectiveness of an educational unit or program. A *composite critiquing score* was created that totaled students' self-assessments of their knowledge, confidence, and experience on these three tasks.

There was a statistically significant relationship between the composite critiquing score and the number of low modality comments posted in Studio Zone ($r=-.897$, $t=-8.099$; $p<.001$). Students with lower perceptions of their experience, knowledge, and confidence in critiquing design tended post more comments of low modality. Figure 1 illustrates this relationship. There was no apparent relationship between self-report of critique ability and the number of high modality comments posted. This indicates that students who rated themselves as relatively more experienced, knowledgeable, and confident in critiquing did not necessarily use stronger language (high modality) in their comments.

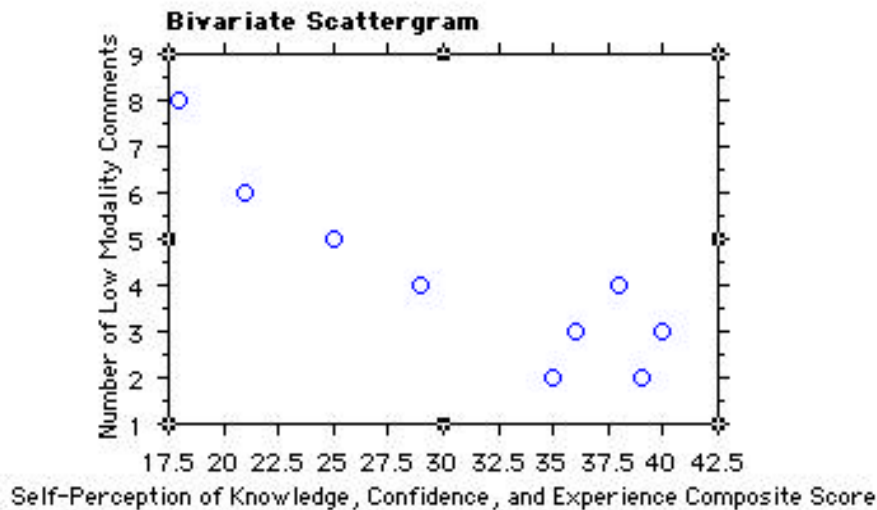


Figure 1. Correlation between modality of comments and self-perceptions of critique-related knowledge, confidence, and experience

What were class participants' perceptions of design critiques?

Overall, students viewed critiques as valuable for their learning. They saw critiques as providing a way to see the progress of other groups, to reflect on their own design, and to get feedback. However, students also revealed interesting reasons why they were hesitant to give certain critical feedback to their peers. These findings refer to design critiques in general; they are not specific to either online or face-to-face critique situations.

Awareness of peers' progress through critique

Students consistently described design as a difficult process made even more challenging because they were relatively new at it. As one student said in an interview, "no one really knew what to expect, which was part of the process." Coming together in critiques seemed to be one important way of checking their own progress by checking the progress of other groups. This interview excerpt exemplifies this theme:

[participating in critiques] helps us to apply what we have learned about software design, because we get to look at somebody else's software design. Think about what we learned and say, 'hey, I did this differently' or 'I did this the same.' You can even relate it back to things that relate to other people's software design that you've read. So, I think that they're very valuable.

Interestingly, when speaking about their experiences in the course, students commonly switched between the use of "I" and "we." They often talked about their individual learning in terms of learning as part of the whole class. This seems to indicate a strong connection to the group, and an awareness of peers' learning. Notice the switching between an individual perspective and a group perspective in this quotation from an interview (with my emphasis added):

...being able to see what other people are doing, coming together and helping each other solve problems. . . I like that collaborative. Even between groups, I'm definitely learning a lot from that. And we go through this process and it's hard for everyone. But we know that even when things don't go right, we're learning something from it that we'll take with us the next time.

Related to the idea of group cohesion, analysis of the student interviews also revealed the general theme of “going through the difficult process together.” As the student quoted above says, “it’s hard for everyone.” This aspect of being new and struggling through the design process seemed to be related to the expressed interest in learning about the progress other project groups. And, participation in critiques was one way of facilitating that learning.

Individual reflection through critique

Though they perceived critiques as not entirely enjoyable, students also viewed critiques as beneficial for individual reflection on design. The process of putting together a presentation of the group’s current thinking in preparation for a critique was itself an activity that was valued as a learning opportunity. The following interview excerpts exemplify this finding:

I think that [reflection] is really a powerful thing to have...where we’ve been, we had to go, but this is where we need to be. And so that was a good process to go through, but a painful one.

It helps to kind of articulate what you have in mind and what you’re thinking because when you do that, you can think to yourself, what was I thinking when I decided to put that here? So I think that it helps to get the feedback, but also to explain it, because you can catch your own mistakes.

Thus, the activity of preparing for critiques requires significant time, effort, and thinking on the part of the students. However, students seemed to value that process since it forced them to monitor their own rationales and identify possible weaknesses in the design.

Feedback through critique

Another general theme revealed in the student interviews was the value of critiques for getting feedback on designs. Students felt their designs were improved by bringing them into a critique and hearing alternative perspectives. The following quotation exemplifies this theme:

other people are coming from a totally different perspective, and are fresh, and haven’t been looking at it for three days. And they give all kinds of different ideas or ways to approach things.

Hesitation and Willingness to Give Critiques

The student interviews also revealed mixed attitudes about giving critiques to their peers and a surprising range of explanations for their attitudes toward critique.

A sense of rapport played a role in how students’ gave and withheld feedback. Some students described how rapport with other students made it easier to engage in critiques. This is consistent with the finding that students had a sense of group connection with others in the class. One student said in an interview,

Since I’ve been working with these people last semester, and they’ve also worked with me, we can kind of approach each other more comfortably on issues than it would have been had we not known each other.

This comment is in line with the instructor’s goal of “creating a community atmosphere where they [students] can critique each other’s work.” In interview, she talked about the importance of making people involved in design feel like they can participate. She said, “people probably always have something to say, it’s just that they don’t feel that they can say it.”

However, the findings indicate that some students didn't always feel comfortable in giving certain critical comments to their peers. In the following case, one student explains why she withholds potentially valuable feedback during a critique:

...I think I have a tendency to be very bossy when working with groups so I've really tried to make an effort this semester, or with this project, to kind of step back.

This hesitance to give suggestions seems to come from a concern for how her feedback will be received by her peers. It seems that to preserve her relationship with her peers, she must not be perceived as "bossy" through her critiques.

Students expressed a weak sense of shared set of criteria for critique. Student interviews also revealed dissatisfaction with a lack of structure felt in the class. Not having a common ground or set of guidelines seemed to contribute to sense of disconnection and hence the kinds of feedback students gave each other.

In the case of one student, the experience of learning design seemed to be closely tied to his experiences with groups. He found it valuable to be able to learn from the skills and strengths of those in his project group. In addition, feeling connected to others in the class by having shared conceptions of "what to look for" seemed also to be important to him. In this quotation, he expressed a need for some structure:

Sometimes that structure, that lack of structure...it does make it difficult. And I think anything that could've helped that along would have been nice. Specific questions that deal with specific issues of the software, you know more guiding questions or something, so people will be talking about things and kind of be referring to the same things.

Another student in the class revealed a resistance to giving feedback about an area in which she has some extra expertise. Because she saw others in the class as *not* having that same expertise, she *held back* from making critiques related to those issues. She said that she was more comfortable making those kinds of critiques and bringing up those issues in her own project group. She said,

As a group we haven't talked about what those elements are in terms of design. So it's very hard to criticize them [other students]...I don't talk about that, so they wouldn't ...so I just don't comment on that sort of stuff, because I don't know how, except within our group. 'Cause I can take the time to explain grids for example.

In her own group she feels more comfortable raising the issues she sees as important because "she can take the time to explain." Like those students who may be withholding certain suggestions, she is concerned about people responding negatively to her feedback. Moreover, her behavior is also related to perceptions of the groups' shared set of criteria for critique. She perceives her expertise as falling outside a shared framework for evaluating design. To some extent, the evaluative framework for this course had been established in the class that all the students took the semester before, which was an introductory course that explored principles of educational software design.

The mismatch between her own and her perception of her peers' criteria for critique was also related to frustration from receiving unexpected feedback in the online critique. She explained that comments tended to focus on aspects such as *motivation* and *metaphor*. However, she thought other design elements should also be addressed. Her comment, "we don't have words for talking about that," suggests a perception of the group's framework that doesn't match her own. In this case, the student's perception of the group's shared set of criteria impacted both her behavior in critiques

and her perceptions of her peer's feedback. This was a common theme in the interview data.

Differing notions "good critique"

Though students found critique to be "very valuable" for them in general, some students were unsatisfied with the responses their group received in Studio Zone. Students thought the responses online were "too nice" or not "critical" enough. Not only did students seem to want a different *level* of feedback, they seemed to want *more* of it. As stated earlier, project groups only received individual feedback comments from less than a third of the class. The following interview excerpts (with my emphasis added) exemplify these sentiments about the online postings:

I put what I wanted to put, in a nice way. But I still made it clear, **but I thought some people kinda skipped over somethings. They really didn't give the feedback that maybe could've helped.** Or, they didn't do, like... we counted comments to be honest. Five people....we're like, ok, where are they? You know, and where was their feedback?

...there were some critical things that came out, that were good to hear, but I think **this was the first time people had done it. People were really nice.** [laughs] And very positive and at that point in the design, I think it was a good thing **because we had no idea about where we were at** and they gave some good feedback. But a lot of it was more, 'this is good,' or you know, 'this looks fine.' 'Cause **maybe they didn't have a really great idea of what was expected as far as like how intense and how deep to go.** And I know there were questions guiding that, and I think people took that. But it was just the level of where their comments went. It was fairly superficial.

I think that even the next time we use it people will just be extremely helpful and just say what needs to be said. At least I will be, **I'm not going to try and couch what I'm saying because it's just gonna help someone make their thing better.** [...] I think it'll make it better, but I think everybody understands that **we're all trying to help each other** and that we're all going through it. It's not like none of us, or it's not like some of us are doing something where we're not commiserating with each other. So we all understand the process.

The *type* analysis of the online comments corroborates these perceptions in that it revealed generally positive responses (28% of comments expressed praise or affirmation). Comments falling in the *poses question* and *makes suggestion* categories were second and third in frequency of occurrence. Often times, questions and suggestions were phrased with *low modality* and often preceded by a statement of *praise or affirmation* which may have contributed to students' perceptions of the online critiques not being "critical enough." Students' suggestions may have seemed "couched" (borrowing an expression from the quotation above) because of their relatively low modality. For example, many comments had the structure, "I like the idea of...However, I think may be a little bit confusing that...."

When asked for an interpretation of why students were posting comments that were "too nice," one student said,

People might have been struggling for things to write...like trying to find things. And that requires on their part, some critical thinking about...instead of just looking at it 'oh, it looks nice,' they have to actually sit there and think what like a student or user, and think like a designer. So it might be hard for people to switch modes like that.

This quotation is interesting in that it reveals a student's perception of the cognitive demands that are required for the critiquer. She seems to believe that students in the class may not have had the kind of knowledge (thinking like a user or designer) required to make a "quality" critique.

How did class participants view Studio Zone as a tool for learning?

When asked about the role of Studio Zone in the course, students' comments generally identified two main features of Studio Zone as particularly useful: (a) the ability to structure critiques, and (b) the time to respond allowed by the asynchronous nature of the Studio Zone environment. Students also identified several weaknesses in the design of Studio Zone: (a) limited dialogue structure, (b) time required to respond to many projects, and (c) the visual orientation of the project pages.

Ability to Structure Critiques

For one student, her beliefs about how design is learned and should be taught seem to have a lot to do with *breaking things down* and *providing structure*. Thus, she sees Studio Zone as a place to create that structure and break things down.

I think the good things about Studio Zone is they are actually giving us a place and a framework for talking about design. Not much in that class is structured and it's really refreshing that Studio Zone be there for providing some structure.

This student seemed to be responding the fact that Studio Zone can structure critiques by organizing presentation and response to work. One particular way of structuring critiques that students seemed to find useful was Studio Zone's guiding questions.

[Guiding questions] are a real plus 'cause then everybody has the same set of questions. You know we do it in class, you don't always pose the same questions for every single one, because it just becomes redundant with the whole group.

That's where those guiding questions are really good. You know whenever you teach something like this you have to break it down into its pieces.

Though students reported that guiding questions were useful, it is not clear how students actually used them to construct their responses. For example, though the questions appeared every time a student composed their comment, data was not collected to determine whether or not students read through all the guiding questions, or the extent to which they relied on the questions.

Time to respond

The fact that communication through Studio Zone is asynchronous and allows users time to study and compose a critique seemed to be valuable to students. These interview excerpts shows how this feature is aligned with the concern to give thoughtful feedback (with my emphasis added):

I felt really comfortable to say things and just...**it gives you time**. Like maybe you want to say something, but doing it online gave you the opportunity to think about how to say, without maybe hurting someone's feelings. Whereas you might in a one-on-one or group setting, just blurt something out without maybe even thinking to consider that person's feelings, 'cause there's just not enough time, and they do want your feedback.

Studio Zone I can tell already is gonna be a good to for doing the critiquing. Because it allows a certain, gives you time to think about it, which I like. **Sometimes you have to reflect on a design for a while before you can have a good comment**. Whereas when you're in class and it's up there on the board, 'ok, does anyone have anything to say.' And, boom, you're onto the next one. What's nice about Studio Zone is you have the time.

The instructor viewed Studio Zone as valuable for extending opportunities for critiques since she viewed it as "too time consuming to do it in class." Though being able to "analyze and critique" design was a high priority goal for her students, she preferred to use class time for group work.

Design Weaknesses of Studio Zone

There were three major weaknesses in the design of Studio Zone that students identified in interviews.

The post-response dialogue structure was viewed as limiting. The structure of critiques online allowed for the presenter to post an image representing the design and some text describing it. Other students could then post comment notes in response. Studio Zone did not allow for the presenter to easily respond to critiques or questions a student may have raised in a comment note. In the following quotation, a student explains how this shortcoming compared to face-to-face critique:

The in-class critiques, I think we got maybe more specific information about what was wrong, like, 'what does this mean? This is kind of strange...this is inconsistent.' And so within class, we were able to talk about it and explain if something was maybe a little bit off, and able to either fix it right then or just kind of take note of it for later. With this online critique the difference was that it wasn't really a conversation, I mean it could've been structured that way, but it was more of a commentary on it.

Hence, the structure and timing of interaction seems to be a key contrasting element between face-to-face and online critique sessions. While allowing students to comment on designs at their own pace was seen as an advantage to using Studio Zone, the drawback was that the students being critiqued could not respond immediately. This was seen as especially important if students felt the need to clarify or justify in defense of their design rationale.

Responding to all projects in Studio Zone required too much time. Another problematic aspect of Studio Zone students identified was the time demand required to respond to projects. While students described the guiding questions as useful as they tried to critique a design, they found it difficult to consider all of the guiding questions for each of the designs posted. In total, there were 20 pages of designs posted on Studio Zone. Thus, making detailed comments to each of these would have required a significant amount of time.

The visual orientation of Studio Zone misguided the critiques. The instructor attempted to guide the online critiques toward discussion of the conceptual aspects of students' designs. Students suggested that the structure of Studio Zone lent itself well to critiques focusing on aspects that are more visual in nature rather than conceptual. The following quotations reflect this issue:

You don't get an idea of the project, you just get an idea of the screen. And if we had looked at it as a whole project I think that that would have helped give it more meaning at that stage.

When we were doing more visual issues, then that was really good. When we were dealing with the guts of it, what was supposed to happen, it wasn't so good.

For the particular stage students were in during the time of the online critique, Studio Zone's emphasis on the presentation of designs in visual form did not neatly fit the kind of presentation they needed to make. Some students voiced the frustration that visual orientation put undue emphasis on visual aspects when the overall task design and learning goals should have been the focus of the critique.

Discussion

This paper began by advocating the idea that social support is an important aspect of learning in design. Indeed, as an activity construct, critiques (whether face-to-face or online) were viewed as valuable for learning to design for the social and

cognitive functions they served for class participants. Just the act of preparing for a critique seemed to be a learning opportunity since presenting a design requires reflection. Students acknowledged the value of reflecting on their designs. As a social activity, critiques also allowed students to see how others were progressing and provided models for assessing their own progress. Critiques were also seen as valuable for the more obvious reason of hearing people's perspectives on their own work that could be applied toward improving a design. These educational benefits probably explain why the instructor valued the activity so much that she wanted to extend opportunities for critique with the help of asynchronous technology.

Students' perceptions of the benefits of critique revealed in this study were not very surprising given that the design "crit" is a staple of pedagogical approaches in design fields like architecture and graphic design. However, this study also uncovered some factors that seem to influence the potential to learn through critiques. Students' conceptions of acceptable *targets* and *ways of critique* were found to be important, as was the general feeling of connection among the students. There was also some evidence that *knowing how* to critique, having *experience* critiquing, and having *confidence* in giving critiques were related to how students participated online (modality of comments). Further study is needed to find stronger evidence of how prior knowledge, experience, and confidence affects learning through critiques.

It was also proposed at the start of this paper that the web-based environment of Studio Zone could potentially enhance opportunities for students to support and learn from each other through design critiques. Was Studio Zone effective in achieving that goal?

The findings show that students certainly gave each other positive and encouraging comments online. Interestingly, this finding can be interpreted to reveal two important features of the social context of critique. One interpretation is that students were concerned about giving critical comments respectfully, out of genuine consideration for supporting one's peers. This is completely understandable, and in fact, it was hoped and anticipated that students would provide each other this kind of social support. Another interpretation is that students might also have elected to make relatively "safe" comments, given the weak sense of what constituted adequate quality critique from one student to another. Because students lacked shared ideas about what kinds of critique were fair game, they tended to avoid making critiques that somehow violated a perceived norm or expectation. Seen in this way, students had good intentions of helping each other by participating in critique, but they did not have the adequate "tools" to do so. They needed shared criteria, norms, and models to be able to give the kind of critiques that they wanted to receive themselves. What is troubling about these results is that the lack of such shared criteria may have limited valuable learning opportunities and weakened the social value of critiques.

What are the implications of the lack of shared frameworks for how students perceived feedback they *received*? The lack of shared norms can explain why students were dissatisfied with the kind of comments they received from others online. "Nice" comments were perceived as insufficient because they did not hit on the issues that needed addressing. Students were also unsatisfied with the levels of participation on Studio Zone. This is understandable especially considering the finding that project groups received averages of one to three comments per page posted on Studio Zone. Although students were only asked to respond to at least one design online, some

seemed to feel cheated by not receiving enough responses. Given the value students held for getting critical responses, this was likely disappointing for students.

What are the implications of the lack of shared frameworks for how students gave critiques? Perhaps the weak sense of “good critique” also discouraged students from feeling comfortable taking the role of the more knowledgeable other in a critique. The findings described instances in which students withheld potentially useful feedback due to a sense of rapport with peers and their perceptions of the lack of shared criteria. It is interesting that while students consistently talked about critiques as valuable for receiving critical responses from peers, they did not explicitly seem to value them for giving feedback to others. Since students expressed a sense of concern for and rapport with their peers, it doesn’t seem likely that students didn’t want to help their peers by giving good critiques. Instead, the more probable explanation is that they just did not know how to go about it. And, the time necessary to respond to all the posts further limited the extent to which students could give the amount of feedback they would like to have received.

These findings are especially problematic since the success of peer critique depends on students feeling comfortable as the critiquer. Seen through Vygotsky’s notion of ZPD, students were in effect declining the position as the knowledgeable other in a zone of proximal development. For students to benefit from each other’s expertise, they must know how to share their knowledge in a socially acceptable way. Hence, even when a zone of proximal development is theoretically created in a critique, there is no assurance that the learning potential will be realized unless these contextual aspects are taken into consideration.

Of course, the points of students’ dissatisfaction with online feedback and the lack of shared criteria for critique should not overshadow the perceived benefits of critiquing online. The ability to structure and guide the focus of the critiquing activity with guiding questions was seen as useful. And, being able to take time to construct critical comments also seemed to be an important advantage to online critique. Weaknesses of the Studio Zone design identified by students pointed to areas that could be refined to better support and enhance the advantages of online critique. The single level *post-response* structure of the critique was seen as inadequate for the kind of dialogue students needed. And, while guiding questions were generally helpful, students could not have reasonably thought about each one for every design posted. Consequently, the visually oriented presentation of designs may have made it easier to respond to visual features rather than the conceptual ones, as suggested by the guiding questions. It seemed that students believed in the potential for Studio Zone as a place for holding critiques, while also voicing reasons why the particular online critique they participated in did not fully meet that potential. These findings are useful since they point to specific features of the technology that can be refined and reevaluated in future study.

It should be noted that the online critique and interview data were collected early in the course. Thus, changes in students’ perceptions that may have occurred by the end of the course were not studied.

Earlier in this paper, I described Rogoff’s (1995) notion of “guided participation” as the “plane of analysis” through which the sociocultural environment would be studied. This unit of analysis highlights patterns of participation and the social and cultural factors that guide that activity. Through this analytical framework, this study

has helped to elaborate a conception of design critique that is useful for improving the design of Studio Zone, or any other educational context where critiques are used. Specifically, the following important aspects of critique characterized the patterns of participation found in this study:

- The content of the critique (what you say)
- The language used to express the critique (how you say it)
- Levels of participation (who critiques, and how much are they expected to critique)
- The content of the presentation (what gets critiqued)
- The manner in which the content is presented (i.e., images, text)
- How much is presented (i.e., the number of designs presented)
- The nature of interaction (i.e., asynchronous, face-to-face)

The two key factors that “guided participation,” or influenced the aspects listed above in this study, were (a) perceptions of shared criteria and norms for critique, and (b) the structure and technology of Studio Zone. These factors worked together to shape the patterns of participation. For example, the content of critiques students made was influenced by their perceptions of *what counts* as a valid point of critique, but they were also influenced by the constraints of the online environment. The structure of presentation in Studio Zone emphasized the posted image, suggesting that the verbal explanations were secondary. This guided critiques toward issues that were more visibly accessible than conceptual issues such as learning goals. The structure also allowed students to present as many images as they wanted, requiring students to sift through many individual pages. The guiding questions were designed to focus the content of responses, but the number of designs to critique may have diminished students’ willingness to give thorough feedback for each posted page. Thus, these factors all played a role in shaping the content of students’ responses.

Implications

The findings reported in this study have implications for the design of technology tools for critiques and how instructors use them. Now that the social aspects of critique are better understood, how can that knowledge be applied to help students learn from critiques? What role can technology play?

One major implication that can be drawn from this study is that students should be encouraged to **build and negotiate shared norms to guide their practice of critique**. The instructor should be cognizant of the need for shared criteria and could explicitly engage in discussion about the ways and purposes of critiquing. Expectations for the content of presentations and responses should be discussed. Shared norms could also be established by providing interaction with experts who can model ways of critiquing and sharing expertise. Web-based technology makes it easier to interact with experts asynchronously and over distances. It seems that a key to maximizing the learning potential through critiques is not to enforce a singular way of critiquing, but to match expectations among participants in a critique. Thus, these expectations should be made explicit whenever possible.

Another implication is that **students should be encouraged to be aware of their own critiquing styles and design skills**. One reason to encourage this is that it may be beneficial for students to understand their own strengths and weaknesses in terms of areas of expertise. They should feel comfortable and be eager to share their expertise in critique when appropriate, but also they should acknowledge when another’s expertise could help an area where the student might be weak. This might encourage students to

seek help and learn from others while also inspiring confidence in their own strengths. For giving feedback, they should be sensitive to the manner in which to critique peers. They should be encouraged to give rationales for their opinions, even for giving praises. Giving positive feedback can be especially constructive if the reasons for that praise are given. When receiving feedback, they should be alert to taking critiques personally. It would also be useful to have a personal policy of when to accept suggestions and when to disregard them. This might also encourage students to give suggestions without feeling they are forcing the other to change their design.

For future research, studies need to further investigate how norms and criteria for critique develop in a community of learners. This study raises more questions such as, where should expectations and criteria for critique come from? Should they be generated by students, the instructor, other experts? What features of the learning environment help participants negotiate shared conceptions?

This study also suggests some specific implications for how an instructor should structure the use of Studio Zone. First, **the instructor should set expectations for the class about the role Studio Zone is meant play in the course.** Students and the instructor should have a clear idea about the purposes of online critiques in relation to face-to-face critiques. There should also be concrete expectations for participation in terms of how often students present work and how much they respond to work. Second, **the structure of activity should help focus critiques in ways that are appropriate to what is being critiqued.** This could involve making sure the focus of critique is not too broad by allowing a limited number of designs to be posted. Fewer guiding questions might also encourage a deeper level of response since students would not have to analyze and comment on a large number of designs. If the focus of the critique is more conceptual, rather than visual (as was the case in this study), the manner of presentation should account for that. One way to do this is to ask students to post conceptual diagrams. Students should also be encouraged to articulate the kind of feedback they would like to receive given their current stage in a project.

For the design of Studio Zone, the findings of this study suggest that web-based technology offers advantages for critique. However, particular features such as guiding questions, the structure of dialogue, and modes of presentation need to be coordinated with the criteria and expectations developed by the instructor and by the students. For example, setting the expectation that students give deep and focused critiques must be matched with software features and structures that allow them to do so. One way to do this might be to rigidly structure students' responses by providing separate text boxes in which students must respond to a specific guiding question. A possible software feature would allow the response structure to be eventually relaxed so that students are not bound by specific instructions. Another possibility is to design a way for students to build the shared norms and criteria for critique by allowing them to collectively build the sets of guiding questions for critiques. For future research, it may be useful to conduct design experiments that manipulate features of Studio Zone (such as guiding questions and dialogue structure) and features of the social context (such as instructor-determined participation expectations and explicit discussions about critique). Such studies can trace the development of students' conceptions and skills over a longer time period in a way that helps us understand how to design more effective environments for learning.

Conclusion

Technically, allowing students multiple ways to present information and communicate online is relatively easy. What is more of a challenge is to leverage the technology to foster positive habits and skills that are needed to support a community of learners. This study begins to shed some light on how to craft both the technology tools and the social context of the educational environment to help students learn through design critiques. As expected, it was found that there are important social aspects of design critiques that need to be considered in the design of a technology tool to support critique. Specifically, perceptions of shared norms and criteria for critique and the structure of Studio Zone were identified as especially important factors in shaping how students participated in critiques.

In the sometimes chaotic and difficult process of software design, the features of the learning environment revealed in this study are important. By accounting for the complex ways students make sense of critiquing activities and acknowledging the connections between social context and cognition, future iterations of the Studio Zone learning environment can do a more effective job of fostering the reflective design practices and social support that beginning design students need.

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Appendix A. Interview Protocols

Student Interview Protocol

Goals: To find out (a) how the student sees himself or herself as a designer, (b) to find out how the student is experiencing learning design in this class, and (c) to find out how the student is experiencing learning with Studio Zone.

1. Can you tell me a bit about your background? What got you interested in educational technology?
2. Why are you taking this class?
3. Do you see yourself as a designer?
4. What kinds of design experiences have you had?
5. Are you confident about your skills?
6. Why are you interested in software design?
7. What are you hoping to get out of this course?
8. Do you have a philosophy about what skills good designers need?
9. Do you think you have the skills to be a good designer?
10. Can you tell me about your learning in the class so far?
11. Can you describe your experience in group critiques (in class and online)? Are they valuable to you?
12. Do you feel comfortable in critiques?
13. How do you see Studio Zone fitting into the class?
14. Do you think the class is benefiting from using Studio Zone?
15. What do you see as the purpose of critiques?

Instructor Interview Protocol

Goals: To find out (a) her philosophy of design and teaching and (b) how she sees Studio Zone fitting into the class.

1. Can you tell me a bit about your background? What got you interested in design?
2. What kinds of design experiences have you had?
3. Do you have a philosophy about what skills good designers need?
4. What kinds of experiences do you think helped you develop your design skills?
5. Can you tell me about your experience teaching design?
6. What do you hope students get out of your class?
7. What approaches to teaching design have worked best for you? Worst?
8. How has teaching design changed for you?
9. How do you see Studio Zone fitting into the class?
10. How do you think the first assignment went (storyboarding)? What would you have done differently?
11. What do you look for in storyboard posts?

Appendix B. Self-Perception Questionnaire

Part 1.

Have you taken ED626?

- yes
 no

What is your gender?

- male
 female

Have you taken other courses in software design?

- yes
 no

Part 2. For each of the questions, indicate by circling a number how you feel about your knowledge, experience, and confidence.

Example:

	Knowledge	Experience	Confidence
Change a flat tire	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

This would mean that I have a great deal of knowledge about changing a flat tire, I have an average amount of experience with changing a flat tire, but I am not confident in my ability to change a flat tire.

	Knowledge	Experience	Confidence
Writing a teaching plan for a class	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Applying a particular learning theory to a subject area	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Working with teachers in developing technology for teaching	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Designing an educational technology application (any platform)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Planning a multimedia project with a team	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Creating a "rapid prototype" of a software design (paper or electronic)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Designing user interfaces	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Using multimedia applications (ex., Director, Photoshop)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Using multimedia hardware like scanners, video cameras	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Choosing an appropriate platform for a	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

technology design			
Presenting the rationale for a design to a group	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Writing a rationale for a design	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Designing a usability test	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Gathering data from a usability test	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Making critical comments (oral and/or written) about the user interface of an educational technology application	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Making critical comments (oral and/or written) about the learning goals of an educational technology application	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Making critical comments (oral and/or written) about the overall effectiveness of an educational technology application	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Making critical comments (oral and/or written) about the interaction design of an educational technology application	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

Appendix C. Instructor's Guiding Questions

There are two perspectives from which to critique a designer and a user.

DESIGNER

You should approach the critique from a designer's perspective. This requires that you acknowledge the challenges that the designers faced in creating the software. When you consider a specific design issue, you should pose the following questions:

- What objective was the designer trying to achieve?
- What are the learning or performance objectives?
- What were the constraints that the designer was operating under?
- What design decisions did the designer make?
- What are some other options?
- What are the tradeoffs in choosing from among those options?
- What do you think was the best choice that could have been made?

USER

- Who would want to do this?
- Does the software seem realistic?
- Is the focus of the activity the right one?
- Does the whole experience make sense?
- Will the user feel he accomplished something?
- Will the user learn anything?
- Was it a memorable experience?

Appendix D. Representative Comments and Analysis

Sample Comment 1.

Phrase	Coded as
"I suggest changing both the button for this section to 'Vacation Sites.'	<ul style="list-style-type: none"> • Makes suggestion • Interface Design Content • High modality
I know I'm a geek but	<ul style="list-style-type: none"> • Gives rationale • (not coded for content) • Low modality
I thought of websites when I saw the button for 'Sites.'	<ul style="list-style-type: none"> • Raises confusion • Interface Design Content • Medium modality
You never know what kids today might think.	<ul style="list-style-type: none"> • Gives rationale • Pedagogical Content • Medium modality
Calling the button "Vacation Sites" also lends consistency to the section title.	<ul style="list-style-type: none"> • Gives rationale • Interface Design Content • Medium modality
I know you probably were struggling with room in the button to write 'Vacation Sites',	<ul style="list-style-type: none"> • Gives rationale • Interface Design Content • Low modality
but maybe you can play around with button and font sizes."	<ul style="list-style-type: none"> • Makes suggestion • Interface Design Content • Low modality

Sample Comment 2.

Phrase	Coded as
"I like the notebook metaphor and the 'guide' dog.	<ul style="list-style-type: none"> • Praises/Affirms • Pedagogical Content • Medium modality
Both related to the family and vacation.	<ul style="list-style-type: none"> • Gives rationale • Pedagogical Content • Medium modality
The buttons are easy to read and locate.	<ul style="list-style-type: none"> • Praises/Affirms • Interface Design Content • Medium modality
Is the language on the button in the students natural language?"	<ul style="list-style-type: none"> • Poses question • Interface Design Content • Medium modality