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A record of the design process

A systematic investigation of the role, value, and effectiveness of the "process book" for interior design students

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Abstract

The aim of this study is to analyze the structure, role, and effectiveness of a design student's "process book" as a method of capturing and facilitating design thinking. The "process book" includes all of the work completed during a design project such as written notes, drawings, and research. This study poses the following research questions: 1) What role and value does the process book have to design students and instructors? 2) How can the process book structure help to reduce a student's cognitive load, yet allow for the spontaneous actions involved in graphic thinking?

This mixed-method research study includes an analysis and exploration of interior design student and instructor perspectives of the process book artifact and tool. The data collection and analysis involves two main components. The first includes an investigation of student and faculty perspectives of the structure, role, and effectiveness of the process book obtained from semi-structured interviews. The second part is an online student survey questionnaire of sophomore, junior, senior, and graduate student perspectives. One interior design program in a large Midwestern university was selected. All students within the undergraduate and graduate program were invited to participate in the survey questionnaire and all faculty were interviewed. Interviews were audio-taped and later transcribed for coding and interpretation.

This study serves as a case study and pilot study to provide a foundation for a larger-scale future research initiative. Results from this study will inform two future initiatives: 1) design of a larger-scale research design involving a multi-university sampling frame, and 2) development of a "digital process book" research study.

Keywords

Design Process, Design Education, Drawing Research

The aim of this study is to analyze the structure, role, and effectiveness of an interior design student's "process book" as a method of capturing and facilitating design thinking, as well as reducing a student's cognitive load as they work through the design process. The "process book" includes all of the work completed during a design project such as written notes, sketches, drawings, and research. This study poses the following research questions: 1) What role and value does the process book have to design students and instructors? 2) How can the process book structure help to reduce a student's

cognitive load, yet allow for the spontaneous actions involved in graphic thinking?

A process book includes representations of all of the activities that occur and the artifacts that are constructed as a student completes a design project. It allows the instructor, jurors, and others to see the process a student goes through to complete a project. Schenk (2007) similarly describes this process work in the graphic design context as "job bags," where this material, for the most part, provides the "drawn record" of the design process. It is also intended to assist students as a tool in the learning and design process.

Theoretical Framework

Central to this research is the concept of cognitive load and cognitive load theory. Cognitive load is a construct that represents the cognitive resources that performing a particular task imposes on one's limited cognitive system (Pass, Renkl, & Sweller, 2004). Students are not able to bring all of their creative abilities to bear on a design project when they must allocate a substantial proportion of their cognitive resources to organizing all of the information involved in a design project, as well as generating and processing new ideas.

One cannot discuss cognitive load without an understanding of working memory (WM), which is the cognitive structure in which conscious processing occurs (Pass, Renkl, & Sweller, 2004). With novel information, WM has two severe limitations. First, it can only hold about seven elements of information. It can process (combine, contrast, or manipulate) no more than about 2-4 elements. The capacity and duration of WM when dealing with new information is severely constrained. Without rehearsal, almost all contents of WM are lost within about 20 seconds. Instructional designs that ignore WM limitations are likely to be random in their effectiveness. Many instructional design recommendations do ignore WM limitations. For this reason it is important to place human WM limitations into a theoretical framework.

The goal of instruction is to give learners specific guidance about how to cognitively manipulate information in ways that are consistent with the learning goal, and store the result in long term memory (LTM). Understanding occurs when all relevant elements of information can be processed simultaneously in WM. Because of limitations of WM, when dealing with novel information, if faced with new material that must be learned, there may be too many elements to simultaneously process in WM. If the elements are essential, understanding cannot occur until it becomes possible to process them. While studying the material, elements are organized and combined into schemas held in LTM. When schema construction and automation have progressed to the point where all of the elements essential to understanding the topic can be processed in WM, understanding has occurred (Marshall, 1995). A large amount of schematically organized information held in LTM can and is used repeatedly, but failing direct guidance through instruction, changes to LTM cannot be organized.

Methodology

This mixed-method research study includes an analysis and exploration of interior design student and instructor perspectives of the process book in terms of its value, role, and effectiveness as a tool to assist the design student in a given design project. One interior design program in a large Midwestern university was the focus of this study. The data collection and analysis involves two main components. The first part includes an investigation of student and faculty perspectives of the structure, role, and effectiveness of the process book obtained from semi-structured interviews. All faculty within the program were interviewed. Interviews were audio-taped and later transcribed for coding and analysis. The second data collection component involves an online survey questionnaire in which all students within the undergraduate and graduate program were invited to participate.

Student and Faculty Interviews

Semi-structured interviews were conducted with five faculty and six students¹ in the interior design program. The intent of the interviews was to obtain perspectives of the role, value, and effectiveness of the process book for students in the design studio. Interviews were approximately one hour in duration. Participants were asked a set of eight questions, as listed below.

1. In your opinion, what is the purpose of the process book in the studio?
2. How well do your process books reflect your actual design process? If there is a misalignment, could you explain?
3. Could you talk about the current strengths and weaknesses of the process book as a tool for learning, designing, and communication aims?
4. What improvements do you see is needed in the process book? Could you describe them?
5. What is the value of the process book to you, as a student?
6. Could you describe the structure/contents of the process book (please be as specific as you can)?
7. What role(s) should the process book have in the studio?
8. How might you develop a digital process book?

Online Student Survey

The second phase of the data collection procedure was an online survey questionnaire directed to all undergraduate and graduate students within the interior design program at the Midwestern university. Like the interviews, the online survey targeted students' perspectives on the role, value, and effectiveness of the process book for students in the design studio. Survey questions were developed based on results of the faculty and student interviews, as well as the content analysis of the process books.

¹ Two students from the sophomore, junior, and senior levels were selected for interviews.

Results

Interviews

Purpose and Role of Process Books. According to the faculty interviews, there are several purposes of the process book in the design studio. They can be summarized as the following: 1) to provide a means for internal communication, 2) to regulate and hold students accountable throughout the design project, 3) to provide clear evidence of the process of the project, 4) to celebrate the process as an important way of defining design, not just design as an end product, 5) to authenticate the designer's claim to a particular approach to solving a problem, 6) to let instructors see how the student thinks, how they develop, and refine their ideas, and 7) to provide a medium for students to store their ideas for later use. As one faculty noted, the process book gives the instructor an idea if the student is really putting down the ideas into the work and to see the direction the student is taking. Another faculty said that students need to keep thinking and creating ideas, but then put them down on paper. However, that is the hardest part. If the student can do that, the purpose of the process book is achieved.

Value of the Process Book. According to the faculty, the value of the process book is that it provides a real time serial documentation of a student's design activities and helps them see where they have been and where they are going in a project. It also provides a talking point for faculty and discussions on what steps have been fruitful for the student. For instructors the process book assists in the communication between student and faculty. Another value of the process book from the faculty perspective is that it holds good ideas in reserve until their "goodness" emerges, because quite often the role and fit of an idea does not become evident until it is paired up with other ideas a student develops. One faculty discusses the value by stating, the process book highlights the differences between superficial guesses and good ideas. The good ideas need a basket to hold them for later use. To have a successful landing a student needs to be able to go back and forth, not just forge through in a linear path. The faculty continues by noting that the process book is more telling than the final product many times. She states,

If I were going to hire a student, I think it is more useful to look at the process book contents than the finished product in isolation. Just the final product doesn't tell me anything about who they are or how they thought and how they work.

Another faculty member reflected that he hoped that the process book would be valuable to a student in terms of their next project, where once a project is completed the student could evaluate their process book or design activities weeks, months, years, or even careers down the road. It could serve as an archival record or journal of a student's design process and thinking.

Even though the process book is seen as a positive addition to the design project, some challenges were also highlighted through the interviews. One instructor admitted that it seemed as though in some instances the process book is viewed as just a requirement that the students complete just to have something to turn in for a grade. One student said,

The people that who put a lot of time and effort into those (process books) are just trying to please someone and it has nothing to do with design. I look at them and think yeah, your stuff looks really pretty but, I'm just not that way. If I have to go back and look at my process work...I built it, I designed it. I know what I put into it. I don't need to go back and look at it. You know, I may flip through it when I put it together. But it's meaningless after I do it.

Another student acknowledged,

Sometimes you make the process book after the fact. I've seen people, like I'm making my process book but we're already done, so you know how can you make your process book when you already have a specific product? So sometimes I think that's kind of weird. The process is how you do it, so how can you be making it then.

Effectiveness of the Process Book. Effectiveness issues from the interviews revealed an increasing competition between manual and computer generated process work and the difficulties with documenting the process since students grow more accustomed to doing their work all on the computer. A faculty member states,

Even the obvious advantage of looking back and returning to a previous generation of the design solution is not often available. There are only "accidental printouts." The problem with any paper/pencil process is that it is not necessarily interactive or does not have rich interactive relations.

Another faculty discusses the gradual reliance of computers and process work as a student progressive through their academic program, noting "at the senior level, once students get into computers, there is no process or documentation. Saving photos/files is one way, but it's hard to get everyone to do that."

An issue that emerged from the interviews was the lack of connections between different ideas and pages of the process book. Many students start out with a lot of good ideas, but then they somehow lose them.

There should be some kind of linkages in time with the ideas. This is why process work should not be redone. Time plays an important role; ideas are developed in a certain time sequence. This is why it is important for a person to be able to see that. If they cannot see the ideas on paper and cannot see how it is developed, they are trapped.

A similar issue to this was the lack of annotation of drawings and sketching. One faculty member stated,

They need to stop at some point in the process and be required to analyze what they had done and add some commentary. I think there should be a summary after each phase of the process. Summary of developed research, of 3D analysis; a pause and reflect component.

The results of the faculty and student interviews offered insight into the perspectives of the process book as design tool for the student designer in their design thinking. It also, however, left many assumptions and questions

that needed to be further explored and analyzed. This was the intent of the student online survey.

Student Survey Questionnaire

A 15-question survey was administered online where all undergraduate and graduate students within the interior design program were invited to participate. An email request was sent and two follow-up reminders were given during the course of the two-week data collection period. 48 students completed the survey of the approximately 120 students in the program. 40% of the students were sophomores, 27% were juniors, 25% were seniors, and 8% of the respondents were graduate students.

Purpose and Role of Process Books. Questions 7 and 8 addressed the purpose of the process book. Respondents were given a list of ten choices that they could select from, and students could check more than one choice as there could be more than one purpose. The listed purposes were the following:

- A. To provide a medium to store ideas for later use in the design process.
- B. To provide a medium for communicating with the studio instructor and myself.
- C. To provide a record of all my design activities in a project.
- D. To authenticate my claim to a particular approach to solving a design problem.
- E. To assist me in developing ideas.
- F. To assist me in refining ideas.
- G. To assist me in analyzing design alternatives.
- H. To assist me in collecting and analyzing research.

As figure 1 depicts, the highest ranked purpose of the process book was item C, "to provide a record of all my design activities in a project." The second highest selection was E, "to assist me in developing ideas." The third most selected choice was B, "to provide a medium for communicating with the studio instructor and myself."

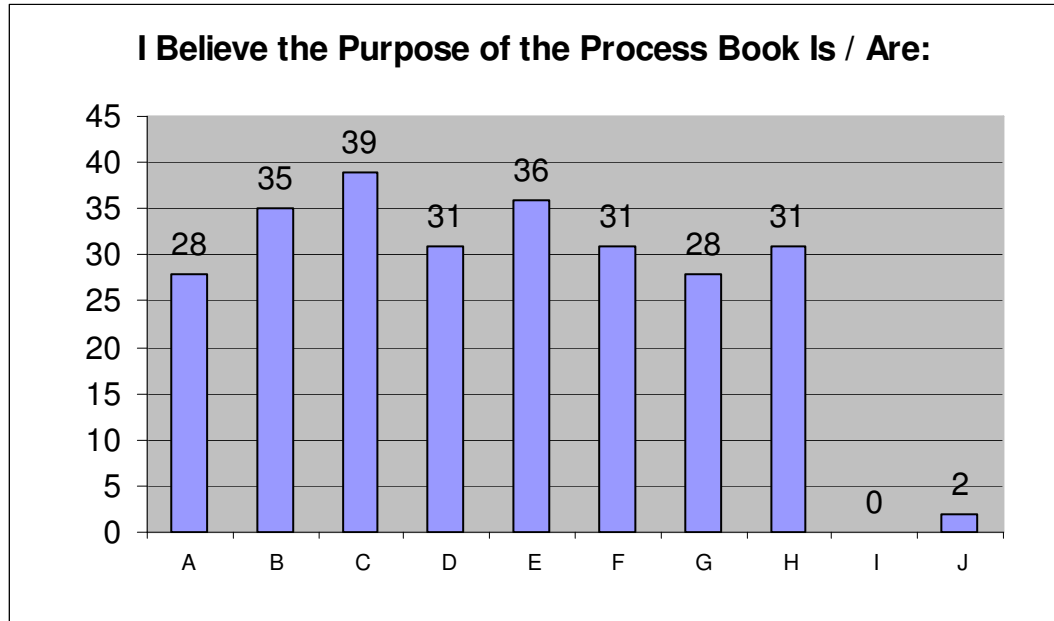


Figure 1 Purposes of the Process Book

Question 8 asked respondents to select the one choice they believed to be the most important purpose of the process book. Selection E, "to assist me in developing ideas," received the highest ranking with 21% of the total number of respondents. Two selections tied for second, which were C "to provide a record of all my design activities in a project," and F "to assist me in refining ideas."

Value of the Process Book. Question 9 of the survey asked respondents to indicate their opinion that the process book is a valuable requirement or tool in a design project. 37.8% of respondents marked "agree" that it was valuable, while 22.2% marked "strongly agree," and 28.9% marked "neutral." Only 11.1% of the respondents disagreed or strongly disagreed that the process book was a valuable requirement in a design project.

Based on faculty interviews that suggested that students looking at other students' process book could be a valuable learning experience to better understand the design process, question 10 asked this directly to the students if it would indeed be valuable to them. 37.8% of the respondents agreed that it would be valuable, while 15.6% marked "strongly agree," and 26.7% were neutral in their opinion. 20% of the students marked "disagree" or "strongly disagree."

Effectiveness of the Process Book. Question 2 asked respondents how much the process book captures their design thinking in their design process. 41.7% of the students believed it captured "some" of their design thinking, while 33.3% said it captured "most" and 14.6% thought it captured "all" of their design thinking. Only 10.4% believed that it captured "very little," and 0% said that it captured "none" of their design thinking.

Question 3 asked students to respond to the following statement: "the process book is an effective way of documenting my design process." 41.7% agreed,

while 25% strongly agreed, and "27.1% marked "neutral." Only 6.3% disagreed, and 0% strongly disagreed with the statement.

Question 4 asked students to respond to the following statement: "the process book helps me manage a large amount of information in my design project." 43.8% agreed with the statement, 20.8% strongly agreed, and 27.1% were neutral. Only 8.3% disagreed with this statement, and 0% strongly disagreed.

From interviews with the faculty, the importance of going back and reflecting on previous pages and ideas in the process book was deemed significant for student learning. Thus, question 5 directly asked students whether or not they did this, and asked them to respond to the following statement: "I go back and look/reflect on previous pages in my process book throughout my design process." 41.7% agreed with this statement, 18.8% strongly agreed, and 18.8% were marked neutral. 20.9% either disagreed or strongly disagreed with the statement. A similar question asked students whether or not they went back and looked/reflected on their process book(s) after a project was completed. Here 29.2% agreed with the statement, 8.3% strongly agreed, and 29.2% marked neutral as their answer. 29.2% disagreed with the statement, while only 4.2% strongly disagreed.

The last four questions on the survey were open-ended questions that asked respondents about the process book's weaknesses, strengths, suggestions for improving the process book, and other comments that the students would like to offer. Several answers related to effectiveness issues. Weaknesses stated by the students seemed to focus on the difficulties of archiving work done on the computer versus the manual design ideations, as well as the lack of connection between a student's actual design process and the contents of the process book. One respondent noted, "a lot of work is done on the computer- all the little changes and versions are not easily presented in the process book. Use of trace is mostly for preliminary work." Other comments suggested that the process book was too structured than they would like, and that it takes too much time to do. Another student wrote, "I never really look at it. It's a hassle to put together because most of the time I'm just sketching in my sketchbook not in my process book." One student cautioned that the process book becomes a project and not a reflection of the project.

While students acknowledged weaknesses of the process book, there were many comments reflecting the positive attributes of this artifact in the design studio. One student stated, "I really like the process book, it shows that I did indeed start from the beginning of the project and refined all my ideas to a final product." Another comment about the process book was that it was

A good communication tool and helps me recall the path which I took to reach my design solution. Keeping and maintaining process is key to understanding the reasoning behind your solution. It is like the "equation" of your program for the project.

Another student wrote,

The process book is great for getting your thoughts out on paper and refining them. If done well, they are a great resource both in finding how the designer thinks as well as seeing how far the project (and designer) have come.

Discussion

Purpose of the Process Book

The data from the interviews and the online survey revealed that the current use of the process book in the interior design studio has distinct purposes for both learning and teaching. In terms of learning, one purpose is to record all of the design activities that occur during a design project. This purpose is similar to Schenk's (2007) "job bag" description of the collection of work in a graphic design project. The process book acts as a tabulate or a passive entity in which a student can store and record ideas. The second purpose as it relates to learning is to assist a student in developing ideas. This purpose is characterized as more dynamic and interactive than the first.

Surprisingly, the process book does not seem to assist the design student in making connections between the various design alternatives and ideas throughout the project. It also does not aid in the synthesis, problem decomposition, and evaluation activities that should occur in a project. The faculty believed that this, in fact, should be a major contribution of the process book. Thus, a future question and research initiative should address this discrepancy and disconnect between what is practiced and what is intended of the process book. This seems to exemplify a cognitive load problem for the design student, and the process book could be refined to provide the structure necessary to manage the large amount of information that a student creates during the life of a project.

In terms of teaching, the two main purposes of the process book are accountability and communication. Faculty believed that the process book assists both the students and the faculty in authenticating the students' claims to a particular approach to solving a problem, as well as to hold them accountable throughout the design project. It helps instructors see how students think, develop, and refine their ideas. The process book also serves as a communication tool between the instructor and student, both during and after a project is completed.

Both the teaching and learning purposes of the process book seem to complement each other and add a positive experience to the design studio environment. The purposes speak to the value of this entity in design education which is discussed next.

Value of the Process Book

Based on results of the online student survey, students believed that the process book was indeed a valuable requirement and tool in the design studio. Only approximately 11% of the respondents believed that it was not valuable. Consequently, over 60% of the students believed that the process book was an important element in the studio. From the faculty perspective, they stated that the value is its ability to provide a real time serial documentation of a student's design activities and to help them see where they have been and where they are going in a project. Another important value of the book is that it holds good ideas in reserve until its "goodness" emerges. It takes time for these ideas to be fully realized and developed, so the process book is one way to manage and organize the large amount of

information. The latter purpose has great potential in improving studio practices and the design process. While this value seems to be agreed upon among the faculty, it has not translated into the perspectives of the students. This function of the process book could be better explained to students. This may also serve as an opportunity for modifying the structure of the existing process book that would better assist students in managing the cognitive load placed upon their working memory limitations.

Effectiveness of the Process Book

Effectiveness issues pertaining to the process book centered on the ongoing dilemma between manual and computer generated drawings. As students become more adept at computer software programs in their later studio courses, they tend not to record the many variations of the design throughout the project. This is one weakness of the current practice of the process book in the studio. Another issue, similar to the discussions earlier, was the lack of connections made between different ideas and pages of the book. Many of the good ideas generated early in the project are somehow lost or forgotten. The process book should be redesigned to better capture and assist the student in a more interactive and dynamic way (rather than just the passive tabulate mode).

How the Process Book Structure Can Help to Reduce a Student's Cognitive Load

The interviews and survey revealed a strong sense of importance of the process book artifact in the design studio, where the process book provides a medium for students to store their ideas for later use. However, this "blank tabulate" artifact does little for helping students make sense of all of the ideas, data, and alternatives that make up their cognitive load—without instructor guidance. This is a crucial point. One faculty member noted that an important value of the process book is that it holds good ideas in reserve until its "goodness" emerges. It takes time for these good ideas to be fully realized and developed, so the process book is one way to manage and organize the large amount of information. However, the *existing* paper-based process book is focused on a linear design model, and by itself does little to emphasize connections between different ideas and pages of the book. Early ideas of the process are sometimes lost or forgotten by the student.

So then, how can the existing paper-based process book, assist the student in managing the cognitive load created by complex design processes?

According to Cognitive load theory (CLT), there are three categories of load: 1) extraneous, 2) intrinsic, and 3) germane cognitive load. The first shall be discussed in relation to the process book. Extraneous cognitive load is caused by inappropriate instructional designs that ignore working memory (WM) limits and fail to focus WM resources on schema construction and automation. The following are instructional principles that are based on cognitive load theory. Each principle takes a commonly used instructional procedure, analyzes it from the perspective of relevant aspects of human cognition, and then redesigns the instruction to reduce WM load and increase schema construction and automation. These principles can then be interwoven into the process book for added structure and value.

The *worked example effect* of CLT is demonstrated when learners studying worked examples that provide a solution to a problem learn more than learners who are required to solve the equivalent problem. Searching for a problem during problem solving places heavy demands on WM and those demands interfere with schema construction. A worked example, by reducing or eliminating search, reduces extraneous cognitive load and therefore, facilitates learning. Thus, in a process book, a worked example could be included into the book, either by the studio instructor or by a student's outside search for an appropriate example. This example or page of the process book should be "tagged" in some way so the student can refer back to these pages in an organized manner so as to not be forgotten. This is an important aspect of the existing process book. Otherwise, these examples, like various other pieces of information in the design process, becomes lost in the vast amount of information, drawings, and research.

The *split-attention effect* of CLT occurs when attention must be split between multiple sources of visual information that are essential for understanding. A geometric diagram and its associated statements provide an example. The multiple sources must be mentally integrated before the instruction can be understood and the material learned. Mental integration imposes a heavy extraneous cognitive load that is reduced by physically integrating the multiple sources of information. In the process books, some faculty note when they review students' books that many times there are diagrams, conceptual sketches, and other graphics are confusing or difficult to understand. It is often the case that even when students do refer back to previous diagrams and drawings that they may have forgotten their own analysis of a drawing in question. Faculty stress the importance of annotations along with graphics on pages that help to assist the students in remembering and understanding. If the process book work was structured with a template for each page that included a designated space for annotations, graphics, and other means of evaluating design alternatives along the way, students may be more apt to make connections among the various parts of a design alternative, and more apt to actually use previous "good" ideas that are sometimes lost among the pages of information created and collected.

Importance of Topic

By better understanding the traces or artifacts of students' design activities (as captured in their "process books"), design educators will know more about their students. Newsteller and McCracken (2001) believe that design students have well-developed prior conceptions and theories about the nature of design that conflict with understandings held by expert designers. Prior knowledge is an essential variable in design learning. Developing students' reflective and metacognition in design is also crucial. Dewey (1933) argues that the development of reflective thought is the most important goal of education. Reflective thought enables the individual to take control of and responsibility for their own thinking in order to participate effectively as a member of a democratic society. This study directly focuses on what people, design students in particular, experience and the systems and actions that create those experiences.

Relevance to Design Education

The studio is the center of interior design education (Guerin & Thompson, 2004), so it is crucial to inform both faculty and students on practices and theories that help to improve learning and instruction. The design process has been studied in many disciplines (Cross, Christiaans & Dorst, 1996; Pedgley, O. 2007) with numerous studies on the benefits and concerns of manual sketching versus computer-generated images. This study does not argue for one versus the other; rather, it focuses on the design process more holistically and asks the questions of how we, as design educators, can assist students in their documentation of the design process, as well as the roles and opportunities that these artifacts might have on learning and designing. Results from this study will inform two future initiatives: 1) design of a larger-scale research design involving a multi-university sampling frame, and 2) development of a "digital process book" research study.

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