

THE RELATIONSHIP OF SCAFFOLDING ON COGNITIVE LOAD IN AN ONLINE  
SELF-REGULATED LEARNING ENVIRONMENT

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## ABSTRACT

Scaffolding learners in self-regulated learning environments is a topic of increasing importance as implementation of online learning grows. Since cognitive overload in hypermedia environments can be a problem for some learners, instructional design strategies can be used to decrease extraneous load or encourage germane load in order to help learners effectively use their cognitive resources. A scaffolding strategy to support learning in potentially confusing environments is to provide high level information in advance of the learning tasks in the form of an instructional organizer.

In 2007–2008, 244 participants completed an online self-directed brief health education course on sexual health randomly receiving one of three pictorial graphic organizer scaffolds, concept, procedural, or metacognitive, in advance of the start of the course. Participants rated the course's cognitive burden and their intentional efforts as very low. The low burdens suggest that the online course was easy to use and navigate and the tasks were minimally challenging. Consistent with prior research, these results confirm that organizers are useful to reduce extraneous cognitive load only when multimedia environments are confusing or disorganized, concepts and material are unfamiliar, and learning materials are challenging. Analysis of learning and reflection outcomes indicate that even in a low-burden course, use of a metacognitive organizer might be beneficial in supporting short and longer term reflection. No significant differences were seen with a learning outcome.

Keywords: Self directed learning; Instructional organizers; Cognitive load; Online health education intervention; HIV prevention; Internet; Men who have sex with men

## TABLE OF CONTENTS

Acknowledgements	i
Abstract	ii
List of Tables	vi
List of Figures	vii
Chapter 1 Introduction	1
Background on the health education course	1
Instructional design of Sexpulse	2
Hypermedia, cognitive load, and scaffolding	4
Research questions statement	7
Chapter 2 Literature Review	9
Scaffolding in instruction	9
Scaffolding purpose types used in instruction	12
Procedural scaffolds	12
Conceptual Scaffolds	14
Metacognitive scaffolds	17
Multiple scaffold types	19
Advance, graphic, and pictorial graphic organizers in instruction	20
Organizers in computer-based instruction	24
Cognitive load theory	31
Intrinsic, extraneous, and germane cognitive load	33
Cognitive load in scaffolding and advance organizer studies	34
Chapter 3 Methods	37
Participants	37

Materials	38
Pictorial graphic organizer scaffold design	38
Consent and screening software	40
Health education course/behavioral intervention (Sexpulse)	41
Entry (baseline) and exit (immediate posttest) online survey instruments	43
Three-month follow-up survey	46
Experimental design	46
Dependent measures	47
Data analysis	48
Reliability of survey items	49
Tests of significance	50
Instructional efficiency graph	52
Qualitative data analysis from open-ended question	53
Procedures	54
Chapter 4 Results	56
Demographic characteristics of participants	58
Reliability tests of cognitive load and learning outcome measures	62
Correlations of overall usefulness of a pictorial graphic organizer scaffold and cognitive load, learning, reflection, and discourse and the difference in usefulness ratings of the scaffolds	63
Test of significance for pictorial graphic organizer and cognitive load	65
Binary logistic regression of pictorial graphic organizer and learning	66
Binary logistic regressions of pictorial graphic organizer and reflection and discourse	67
Use of pictorial graphic organizer, learning and sexual risk at 3 months	69

Instructional efficiency of the pictorial graphic organizer conditions	70
Qualitative analysis of open ended questions	72
Chapter 5 Discussion	78
Findings and discussion	79
Limitations	86
Implications and recommendations for future research	89
References	94
Appendix A Pictorial graphic organizer scaffolds	103
Appendix B Entry survey questions	107
Appendix C Exit survey and 3-month follow-up survey questions	109

## LIST OF TABLES

Table 1. Table of Measures	48
Table 2. Table of Tests	51
Table 3. Demographic Characteristics of Participants Who Completed Post-Intervention Survey and Who Used Guide (N=244) <sup>a</sup>	60
Table 4. Demographic Characteristics of Participants Who Completed Sexpulse Exit Survey by Guide Usage (N=275) <sup>a</sup>	61
Table 5. Intercorrelations Between the Three Cognitive Load Items (N=244) <sup>a</sup>	62
Table 6. Correlations of guide usefulness and cognitive load, learning, reflection, and discourse (N=244)	64
Table 7. Summary and Distribution of Responses to Question Rating Pictorial Graphic Organizer Usefulness (N=244)	65
Table 8. Nonparametric Analysis of Variance for Cognitive Load by Pictorial Graphic Organizer Type (N=244)	66
Table 9. Binary Logistic Regression Assessing Reflection, Discourse (N=244), 3-Month Reflection, and 3-Month Discourse (N=235) by Pictorial Graphic Organizer	69
Table 10. Summary of Coded Responses to All Open-Ended Questions Based on Cognitive Load and Performance (N=244)	74



## LIST OF FIGURES

Figure 1. Experimental Design Matrix	47
Figure 2. Graph for displaying mental and instructional efficiency (Paas, Tuovinen et al, 2003)	53
Figure 3. Participant recruitment	55
Figure 4. Instructional efficiency plot of pictorial graphic organizers	72
Figure A-1. Concept organizer	104
Figure A-2. Procedure organizer	105
Figure A-3. Metacognitive organizer	106

## CHAPTER 1

### INTRODUCTION

The focus of this study is to examine the relationships between three different types of learner scaffolds and cognitive load, learning, and reflection in a web-based self-regulated, brief health education course on sexual health. Health education courses are designed to foster the motivation, skills and confidence (self-efficacy) necessary to take action to improve health (Cottrell, Girvan, & McKenzie, 2008). The health education course used for this study was a new, brief version based on a 2-day on-ground workshop. This chapter consists of sections that review the background of the brief health education course and the broader study, which contains this substudy; the instructional design of the course; the relationships between hypermedia, cognitive load, and scaffolding; and a statement of the research questions.

#### Background on the health education course

The online health education intervention, “Sexpulse,” was designed around the Sexual Health Model to influence a reduction in men’s sexual risk-taking behavior (Robinson, Bockting, Rosser, Miner, & Coleman, 2002). In the Model, educating men in a comprehensive manner about all aspects of their physical, mental, emotional, and sexual health builds their self-efficacy, their belief they can attain the goal of making good health choices, and their self-regulation of behavior in actually making good health choices. The Model is holistic and puts forth the idea that the Model’s components are synergistic and thus must be learned together as a whole; a piecemeal approach is not likely to engender the desired learning. In addition, reflection on current behaviors, past experiences, and future goals is a key part of the Model’s learning procedures. However,

the Model still considers learning to be an individual cognitive process, thus learning may or may not result in changed behaviors.

After using the Sexual Health Model to develop a successful face to face workshop, (Rosser et al., 2002), the National Institutes of Mental Health awarded a grant to study risk behaviors in men who have sex with men (MSM) and to develop and test a web-based brief health education course based on the Sexual Health Model to educate MSM about HIV risks. The grant is named the Men's Internet Study-II (MINTS-II), and Sexpulse is the name of the health education course designed for the grant. As part of the MINTS-II grant, Sexpulse was tested in a randomized control trial with 276 men finishing the treatment condition and 311 men finishing the null control condition. The primary outcome measure of the main trial was the number of unprotected anal intercourse male partners in the last 3 months. Surveys at 3, 6, 9, and 12 months asked men to self-report the primary outcome measure, which was then compared to the measure reported at the baseline survey taken at the start of the study. Measures of changes in knowledge or skills were not included in the main study. The study reported by this dissertation was a substudy completed with only the Sexpulse (treatment condition) participants in the randomized control trial. Measures for the substudy were included in the immediate posttest exit survey and at 3 months follow-up.

#### Instructional design of Sexpulse

Sexpulse contained thirteen modules of activities exploring concepts in the Sexual Health Model, divided into a basic and an advanced session. Sexpulse was designed to be completed in less than 3 hours and could be completed in multiple sessions. The suggestion was to complete within 1 week though some participants took 3 weeks. The

instructional design of the health education course follows a self-regulated learning instructivist approach. Rieber (1992) defined instructivism as a hybrid between a purely learner-centered constructivist approach and a direct content-centered approach. The intervention allows for multiple paths and exploration and contains substantial interactivity. However, the path variants through the content are pre-defined, the content is the focal point of the brief course, and the environment does not adapt to the learner throughout the course. The intervention was designed and programmed by an external e-learning company. A short video overview of Sexpulse developed by the author is available at <http://www.sph.umn.edu/epi/research/hips/sexpulse-video.asp>. In addition to following an instructivist approach, Sexpulse also follows the model of a self-regulated learning environment. Zimmerman (1990) describes self regulated learning environments as those that require the learner to plan, conduct, monitor and evaluate his own learning process, without the aid of a human instructor and without interactions with other course participants. However, leaving the learner to understand the content and concepts on his own may not be sufficient to engender learning. Kollar and Fischer (2006) state that learners in self-regulated environments need another source of regulation, that is, scaffolding, in order to be successful. Additionally, Jonassen (1989) asserts that with the increase in use of computer-based instruction and hypermedia environments, the greater cognitive demands of navigating these multiple path, multiple option environments may increase the chance of learner cognitive overload. Learners can become disoriented in these environments and might therefore need to spend greater cognitive resources in understanding and navigating the hypermedia, diminishing the resources that can be applied to learning.

## Hypermedia, cognitive load, and scaffolding

A framework for discussing the possibility of increased learner cognitive demands imposed by hypermedia environments is provided by Cognitive Load Theory (CLT). CLT examines the consequences of instructional designs and techniques on cognitive resources used for learning (Sweller, van Merriënboer, & Paas, 1998). Cognitive load is a construct representing the burden that performing a particular task imposes on a learner's cognitive system. Cognitive load has three components, intrinsic, extraneous, and germane, which are additive. The intrinsic load is associated with the nature and interactivity of the materials being learned. Extraneous cognitive load is the demand placed on working memory due to the manner in which material is presented or delivered. The germane load is the result of intentional effort a learner expends to actively create or automate schema. The total load amount for which a person has capacity is fixed in an individual (Sweller et al., 1998).

Since cognitive overload in hypermedia environments can be a problem for some learners (Mayer, Heiser, & Lonn, 2001), instructional design strategies can be used to decrease extraneous load or encourage germane load in order to help learners effectively use their cognitive resources. Scaffolding, any kind of aid or support for learning that helps a learner attain a new level of understanding (Lajoie, 2005), can be used to mediate individual cognitive load constraints and help support schema creation to reach a higher level or performance. Scaffolds used for instruction fall into four types: (a) procedural, (b) conceptual, (c) metacognitive, and (d) strategic (Azevedo & Hadwin, 2005; Hannafin, Land, & Oliver, 1999). For this research project, scaffolds are defined as tools for

supporting the learner in assuming control of learning and task completion in the Sexpulse learning environment.

A strategy to capture and focus a learner's attention in what can be a confusing or overwhelming hypermedia environment is to use scaffolds that are external representations of the procedures, concepts, or metacognitive strategies used to support learning. In addition, not only can an external scaffold capture a learner's attention, an external scaffold with instructional elements presented in a more graphical form may be perceived as an essential aspect of the task environment (Suthers & Hundhausen, 2003). An additional strategy to support learning in potentially confusing environments is to provide high level information in advance of the learning tasks. Since the high level information can be studied beforehand, a cognitive schema may be constructed in long-term memory that can subsequently be activated in working memory during task performance in the learning environment (van Merriënboer, Kirschner, & Kester, 2003). This strategy has potential to reduce extraneous or support germane cognitive load. Scaffolds that contain information to be used in advance of learning and designed in graphical form are called pictorial graphic organizers and stem from concepts and research on scaffolds called advance organizers, developed by psychologist David Ausubel (Ausubel, 1963; Hawk, McLeod, & Jonassen, 1985).

In order to support how MINTS-II study participants learned with Sexpulse, a self-regulated hypermedia environment in which there was only participant-computer interaction and no peer or instructor interactions, I developed pictorial graphic organizers designed along the procedural, conceptual, and metacognitive scaffold instructional purpose categories. I surmised that scaffolds designed for a specific purpose (that is,

procedures/navigation, concepts, metacognition) might have differing influences on the components of cognitive load and on a learning outcome. I further hypothesized that the procedure scaffold might have the most impact on extraneous cognitive load. In addition, because Sexpulse is a complex, self-regulated learning environment, I surmised that scaffolding metacognition might be the most instructionally efficient method, might result in higher perceived learning, and might prompt additional reflection. Specifically, participants who enrolled in the MINTS-II Sexpulse study were randomly assigned one of the three pictorial graphic organizer scaffolds. The participants were required to open and download the one-page scaffold before they could proceed into the Sexpulse environment. After completing Sexpulse, the participants received an exit survey that contained measures for both the MINTS-II Sexpulse study and this study. For this substudy, participants answered questions about cognitive load, self-perceived learning, engagement in reflection or discourse, and open-ended questions about their experience in the environment. The questions about reflection and discourse were repeated in the MINTS-II 3 months follow-up survey.

In designing and testing pictorial graphic organizers for Sexpulse, I was constrained by the necessity to prevent having a negative impact or to not introduce confounders into the goals of the main study. The goal of the main study was to reduce unsafe sexual behaviors in Internet-using men who have sex with men. As a substudy, I could not impact any programming, content, navigation, or visual elements within the main study. Therefore, I chose an aid that was confined to a one-page, downloaded handout which excluded designing a graphical organizer based on strategic scaffolds; a one-page fixed handout cannot adapt to choices a learner makes in the learning

environment. Also, a control group that offered no organizer could not be used since the lack of an organizer could impact an outcome of the main study. Additionally, because lengthy surveys might cause participants to drop out, I was constrained to add as few questions as possible to the MINTS-II survey instruments. Thus, traditional knowledge acquisition or recall measures had to be abandoned in favor of a couple of self-reported learning questions.

Even with these constraints, the research study follows theory in scaffolding, graphic pictorial organizer design, and cognitive load. Azevedo and Jacobson (2008) criticize the overall quality of research on learning with hypermedia and hypertext. Their first major issue was their claim that the majority of the research is atheoretical and based on intuition regarding the design of hypermedia system features. Many of the published studies failed to adopt a theoretical framework to guide the research questions, to determine the types of data collection methods and corresponding analyses, and to draw appropriate inferences from which to inform scientifically based design guidelines. This study adds to the field by employing designs theoretically grounded in pictorial graphic organizer design, utilizing theoretical concepts in scaffolding, and using accepted data collection instruments to measure cognitive load. This is the first study to examine the relationship of pictorial graphic organizers designed around three categories of instructional scaffolding purposes on learner cognitive load in a self-regulated hypermedia environment.

#### Research questions statement

The purpose of this study was to examine the relationship of pictorial graphic organizer scaffolds designed for three different purposes—procedural,



conceptual/cognitive, and metacognitive instruction, on self-perceived cognitive load, learning, and reflection in a self-regulated online brief health education course.

Specifically, this research addressed the following questions:

1. To what extent did using the assigned scaffold affect learner perceived cognitive load (i.e. intentional mental effort (germane), stress (extraneous), and task demands (intrinsic))?
2. To what extent did using the assigned scaffold affect self-reported learning outcomes?
3. To what extent did using the assigned scaffold affect reflection or discourse about course content or ideas immediately after the course and at a 3-month follow-up?
4. To what extent did using the assigned scaffold affect sexual risk behavior at 3 months follow-up?
5. To what extent did learning outcomes affect sexual risk behavior at 3 months follow-up?
6. To what extent did using the assigned scaffold affect instructional efficiency of learners within the course?

## CHAPTER 2

### LITERATURE REVIEW

The purpose of this study was to examine the relationship between pictorial graphic advance organizers designed around three scaffold purpose types and learner cognitive load, learning, and reflection in a self-regulated online brief health education course for an at-risk population. This chapter consists of three sections that review the theoretical and practical literature that corresponds to the three main conceptual frameworks of this research. The chapter begins with a review of the evolution of scaffolding in instruction, including examples of practical research in the three scaffold purpose types used for this study. The second section reviews the evolution of advance organizers in instruction, an exploration of types of advance organizers, and examples of research on organizers used in computer based environments. The third section reviews the foundations of cognitive load theory and its explicit use in research with scaffolds and advance organizers.

#### Scaffolding in instruction

The concepts behind scaffolding can be traced back to 1930, with Russian psychologist Lev Vygotsky and his ideas on Zone of Proximal Development (ZPD) (Vygotsky, 1978). ZPD is defined as the range of activities a person can do with assistance but cannot do without the assistance. Another way to think of ZPD is to consider the gap between an individual's ability level as measured by independent problem solving and the individual's higher ability level as determined through problem solving under the guidance of more expert persons. Building on Vygotsky's ideas for application in education, Jerome Brunner first used the term scaffolding in the 1950s to

describe adult support of children's language acquisition (Wood, Bruner, & Ross, 1976). The support given by adults to children to help them attain a higher verbal ability was described as scaffolding. Some of the earliest ideas around how scaffolds should be constructed included using dynamic assessment, graded support during learning, and fading of the scaffold once the learner demonstrated mastery (Pea, 2004).

From these beginnings, the ideas behind scaffolding have been extended to include paper or computer tools and resources used to support student learning (Puntambekar & Hubscher, 2005). In a broad sense, a scaffold is any kind of aid or support for learning that helps a learner attain a new level of understanding (Lajoie, 2005). Although some criticism has been leveled against broadening the definition to include any kind of instructional support (Pea, 2004; Puntambekar & Hubscher), even these same critics agree that the definition has evolved and continues to evolve. Pea and Puntambekar and Hubscher also outline common foundational ideas and techniques that hold even as the definition evolves. First, scaffolds can be human experts, peers, or tools such as models, paper guides, or software. To be effective, the learner must share the same understanding of the goal of instruction as the scaffold designer or the person acting as the expert scaffolding the learner. Also, scaffolds should organize procedures and concepts to make them more explicit and transparent to the learner. Additionally, a scaffold should constrain the learner to focus on the most effective methods and concepts to achieve the resultant improvement in performance.

Building on this loose framework, Azevedo and Hadwin (2005) describe how scaffolds can serve four instructional purposes: (a) learning domain knowledge, (b) learning about how to learn, (c) learning about using the instructional tools and

environment, and (d) learning how to adapt and modify instructional features or contexts. Among these four goals, declarative, procedural, conceptual, or metacognitive knowledge can be supported. Hannafin et al. (1999) describe four similar categories of purpose for scaffolds in learning environments. Procedural scaffolds orient a learner to the available tools, navigation, and features of a learning environment. These types of scaffolds assist the learner in visiting the different resources and areas of the environment, in activating special features, and in understanding the cues for progress. Conceptual scaffolds support thinking about the information, ideas and theories presented in the learning environment. Metacognitive scaffolds assist guidance in how to think about learning within the environment. These scaffolds can assist a learner in framing goals, in linking new ideas or models to current understanding, or in monitoring progress towards completion of a task. Strategic scaffolds provide alternative tactics to explore or adapt to changes the learner makes in the instructional environment. For example, a strategic scaffold might suggest a different range of information or a different approach to inquiry based on a learner's prior choices in the learning environment. Because learners in computer based learning environments generally have difficulty regulating their learning and understanding topic concepts, it is important to design appropriate scaffolds for these environments (Azevedo & Hadwin, 2005). Not only must the scaffolds be appropriately designed, the scaffolds also need to be perceived as closely related to and useful to task performance. Learners rarely used scaffolds perceived as peripheral to task performance (Quintana, Zhang, & Krajcik, 2005). Thus, scaffolds—whether procedural, conceptual, metacognitive, or strategic—need to be both immediately available and apparently relevant to task completion (Sharma & Hannafin, 2004). Scaffold use is likely to increase

when scaffolding tools are explicitly identified and their functions clarified (Saye & Brush, 2002).

#### Scaffolding purpose types used in instruction

The following section examines relevant research on the three scaffold types, procedural, conceptual, and metacognitive, used in this study. The focus of this section is on scaffold types used in online learning environments.

##### *Procedural scaffolds*

Much of the research on procedural scaffolds in hypermedia environments concerns the navigation challenges posed by these environments. For example, Puntambekar and Stylianou (2005) studied the effect of providing metanavigation scaffold prompts in a science instructional module after their earlier research showed that navigable concept maps and text hyperlink navigation were not sufficient for mastering domain knowledge. The instructional environment, called CoMPASS (Concept Mapped Project-based Activity Scaffolding System), was a hypertext system that used two external representations, concept maps and text, to facilitate multiple iterations of navigation through and study of content. The concept maps were navigable as partial view representations of the whole system and the complete set of concepts, and were centered on the current location (concept) in the system. The text concepts were hyperlinked. In this later study, two groups of sixth-grade students were randomized to either receive the metanavigation prompts or no support. Students in both the treatment and control group worked in small groups of three to four. The students were given a task that they would research in the system during a session on each of 2 days. The navigation

logs of the treatment group were analyzed to provide a written navigation aid tailored to each, small group along with one of three less optimal navigation style clusters. Students received the metanavigation scaffold on the second day of using CoMPASS, and on the third day were tested on the learned subject by creating a concept map. Students who received the tailored metanavigation scaffold performed better on the concept map test than the control group. The authors believed the additional scaffold tailored to overcome deficient navigation by prompting the users to navigate back and forth among related concepts also clarified the nature of the relationships among the conceptual units, thus allowing students to gain a better understanding of the domain knowledge. These studies did not use an explicit theoretical basis for the design of the navigation scaffold, which may have contributed to the lack of significant results in the earlier research study they reference. Also, the navigation scaffold was not used as much as the researchers expected. As discussed earlier, if learners do not perceive the usefulness of a scaffold, they will not use it (Quintana et al., 2005; Sharma & Hannafin, 2004). The tailoring used in this later study followed general expert level personal scaffolding ideas which might have contributed to helping students overcome their navigation difficulties. Also, the personal attention of the researchers focused the learners on the importance of the scaffold. By emphasizing its importance, students used it more. Much of the additional research on navigation scaffolds in online environments follows an advance organizer approach and is covered later in this review.

### *Conceptual Scaffolds*

Conceptual scaffolds have been a prominent theme in learning since the 1980s and are usually represented by some kind of concept map (Novak & Gowin, 1984). In a review of research on knowledge map scaffolding, a concept map scaffold that follows a standard set of symbols, linkages, and notations, O'Donnell, Dansereau, and Hall (2002) describe a couple of key trends in the research. The first is that students recall more central ideas when they learn from a knowledge map than when they learn from text. The second key trend is that students with low verbal abilities or low prior knowledge often benefit the most from knowledge map formats in measures of recall, but not necessarily in knowledge acquisition. The authors believe this effect from knowledge and concept maps might be attributed to the maps guiding learners in understanding macrostructural knowledge and reducing cognitive load by reducing the amount of needed text processing in working memory. Much of the research on concepts maps has focused on whether concept maps that are generated by the learner either alone or in a group, with or without an instructor, result in better learning outcomes versus completed concepts maps designed by an expert.

For example, Lee and Nelson (2005) studied the effects of prior knowledge of concepts and concept map types on problem solving. Participants were randomly assigned to a group that was given a completed, final form concept map or to a group that was to generate their own concept map through activities in the course. Within each concept, group participants were evenly assigned to high or low prior knowledge subgroups based on pretest scores. At the end of the 7-week course, participants took tests containing well structured and ill structured problems to solve. Though the authors

used the concept maps in a similar fashion to advance organizers, they did not explicitly design the maps or the mapping activities as advance organizers. Results of the study indicate the participatory concept map group performed better on well structured problems, but that there was no significant difference with ill structured problems. The authors also found that having high prior knowledge resulted in better well structured problem scores but did not result in better ill structured problem solving scores. The authors believe that by actively participating in the concept map creation, participants were better able to build schemas for problem solving. This effect, though, did not carry through to the participants' ability to transfer their learning to ill structured problems. However, the group sizes were very small ( $n=11$ ), thus it is difficult to interpret statistical significance with any of the findings.

Lim, Lee, and Grabrowski (2009) built on this line research by studying the effect of three concept map strategies and high or low self-regulated learning skills on knowledge acquisition in a self-directed online instruction module. Participants were randomly assigned to a group given an expert created final form concept map, a group that received a partially completed concept map, or a group where each participant was instructed to generate his own concept map. All groups were given instruction on how to use or create concept maps. Although the authors used the concepts maps in a similar fashion to advance organizers, they did not explicitly design the maps or the mapping activities as advance organizers. Each concept map group was divided into a high and low self-regulated learning skill subgroup based on the results of a test. Each subgroup had approximately 20 participants. Overall results showed that participants in the group that created their own concept map scored higher on the knowledge acquisition test than



participants who received the expert created final form concept map. There was no significant difference between the scores of participants who completed the partial concept maps and the other two groups. However, the authors also found that participants with higher self-regulated learning skills performed better across all the concept map conditions than participants with lower self-regulated learning skills. Because the authors did not adjust the significance level in their pairwise comparisons of interaction effects, their additional results are difficult to interpret for significance. However, one comparison was likely significant, even with an adjustment or in an adjusted post hoc analysis. The authors found that the group with high self-regulated learning skills that generated their own concept map scored significantly higher than the group with low self-regulated learning skills that received the expert created final form concept map. By analyzing the tables and graphs of their results, the comparison of these two subgroups likely accounted for most of the significant difference in scores among high and low self-regulated learning skills groups and among the self-created concept map group and the expert-created concept map group.

In another earlier example of this style of concept map comparison study, using the same self-regulated instruction module as used in the Lim et al. (2009) experiment, Taricani (2007) studied participants randomly assigned to one of five groups: a control group that received an expert generated concept map with no additional feedback, a group that received a partial concept map that received tailored feedback on their concept map, a group that received a partial concept map that did not receive feedback, a group that needed to generate their own concept map that received feedback, and a group that needed to generate their own concept map that did not receive feedback. Taricani found

that there were no significant differences between the five groups when comparing concept mapping and feedback on the total posttest score. This study, in contrast to the Puntambekar and Stylianou (2005) study, found no evidence that tailoring feedback improved the effectiveness of the scaffolds. In addition, though both the Lee and Nelson (2005) and Lim et al.'s studies have shown that participants' prior knowledge or ability to self-regulate their learning impacts learning outcomes, their results—along with Taricani's—do not convincingly demonstrate that individuals who create their own concept maps perform better than individuals who receive an expert created concept map. Thus, based on the results of these studies, using expert created scaffolds remains, without tailoring or feedback, a viable strategy in scaffolding.

#### *Metacognitive scaffolds*

Metacognitive scaffolding has received increased attention in the last several years as researchers view strong metacognitive skills as important factors for successful learning generally, and specifically in self-regulated online learning environments (Azevedo & Hadwin, 2005). In a recent study, Bannert, Hildebrand, and Mengelkamp (2009) studied the results of using a metacognitive scaffold on students' metacognitive and strategic learning activities and learning outcomes. Prior to the actual learning activities, the experimental group spent 30 minutes with a computer instruction module reviewing why metacognitive and strategic activities were useful and how to apply them during learning. The experimental group also received a one-page graphical organizer with metacognitive strategies. The control group received 30 minutes of instruction and a planner on organizing a workspace. Both groups then had 60 minutes to review and learn

from a printed chapter on the learning topic. The pre-instruction about metacognitive strategies and the organizer resulted in the experimental group performing significantly better than the control group on two of the four metacognitive and strategic measures and on one of the three learning outcomes measures. The scaffolding had no effect on recall or knowledge acquisition, but did have an effect on transfer tasks. The authors believed that the metacognitive scaffolding prompted deeper thinking, allowing the experimental group participants to see different perspectives and connections. However, the scaffolding did not have an impact on declarative knowledge. Because the computer instruction and one-page organizer were used as a unit and not measured separately, it is not possible to determine how much each individually contributed to the experimental group's results.

In a science classroom study of metacognitive scaffolding of reflection and reflective behavior, Davis (2003) found that students receiving more generic scaffolding prompts developed more coherent understandings than students receiving specific directed prompts. The prompts were given using a computer-based science curriculum support program (Knowledge Integration Environment) that was used along with face-to-face instruction in the science classroom. The author surmised that the directed prompts promoted greater confusion in interpreting the outcome expectation than the more general prompts.

In another study of metacognitive scaffolding, Wolf, Brush, and Saye (2003) considered the effects of a metacognitive scaffold on student achievement in a writing assignment. Eighteen students in one intact middle school class received instruction in the Eisenberg and Berkowitz Information Problem Solving model and training on how to

use the metacognitive prompts and supports in the multimedia database used for the writing assignment. The model included guidelines and steps for planning a research paper, how to allocate time, and how to monitor progress. Seventeen students in a separate intact class did not receive instruction in the model or on how to use the prompts and supports in the multimedia database. The class that received the metacognitive scaffolding performed significantly better on their scored papers compared to the nonscaffolded group. These three studies provide evidence that metacognition can be successfully scaffolded, though successful scaffolding with only a one-page overview without instructor guidance has not yet been proven to date.

#### *Multiple scaffold types*

Only one other study identified to date compared the effectiveness of using three instructional purpose category scaffolds—procedural, conceptual, and metacognitive—on learning, but not on cognitive load. Zydney (2005) researched the effect of these scaffolding types on students learning how to understand an ill defined problem and the ability to formulate hypotheses and questions around said problem. The control group received a procedural scaffold, a second group received the procedural and concept scaffolds, the third group received the procedural plus the metacognitive scaffolds, and the fourth group received all three scaffolds to be used within the multimedia learning environment. The scaffolds were embedded within the multimedia environment as opposed to being external to the environment. Overall, the cognitive/concept organization plus procedure scaffold performed best and helped students to significantly better understand the problem, formulate hypotheses, and ask highly specific questions.

Students who used the metacognitive scaffold along with the procedural scaffold tended to better integrate the multiple perspectives of the problem since they were prompted to reflect upon the perspectives. Although the fourth group, which received all the scaffolds, performed better than the control group, they did not perform as well the concept scaffold group on problem understanding or hypothesis formulation, nor as well as the metacognitive scaffold group in integrating multiple perspectives. Although the Zydney is uncertain to the reason that using all three scaffolds produced poorer results than groups that only used two, she speculated that the fourth group may have had less time to complete tasks because reviewing the additional scaffold detracted from task time. It is also possible that the use of all three scaffolds combined with set maximum task time introduced too much of a cognitive burden on the students who needed to integrate the different purposes of the different scaffolds. Thus, in order to minimize possible multiple instructional organizer confounders and ambiguity in the research design, the study in this dissertation took the approach of studying the use of an individual scaffold type.

#### Advance, graphic, and pictorial graphic organizers in instruction

The following section reviews advance organizers as a specific technique in scaffolding, overviews the types of advance organizers, and explores examples of research on organizers used in computer-based environments. Ausubel (1963) proposed a specific strategy to scaffold learning, an instructional organizer, to bridge the gap between a learner's current cognitive structure and new concepts. The organizer was used to facilitate the retention of meaningful verbal and text information and was presented in advance of learning. Ausubel's advance organizers are defined as introductory material at a higher level of abstraction, generality, and inclusiveness than the learning passage

itself. Advance organizers are not overviews or simple summary presentations of the principal ideas in a passage that are not written at a higher level of abstraction, generality, or inclusiveness. Rather, the main feature of the overview is to omit specific details about the principal ideas (Ausubel, 1963). Advance organizers abstract more inclusive ideas and attempt to relate the abstracted or generalized concepts to familiar existing ideas in an individual's cognitive structure by deliberately introducing them in advance of learning material to bridge the gap between what the learner already knows and what he needs to know in order to learn new subject matter effectively (Ausubel, 1978). Advance organizers are designed to favor meaningful learning, and hence measurements that require only verbatim retention or memorization of material should not be used exclusively. Measuring the application of concepts to novel problems, especially when conducted 6 weeks or more after instruction, is suggested to determine if meaningful learning results from an appropriately designed advance organizer (Ausubel, 1978).

Advance organizers were initially conceived by Ausubel as verbal prose or text outlines to be used in learning with printed materials. However, Barron (1969) extended Ausubel's ideas by proposing an organizer, specifically, a graphic organizer that used lines, arrows, and space, and arrangement to overview the structure and relationships in the text. These graphic organizers, also called structured overviews, organized the concepts into hierarchical tree structures. Barron's organizers also differed from Ausubel's in that they could be written at the same level as the material to be learned rather than requiring a more abstract level. Furthering the development of graphic organizers, Hawk et al. (1985) included pictorial and symbol elements into their graphic organizers. These types of organizers are called pictorial graphic organizers. Other

researchers have extended the advance and graphic organizer concepts to include learning from hypertext, learning in computer environments, and learning in nontext modalities (Brinkerhoff, Klein, & Brush, 2005; Coffey & Canas, 2002; Kang, 1996; Kenny, 1995). Advance organizers are also designated as fixed—or final form—or as participatory organizers. Fixed form organizers are already completely filled in by the instructor or expert, whereas participatory organizers are filled in by learners as they accomplish learning tasks either in a group, with or without the instructor, or on their own. Participatory organizers and generative concept mapping share the same foundational idea: that continual cognitively stimulating interaction with a scaffold results in better learning. Although research is conducted with participatory advance organizers, especially pictorial graphic organizers, according to Ausubel, advance organizers should be fixed form, and they cannot be generative activities. Using Ausubel's definition, the advance organizer does not engage the learner in overt, active learning, but rather is an orienting activity.

Research using the various styles of organizers to improve learning has occasionally engendered controversy. Early reviews of advance organizer research highlighted mixed effectiveness of the organizer. Barnes and Clawson (1975) rated 32 studies based on whether the results were statistically significant or not. Nonsignificant results outnumbered the significant results almost 2 to 1, leading the authors to conclude that advance organizers do not impact meaningful learning. However, Ausubel (1978) criticized Barnes and Clawson's methodology and study inclusion criteria, and concluded that many of the studies included in the meta-analysis did not properly construct an advance organizer. Mayer (1979a) also criticized Barnes and Clawson's methodology,

and in his review of studies, concluded that advance organizers had a small, but consistently significant impact on learning. Mayer also concluded that organizers work better with far transfers in learning rather than immediate retention and recall. Luiten, Ames, and Ackerman (1980) found in their meta-analysis of 135 studies that organizers had a facilitative effect on learning and retention. Also, in a later meta-analysis, Stone (1983) concluded that among the 29 studies included in his research results, advance organizers were shown to be associated with increased learning and retention of the material to be learned. Following Stone and examining graphic organizers instead of the text advance organizers in a meta-analysis, Moore and Readance (1984) concluded that the graphic organizer did have an effect on learning, but post-organizers benefitted learners more than advance organizers in measures of retention and recall. In addition, they concluded that organizers that required the learner to fill in an incomplete organizer had a stronger impact than organizers that were presented as complete or in final form.

Although there have been no reviews of the effectiveness of pictorial graphic organizers, some of the earliest studies of pictorial graphic organizers were conducted by Hawk, McLeod and Jeane. Two studies (Hawk & Jeane, 1983; Hawk, McLeod, & Jeane, 1981; cited in Hawk et al., 1985) reported statistically significant results on knowledge acquisition from the use of participatory pictorial graphic organizers. Following those studies, in three more experiments with participatory organizers using three different subject domains, Jonassen and Hawk (1984) used diagrams as organizers for text passages. The diagrams used common graphics, such as boxes, lines, and arrows, along with labels and strategic spatial layouts. In each experiment, the immediate post test knowledge score of participants using the organizer was significantly better than the



scores of participants in the control group. Their findings suggest that a pictorial graphic diagram used as an organizer can present key ideas at a more abstract level, allowing students to construct a schema of the following content in which details can be incorporated with less difficulty. Although these studies and Moore and Readance's (1984) conclusions point to the success of the participatory organizer, these assertions along with assertions of the effectiveness of post organizers, are not consistent with findings from other studies using organizers in computer based environments. Inconsistent results from the use of various forms of instructional organizers continue in the literature today.

#### Organizers in computer-based instruction

With the rising popularity of computer-based instruction, researchers took notice of continuing issues of learner cognitive overload and learner disorientation in the computer-based environments (Eveland & Dunwoody, 2001; Lee & Nelson, 2005; Mayer et al., 2001; Niederhauser, Reynolds, Salmen, & Skolmoski, 2000; Tripp & Roby, 1990). Content that is unfamiliar or organized in an unfamiliar fashion will be learned poorly unless the individual is provided with or develops concepts or organizing principles that aid the acquisition process. In fact, in early research with hypertext, Tripp and Roby (1990) discuss the importance of orienting the learner to the environment and the concepts within the environment. Organizational or structural aids can help outline the structure of hypertext and be extended to organize broader hypermedia environments. These hypermedia environments can be made more accessible to learners by presenting preview material that either relates to familiar content or helps build mental scaffolding on which to add new information. This way a learner has more cognitive power available

to learn new material. Traditionally, the instructional organizer has been used as a device for orienting students to content (Ausubel, 1978).

In an early study using organizers in a computer-based learning environment, Kenny (1995) examined the use of participatory and final form organizers, along with a traditional advance organizer, with nursing students using a computer-based interactive video instruction module. He found that his final form pictorial graphic organizer was the most effective in producing the highest recall and knowledge acquisition scores. In contrast with the studies by Hawk, McLeod and Jeane (1981) and Jonnasen and Hawk (1985), the participatory pictorial graphic organizer was the least effective as measured by the post test recall and knowledge acquisition items. Kenny believed that the final form produced stronger results because the instructional environment was highly disorienting. The final form organizer provided stronger navigational clues than the participatory form and thus participants were not as distracted from concentrating on the content. In other words, the interactive video environment had a high extraneous cognitive load due to poor structure and navigability, and the final form organizer provided the aid needed to reduce those cognitive demands, freeing up resources to learn the content. Kenny did not use a “no organizer” control, so he could not conclude that use of an organizer produced better results than not using an organizer.

The lack of effectiveness of organizer use in computer-based instruction continues some of the arguments made in the earlier days of instructional organizer research. For example, in a study in the same year as Kenny’s study, Smith and Dwyer (1995) compared knowledge acquisition between a college aged control group not using an organizer, a group receiving a final form concept map graphic organizer, and a group

receiving a participatory concept map organizer that participants needed to complete. In the posttest measuring of knowledge acquisition, the scores among the three groups did not differ. The authors believe the lack of results may be attributed to participants' lack of familiarity with concept maps and not scaffolding the use of a concept map as an orienting aid.

In another computer based instructional environment study using a 'no organizer' control group, Brinkerhoff, Klein and Koroghlanian (2001) examined the effect of a structured overview graphic organizer, a headings unstructured overview which would not be considered an advance organizer, and no organizer or overview on learning from a hypertext computer-based instruction module. The authors also researched the impact of amount of computer experience on learning from the hypertext module. Results showed that there was no significant difference in posttest scores between the organizer, the unstructured overview, and control groups. The authors believed that the structure of the hypertext instructional module was so simple and well organized that the participants did not benefit from an overview or advance organizer. However, the authors did find that participants with higher computer experience learned more from the hypertext program than those with less computer experience. This result is likely due to highly experienced computer user participants feeling less disorientation and having less extraneous cognitive load in using the system as compared to participants with low computer experience. The lessened extraneous cognitive load therefore likely freed up mental resources for learning the content.

In research using additional multimedia components beyond structured hypertext, Lin and Dwyer (2004) examined the instructional effectiveness of computer animated

instruction in a web-based module complemented by two types of instructional strategies, advance organizers and adjunct questions with feedback, on learner achievement. The control group received the web-based module without animations or added instructional strategies. The advance organizer consisted of guiding, higher level text that appeared before each module segment that contained a new animated concept. There were no significant differences in learning outcomes between the four groups. The authors speculate that the lack of results may have been due to learners' high prior knowledge and the relatively straightforward structure and content of the web-based instructional module. If cognitive demands are not high, advance organizers and animated scaffolds, techniques to reduce load, would not have much effect.

A more puzzling lack of significant results in organizer research in computer-based environments is exemplified in a recent study by Calandra and Barron (2005). Calandra and Barron studied advance organizers for a multimedia information resource and instruction website in a repeated design across two college campuses, and did not find any differences among the control and treatment group. At each campus site, research participants were divided into a control group with no organizer, an advance organizer group, and a pictorial graphic organizer group. Across both campuses, there were no differences in the posttest attitude or knowledge scores across the control and treatment groups. Because the authors followed Ausubel and Mayer's guidelines in developing organizers, because the participants had low prior knowledge of the content, and because they did not find any demographic differences among the randomized groups, they could not offer an explanation for their failure in producing a favorable impact with the organizers. One possible explanation that the authors did not consider is

the possible lack of fidelity of their measurement instruments. If the pre test and post test did not accurately measure prior knowledge and application of new knowledge, they would not be able to show any differences. One other possible explanation could be a lack of motivation on the part of the participants to learn to the best of their abilities.

Although some of the studies completed since the meta-analytic reviews and reviewed here showed no significant effects of various types of advance organizers, other studies with a 'no organizer' control group did show positive results using organizers in computer-based environments. For example, Kang (1996) studied the effect of a conceptual outline advance organizer in a simple multimedia computer simulation environment to foster metacognitive skills used by primary and middle school students. The groups were stratified by grade level, and those using the advance organizer scored significantly better on a metacognitive skills and knowledge posttest when compared to the control groups, who did not receive the organizer. The author believed that the organizer oriented the students on how and where to focus in the environment, thus reducing their disorientation and cognitive burden.

In a later, more complex set of studies, McDonald and Stevenson (1999) performed two studies that examined the effects of aids on navigation and learning in hypertext. The first experiment examined the effects of nonnavigable node navigation spatial maps, textual contents lists, and a no-aid control on participants' ability to navigate the system and on their knowledge acquisition scores. The spatial map and content list did not have direct links into the hypertext module, but were displayed in a separate window. The authors found that the control group performed significantly worse on navigation and learning than the two experimental groups. Results also demonstrated

that the node spatial map was better than a contents list at facilitating navigation, but the two experimental conditions did not differ in their knowledge acquisition. Their second experiment compared a nonnavigable structured spatial map, a pictorial graphic concept map, and no organizer control on both navigation and learning. The study demonstrated that navigation was best with the node spatial map, but knowledge acquisition was significantly better with the concept map. Again, in this study, the control group had the greatest difficulty navigating the system. They attribute the better navigation to improved mental models of the hypertext structure with the node spatial map and the significant learning results to the enhanced schema developed by participants using the concept map organizer. McDonald and Stevenson's node spatial map organizer can be considered a limited version of Hannafin, Land and Oliver's procedural scaffold, and McDonald and Stevenson's concept map organizer corresponds to their conceptual scaffold. From a cognitive load perspective, the procedural scaffold was successful in reducing extraneous cognitive load by offloading navigation processing to the scaffold. The conceptual scaffold was successful by either reducing the extraneous cognitive load surrounding the relationships within the instructional material or by fostering use of germane cognitive load.

In another broad, complex study examining the use of various forms of instructional organizers, Ertl, Kopp and Mandl (2008) researched the difference in performance with the use of a script outlining steps in collaboration, that is, a process advance organizer, compared with the use of a participatory graphical content scheme organizing the concepts to be learned, that is, a pictorial graphic organizer. The organizers were external to the system and not embedded, and the study was conducted in

an online distance learning environment. Ertl et al. found that the groups who used the graphic organizer scheme performed better in the results both as a group and also as individuals when they were given an additional analysis test after the group project. The authors believe that the graphical content schemes provided a scaffold to bridge prior understanding with the desired outcome state. Ertl et al. also note that because the scaffolds were external to the system, they focused the learners' attention on the most important concepts and relationships. The strategy was successful within a group setting and the new learning structure remained with each individual in the secondary test. In contrast, the group that used the process advance organizer script only produced better results in the secondary individual tests. The researchers believe that within the organizer script group, individuals interfered with each other in executing the process. The text outline could be interpreted slightly differently by each group member, thus resulting in conflict. However, when working alone, an individual could make full use of the text outline advance organizer using their own interpretations. The difference in text meaning interpretation possibly increased extraneous cognitive load to a level that resulted in the individuals being overwhelmed, unable to process the tasks that needed to be accomplished as a group.

Although the results of studies researching their effectiveness are mixed, there is enough evidence from studies using organizers in more complex online environments to warrant continued study. In addition, the amount or effects of cognitive load, though not directly measured, often seem to be used to help explain the obtained results in organizer studies. However, the direct mechanism for an advance organizer's effect is generally attributed to assimilation theory (Mayer, 1979b). Assimilation theory requires three main

factors for successful assimilation: (a) information must be received into working memory, (b) anchoring knowledge must be available in the long-term memory, and (c) anchoring knowledge must be transferred to long-term memory. If all three factors are present, assimilation theory predicts successful encoding should result in the transfer of new cognitive structure to long-term memory (Ausubel, Novak, & Hanesian, 1978; Mayer, 1979a). Assimilation theory is similar to schema theory (Anderson, 1978), as both are cognitive views of human learning through a mechanism of modifying a person's knowledge and beliefs around a set of concepts (schemas) (Ormrod, 2004). The ideas are refinements stemming from Piaget's ideas on assimilation, accommodation, and schema. The advance organizer acts as an orienting tool that provides the scaffold for a learner to bridge his level of understanding from a lower level to the target level through assimilating the new information into existing schema. Extending this viewpoint is the idea that extraneous cognitive load is reduced through orienting the learner to the structure of the instructional and concepts to be learned, thus freeing up cognitive resources for actual schema construction and automation activities (Kalyuga, 2007a; Paas, Renkl, & Sweller, 2003).

### Cognitive load theory

Cognitive load theory (CLT) is an established framework in learning technologies for examining the consequences of instructional designs and techniques on cognitive resources used for learning. CLT arises from an understanding of human cognitive architecture and principles in learning and instruction (Sweller, van Merriënboer, & Paas, 1998). Essential components of cognitive architecture are long-term memory (LTM) and working memory (WM). LTM is thought to consist of stored knowledge, that is,



information and processes, organized in a hierarchical schematic structure (schema). The large store of knowledge is considered to have an almost unlimited capacity and longevity. However, immediate, substantial changes to the structures in LTM are restricted. Instead, changes to LTM are mediated through WM. Learners use working memory as a processing space to integrate new information with existing knowledge. That is, learners draw on schema stored in long-term memory to make sense of incoming information and incorporate new information into existing schema through assimilation and accommodation (Kirschner, 2002).

In contrast to LTM, WM is limited in capacity and duration when coping with novel information. WM can hold approximately seven elements, and when required to process rather than hold information, it can handle two to three elements (Sweller et al., 1998; van Merriënboer & Ayres, 2005). The elements can be verbal, represented by spoken word or text; visual, such as pictures, objects, or diagrams; nonspoken word auditory elements; or schema retrieved from LTM. Thus, the more developed and robust a recalled form LTM schema is, the greater the amount of structured information and processes in WM that are available for holding or processing. However, WM is easily overloaded when required to process too much information, and cognitive load is the condition experienced by learners operating within these WM and LTM limits. The experienced cognitive load (CL) is conceived as being comprised of three components, (a) intrinsic, (b) extraneous, and (c) germane.

### *Intrinsic, extraneous, and germane cognitive load*

Intrinsic cognitive load (ICL) relates to the inherent characteristics and complexity of the topic to be learned. If the nature of the learning task requires many elements to be processed simultaneously in order to try to understand the material, a large intrinsic cognitive load is placed on the learner (Kirschner, 2002). Although it had been thought that ICL could not be reduced through instructional design or support, ICL is influenced by a learner's prior knowledge (Sweller et al., 1998). However, more recently, Gerjets, Scheiter, and Catrambon (2004, 2006) found that ICL could be influenced by instructional task design. In a series of studies, their results demonstrate that through the careful design of worked-out examples, intrinsic cognitive load can be reduced.

Extraneous cognitive load (ECL) is the second component of overall cognitive load. ECL results from the learner engaging in any activity, whether caused through instruction, the environment, or delivery medium, that is not directly involved in creating or automating schema related to the concepts or skills to be learned (Paas, Renkl, et al., 2003). The cognitive demands in navigating a hypermedia environment or in understanding instructions to complete a task are examples of ECL. The final part of cognitive load is germane cognitive load (GCL). GCL is the additional intentional cognitive processing in which learners engage for constructing and automating schema (Sweller et al.). For example, a person who is interested and engaged in the learning process and has motivation for learning the concepts is able to apply cognitive resources not used for navigation or rote completion of learning tasks to the actual process of schema development. Instructional design can be used to increase GCL through attempts to engage or support motivation in order to focus the learner on creating the appropriate

schema and to improve successful performance or learning outcomes. However, the combination of ICL, ECL, and GCL must remain within the limits of the learner's working memory.

#### Cognitive load in scaffolding and advance organizer studies

Cognitive Load Theory can be applied to instructional design by developing instruction that directs cognitive resources toward activities that are relevant to learning or schema construction (Sweller et al., 1998). Instructional materials such as scaffolds, including advance organizers, can be used to reduce extraneous cognitive load or encourage germane cognitive load in learning. For example, Doering and Veletsianos (2007) describe an online learning environment that contains multiple multimedia scaffolds in a problem-based geographic information system environment. Doering and Veletsianos were interested in the relationships between cognitive load over three time points in time, participant problem-solving ability, and utilization of the scaffolds. Cognitive load was measured using the construct developed by Paas, van Merriënboer, and Adam (1994) that measured overall cognitive load. The researchers' data showed that in the first time point, every minute spent in three of their scaffolds resulted in the mental effort exerted on the task to significantly increase by a half unit. No other relationships between scaffold use and cognitive load at other time points proved significant. The relationship between the scaffold use and increased cognitive load could be attributed to either intrinsic cognitive load in the scaffold use or activity or in germane cognitive load being used by participants to solve the problem. However, since no other results proved significant, the scaffold's importance in either reducing cognitive load or encouraging germane cognitive load at later time points is unknown.

In a study examining cognitive load in hypermedia, Waniek and Ewald (2008) examined structured hierarchical maps and a chapter's outline list in both navigable and nonnavigable forms. Cognitive efforts were measured by users' eye movement data using eye-tracking hardware and software rather than a self-reported cognitive load survey instrument. Additionally, data from users' navigation operations, knowledge acquisition, and subjective evaluation of the hypermedia system were collected. Results show that cognitive requirements were higher for using the map rather than using the content list. Cognitive requirements were also higher for those using a nonnavigable aid over those with the navigable aid. However, there was no difference in learning among the four organizer type groups, and higher cognitive load did not result in less learning nor did lower cognitive load result in greater learning. Their results indicate that although cognitive load levels varied by navigation scaffold organizer type, having greater cognitive resources available did not mean that the learner would use those additional resources to actually improve achievement.

In another study investigating navigation scaffold type in a hypertext environment, Morozov (2009) examined the effects of no on-screen navigational aid, a hierarchical text organizer (a graphic organizer), or a semantic concept map organizer on learning. Morozov measured hypertext system disorientation on an eight question scale as a proxy for cognitive load. In results similar to Waniek and Ewald's (2008), Morozov found that participants who used the semantic concept map experienced significantly greater disorientation (extraneous cognitive load) when compared to the other two groups. Also, the author did not find any difference in knowledge acquisition among the three experimental groups. As with Waniek and Ewald's study, higher or lower levels of

extraneous cognitive load did not result in any difference in applying cognitive resources to learning.

However, even with the mixed results in studies directly measuring scaffold use and cognitive load, several of the studies cited earlier in this review that had significant positive results have either explicitly conjectured about the role of cognitive load in their results or can have their results interpreted to include explanations that factor the impact of cognitive load (Brinkerhoff, Klein, & Koroghlanian, 2001; Kenny, 1995; McDonald & Stevenson, 1999). Because there have been very few studies examining the relationship of scaffolds, and more specifically organizers, on cognitive load, further study into the impact of scaffold and instructional organizer design on cognitive load continues to be warranted.

## CHAPTER 3

### METHODS

This study examined the relationships between scaffold purpose type and perceived cognitive load, learning and reflection. This chapter describes participant recruitment, the materials used, the design of the experiment, dependent measures, the data analysis plan, and the procedures used for the study. All study materials, assessments, and procedures were approved by the University of Minnesota Institutional Review Board (#0405S59661, #0711E21341).

#### Participants

This research study used participants recruited for the National Institute of Mental Health's grant (grant# 5R01-MH063688-05), Men's Internet Study II (MINTS II) Sexpulse randomized control trial. MINTS-II participants met eligibility by being male, users of a sex-seeking website targeted to MSM, 18 years or older and US residents with a recent history of engaging in risky sexual behavior with at least one other man. In addition, participants needed to assent to viewing sexually explicit materials, to spending up to 6 hours on the study, and to completing all activities and surveys within 7 days.

The participants were recruited with banner advertisements placed on two of the nation's largest gay websites. Recruits could click through the banner to connect to the study website to begin the consent process. Individuals were blocked from screening for eligibility more than once. A portion of the recruitment pool consisted of 1,324 men who had completed an earlier phase of the study in August 2005 and had expressed interest in participating in the randomized controlled trial. This portion of the pool received in December 2008 expiring one-use e-mail invitations to participate. An additional 4,566

potential participants were also recruited via web banner in December 2008. From this combined pool, participants were screened for eligibility. A sample of N=650 for the intervention was deemed sufficient in *a priori* statistical power calculation. From the larger MINTS II intervention participant pool, this study comprised the 276 participants who were randomly assigned to the intervention arm of the trial and who also completed the health education intervention/course. Participation was voluntary and participants each received \$80 for completing the intervention section of the study along with the exit survey. The study took place over a 3-week period from December 2008 through January 2009 with responses to the 3-month follow-up survey completed in April 2009.

### Materials

The materials used in the study consisted of three, one-page, pictorial graphic organizer scaffolds (i.e. procedural, cognitive/concept, and metacognitive), online screening and consent software, the online health education course/behavioral intervention Sexpulse, entry and exit online survey instruments, and a 3-month follow-up survey that repeated questions for reflection and discourse.

#### *Pictorial graphic organizer scaffold design*

Three one-page pictorial graphic organizer scaffolds were used in this study following the purpose categories outlined by Hannafin et al. (1999). In addition, each of the graphic organizers followed the general guidelines requiring advance organizers to contain higher level of abstraction, generality, and inclusiveness for the content (Ausubel, 1963, 1978). The layout of each scaffold followed general layout and design ideas for display of graphical and text information as discussed by Tufte (1990) and Hawk et al.

(1985). Icons and graphics were used in place of text when they linked directly to the content, when they represented important ideas, or when they were important features in the course. The graphics used in the course were used in the scaffolds whenever possible. Color delineated different groupings of concepts or activities. Arrows indicated directionality and size of arrows indicated strength or importance of linkages. Text headings in larger type were used to group concepts or procedures, while bullets and indenting demonstrated hierarchies. Each scaffold also had elements that were specific to the type of graphical organizer scaffold used.

The procedural scaffold followed a complex procedure flow diagram or flow map paradigm shown to have efficacy (Phillips & Quinn, 1993). This scaffold presented an overview of the steps needed to complete the course, the navigation features used to continue through an activity, and special features found in Sexpulse. Screen shots were used to orient the learner to the environment, and each activity module was represented by the graphic used in the course.

The concept scaffold was modeled on concept map designs found useful by Coffey and Canas (2002) and Willerman and Harg (1991). The overall concepts and models in the course were placed in concept bubbles and the module activities that related to each concept were linked. All activities and concepts were linked to the sexual health overview theory, and then linked to the “make a plan” behavioral objective. Each activity module was represented by the graphics used in the course. The concepts that represented the dimensions of sexual health used in Sexpulse were enclosed in a circle. Activity modules that supported the sexual health model but were not directly linked to one of the sexual health dimensions were placed in an area outside the dimensions of the



sexual health circle, and the area was enclosed in a supercircle that encompassed the entire concept map. Both Inspiration 8 and Cmap Tools, concept mapping software, were used to help conceptualize the design.

The metacognitive scaffold was informed by the ideas and diagrams used by Cuevas, Fiore, Bowers, and Salas (2004) and the flow chart used by Bannert et al. (2009). However, visual and graphical elements were included to highlight or represent a scaffolded concept. The metacognitive concepts used for regulating learning were derived from Osman and Hannafin (1992). This scaffold contained support for how to start the course, the goal of the course, the concepts behind the activities, how to allocate time, and learning strategies such as note taking and relating content to one's own experiences. The scaffolds are included in Appendix A. All scaffolds were designed using Microsoft Visio 2003 and converted to Adobe portable document format (PDF) Version 5.

#### *Consent and screening software*

After participants clicked on the e-mail invitation or web banner advertisement, they were taken to the study website where they were asked to go through the screening and consent process. The software validated eligibility to participate and provided informed consent screens to which the potential participant must assent. The consent and screening software was developed in Macromedia Flash, Version 8.

*Health education course/behavioral intervention (Sexpulse)*

The online brief health education course was designed by a multidisciplinary team of health professionals, computer scientists, and e-learning specialists and developed by a leading e-learning software development company. Sexpulse modeled 14 criteria the MINTS II investigative team identified for “state of the art” Internet-based HIV prevention interventions. They claimed that interventions should be: (a) engaging, (b) fun, (c) visually appealing, (d) realistic, (e) theoretically sound, (f) based on curricula demonstrated to be effective, (g) comprehensive, (h) targeting risk behavior, (i) population appropriate, (j) community relevant, (k) community sensitive, (l) challenging, (m) scientifically validated, and (n) clear in communication.

The content areas for the course/intervention were informed by an extensive needs assessment (Hooper et al., 2008). Key findings of the assessment were that to be acceptable to the target population, online HIV prevention must be comprehensive and not only target obvious risk behaviors, but be much more visual and more sexually explicit than prior conventional HIV prevention programs. Respondents to the survey were interested in multiple sexual health topics including sustaining relationships and dating. The needs assessment also identified a barrier to participation in HIV prevention programs. The survey participants reported less interest in traditional, obvious HIV prevention content such as proper condom use.

The health education course curriculum was grounded in the Sexual Health Model approach to HIV prevention (Robinson et al., 2002). The Sexual Health Model hypothesized that sexually healthy persons were more likely to make sexually healthy decisions, and that a comprehensive approach to sexual health was also necessary. The

starting point for the online course curriculum was a face to face sexual health seminar tested and found to be effective for men who have sex with men (MSM) (Rosser et al., 2002). The new curriculum was thus designed to achieve equivalent objectives using online educational games and activities.

The investigative team approached the development of the organization, structure, look, and feel of the online course from the perspectives of persuasive computing (Fogg, 2003) with a special focus on human-computer interaction elements (Preece et al., 1994). The course was structured as a set of modules with user flexibility over the visit to maintain the feeling of control typical in both graphical user interfaces and web interactions. The individual modules borrowed most directly from simple computer games and reflective exercises, which have a long history of presenting persuasion opportunities. However, some modules also incorporated video segments, interactive text, and animations.

From the participant's perspective, the overall goal of the intervention was presented as building a personal "portrait of sexual health," with modules yielding a portrait piece that contributed to the overall picture. Module examples included an interactive "hot sex" calculator which calculated the odds of great sex while teaching dating decision making; a virtual gym where men could explore body image concerns common in this population; an online chat simulation where users selected different responses to explore ambiguity and evasiveness; and a reflective journey where participants could identify and graph effects of past disappointments and successes, identify goals, shed secrets, and deepen spirituality. These modules were supplemented by virtual "peers" who contributed their experiences from diverse perspectives,

reinforcements in the form of 15 second humorous cartoons, polls where participants could compare their answers with those of other participants, and “frequently asked questions” where learners could seek information on specific issues. Two modules consisted of personal video vignettes of MSM living with HIV and HIV-negative MSMs discussing ways of modeling behavior for avoiding either transmitting or acquiring HIV. Prototypes were reviewed internally by a team of experts and tested with subjects from the target population in a usability laboratory, separately using think-aloud protocols and eye-tracking. A short video overview of the brief health education course/intervention is available at: <http://www.sph.umn.edu/epi/research/hips/sexpulse-video.asp>. Sexpulse was developed in Macromedia Flash, Version 8.

*Entry (baseline) and exit (immediate posttest) online survey instruments*

After consenting and before beginning the course/intervention, each participant was asked to take an online entry survey. This entry survey asked participants about their demographics, their sexual risk behaviors, and sexual risk co-factors. This study used only the demographic data and the number of unprotected anal intercourse male partners (UAIMP) collected in the entry survey. Appendix B lists the survey questions used.

After completing the course/intervention, participants were presented with the online exit survey. Most of the questions in the exit survey were designed to collect data for the main MINTS II trial. This study incorporated a question about the use of the scaffolds, the instrument for measures of users’ perceptions of cognitive load during the intervention, the questions for self-reported deep learning engagement used for estimating learning and reflection, and an open-ended question asking about a memorable

experience in the course. In addition, a series of MINTS II open-ended questions about participant likes, dislikes, and improvement suggestions were also used for this study.

Appendix C contains the exit survey measures used for this study.

Paas, van Merriënboer, and Adam (1994) successfully demonstrated that cognitive load could be successfully measured with a self-reported ordinal scale. Expanding on their work, Gerjets, Scheiter, and Catrambone (2004, 2006) developed subscales based on a physical and mental subjective workload assessment developed for NASA, the NASA-TLX (task load index) (Hart, Staveland, Hancock, & Meshkat, 1988). The NASA-TLX is a validated scale that consists of six user-weighted subscales: mental demands, physical demands, temporal demands (time pressures), performance, stress, and frustration level. The measures were validated through multiple iterations of experimental tasks, including simple cognitive and manual control tasks, complex laboratory and supervisory control tasks, and aircraft simulations.

Gerjets et al. (2004) adapted the mental/cognitive and task constructs of the NASA-TLX to measure component cognitive load. Building on the mental effort construct by Paas et al. (1994) and the mental demand, physical demand, and stress constructs of the NASA-TLX, Gerjets et al. (2004) developed a 3-item subscale defined as effort, task demand, and stress. Gerjets et al. (2006) further expanded their subscales to include navigation demands and feelings of success. In their studies, task demand was mapped to ICL and effort was mapped to GCL. The task demands measured the amount of cognitive load inherent in the learning activity. That is, how many elements must a learner hold in memory or process simultaneously in order to complete the task? Effort is a measure of the intentional load a learner applies to understand the content and concepts and develop

new schemas. In 2006, Gerjets et al. mapped ECL to navigation demand. However, ECL is composed of demands imposed by several factors, including the external and learning environments and the delivery media, in addition to navigation (Paas, Renkl, et al., 2003). Thus, this study's author chose to use the stress subscale used by Gerjets et al. in 2004 as a more appropriate measure of ECL. The stress subscale measured the irritation, annoyance, and discouragement, all non-schema building mental loads, a learner had in completing a learning activity.

Because the brief health education course was designed as a behavioral intervention, learning or performance measures common in education or human resource development were not included in the MINTS II instrument. Instead, to incorporate a measure of learning, the study author adapted a validated scale for deep learning engagement (C. Pyke, personal communication, September 17, 2007; Lynch, Kuipers, & Pyke, 2005). The original six items, constructed on a 5-point ordinal scale are: (a) the things we did in science class changed my ideas about the world around me, (b) I found ways to stay deeply involved in all the experiments, (c) I learned ideas that I now use to understand things in my life outside of school, (d) I talked about the work we did with the teacher to test my understanding, (e) I talked about the work we did with other students to test my understanding, and (f) I did more than just listening to the teacher to really learn the science ideas. The study author adapted items *a* and *c* to measure self-reported learning and items *d* and *e* to measure if the course prompted discourse and reflection. The author also included an open-ended question about a memorable experience in the course/intervention to elicit responses that might illuminate a participant's rating on

learning, reflection, or cognitive load. The main behavioral measure was number of unprotected anal intercourse male partners (UAIMP) in the last 3 months.

#### *Three-month follow-up survey*

The 3-month follow-up survey included the sexual risk (UAIMP) and co-factor to risk measure used for MINTS II. In addition, this survey repeated the reflection and discourse questions from the exit survey, updated to reflect the differing timeframe, and asked a new open-ended question about behavior change. This study examined the outcomes of the reflection and discourse questions and used the UAIMP measure. These questions are included in Appendix C.

#### Experimental design

This study employed a single factor experimental design. The single experimental factor was the type of pictorial graphic organizer scaffold. The pictorial graphic organizer scaffold type factor consisted of three levels: Level 1, a concept map graphic organizer scaffold to assist the participant in bridging the gap between the concepts in the course/intervention and his own current schema that might influence GCL; Level 2, a procedure flow scaffold that might influence ECL; and Level 3, a graphic organizer metacognitive scaffold that might influence GCL and impact reflective behavior. The graphic organizer scaffold was a between-subjects factor (i.e. a different group of subjects was used for each level of the variable).

Organizer Assignment	Cognitive Load			Learning	Outcomes			
	Extraneous (Stress)	Intrinsic (Task Demands)	Germane (Mental Effort)		Reflection		Discourse	
					Post	3Mo	Post	3Mo
Concept								
Procedure								
Metacognitive								

Figure 1. Experimental Design Matrix

### Dependent measures

The quantitative dependent measures used in this study were mental effort, stress, task demands, learning, reflection, and discourse. Mental effort, stress, and task demands were measured by using participants' ratings on the cognitive load questions as described in the *Entry and exit online survey instruments* section. Learning was measured by calculating the median of the two 5-point, Lickert-style, self-reported learning questions. Reflection and discourse were measured on a 5-point, Lickert-style, ordinal scale as described in the *Entry and exit survey instruments* section and the *3-month follow-up survey* section. Table 1 summarizes the dependent measures.



Table 1.  
Table of Measures

Measure	Description	Scale
Usefulness of user guide	Usefulness of pictorial graphic organizer scaffold (guide); Option 6 was “did not use”	1-5 Lickert style
Intrinsic cognitive load	Physical and mental effort to accomplish instructional tasks	1-9 Lickert style
Extraneous cognitive load	Stress and annoyance felt in Sexpulse	1-9 Lickert style
Germane cognitive load	Effort expended to learn content or concepts	1-9 Lickert style
Learning: changed ideas	How much did participant change ideas about risk behavior?	1-5 Lickert style
Learning: ideas to use	How much did participant learn ideas he can use?	1-5 Lickert style
Reflection	How much did participant think about the ideas in Sexpulse?	1-5 Lickert style
Discourse	How much did participant talk about the ideas in Sexpulse?	1-5 Lickert style
Reflection: 3-month follow-up	How much did participant think about the ideas in Sexpulse over the last 3 months?	1-5 Lickert style
Discourse 3-month follow-up	How much did participant talk about the ideas in Sexpulse over the last 3 months?	1-5 Lickert style
Unprotected anal intercourse male partners, at entry and at 3 months	Number of men a participant engaged in unprotected anal intercourse over the last 3 months	Whole number

### Data analysis

The analysis of the data from this research consisted of seven phases: (a) descriptive: an analysis of the descriptive statistics; (b) cognitive load: a Cronbach’s alpha reliability analysis of the CL survey items, correlations of the CL items, analysis of variance of ICL, ECL, and GCL; (c) learning: a Cronbach’s alpha reliability analysis of the learning survey items; (d) learning, reflection, and discourse: an analysis of odds

ratios for learning, reflection, and discourse immediately after completing the course and for reflection, discourse, and any sexual risk behavior at 3 months after course completion; (e) learning: an analysis of odds ratios for learning with any sexual risk behavior at 3 months after course completion; (f) mental and instructional efficiency: visual plot of organizer scaffold type group means (instructional efficiency) and an analysis of variance of the instructional efficiency; and (g) a qualitative analysis of the open-ended questions to understand participant thoughts on their efforts in completing the course, their learning, and their reflections. Although some of the constructs underlying the ordinal scales measure used in this study are likely to be interval/continuous, the study author chose to be conservative and assume that the distance between points on the ordinal scales are not of equal distance. Thus, nonparametric statistical analyses were used to examine survey data even though these techniques result in a loss of power (Agresti, 1984; Field, 2005; Howell, 2002).

#### *Reliability of survey items*

Although the Gerjets et al.(2004) measures were validated, in order to be confident in the scales and the study author's decision to treat each subscale as empirically independent, correlations and a test of Cronbach's alpha were conducted. In addition, since the study author modified the learning engagement items, the same tests were conducted to verify that a combination of the two learning items was valid. For all quantitative analyses, Cronbach's alpha was set at 0.70 (Field, 2005). Kendall's Tau-b was used to calculate the correlations of the ordinal data (Field, 2005; Howell, 2002).

### *Tests of significance*

The Kruskal-Wallis test, a nonparametric test of significance equivalent to ANOVA's for parametric data, was used to test for significant effects of scaffold type on the descriptive dependent variable of organizer usefulness and on the main dependent variables (mental effort, stress, and task demands) (Agresti, 1984; Field, 2005; Howell, 2002). Each subscale of cognitive load was treated as empirically independent (Field, 2005; Howell, 2002). Alpha was set to 0.05 to test significance. Planned a priori comparisons for each pairwise combination to ascertain significance between scaffold types were run using the Kruskal-Wallis test, equivalent to the Mann-Whitney test in these cases (Agresti, 1984). A Bonferroni Correction was made and the alpha set to  $(0.05/3)=0.0167$  for these comparisons.

Binary logistic regressions were run to determine significant odds ratios of the independent variable, organizer scaffold type use, on the reflection and discourse dependent variables for both the exit survey and the 3-month follow-up survey and for the learning level outcome variable in the exit survey. Binary logistic regressions were also used to determine significant odds ratios of the used organizer on absolute sexual risk at 3 months and the level of reported learning on absolute sexual risk at 3 months. A one-way ANOVA was used to determine the significance in instructional efficiency among organizer scaffold usage. Table 2 summarizes the tests used in this research.

Table 2.  
Table of Tests

Independent Variable	Dependent Variable	Test	Significance Level
Usefulness of scaffold	Cognitive load component, Learning outcome, Reflection, Discourse, 3-month Reflection and Discourse	Kendall Tau- <i>b</i> Correlation	.3
Scaffold type	Usefulness of scaffold	Kruskal-Wallis	.05
Scaffold type pairs	Usefulness of scaffold	Mann-Whitney <i>U</i> post hoc pairwise	.05/n comparisons
Scaffold type	Intrinsic cognitive load	Kruskal-Wallis	.05
Scaffold type pairs	Intrinsic cognitive load	Mann-Whitney <i>U</i> - pairwise	.0167
Scaffold type	Extraneous cognitive load	Kruskal-Wallis	.05
Scaffold type pairs	Extraneous cognitive load	Mann-Whitney <i>U</i> - pairwise	.0167
Scaffold type	Germane cognitive load	Kruskal-Wallis	.05
Scaffold type pairs	Germane cognitive load	Mann-Whitney <i>U</i> - pairwise	.0167
Scaffold type “Metacognitive” reference	Learning level (Less, More)	Binary Logistic Regression	.05
Scaffold Type “Metacognitive” reference	Reflection (Less, More)	Binary Logistic Regression	.05
Scaffold Type “Metacognitive” reference	Discourse (Less, More)	Binary Logistic Regression	.05
Scaffold Type “Metacognitive” reference	Reflection: 3-month follow-up (Less, More)	Binary Logistic Regression	.05
Scaffold Type “Metacognitive” reference	Discourse: 3-month follow-up (Less, More)	Binary Logistic Regression	.05

(cont.)

Independent Variable	Dependent Variable	Test	Significance Level
Table 2. (cont.)			
Scaffold type	Absolute sexual risk (unprotected anal intercourse with male partners) at 3 months (Some, None)	Binary Logistic Regression	.05
Learning outcome	Absolute sexual risk (unprotected anal intercourse with male partners) at 3 months (Some, None)	Binary Logistic Regression	.05
Scaffold type	Instructional efficiency	Group means scatterplot (Paas, Tuovinen, Tabbers, & Van Gerven, 2003)	--
Scaffold type	Instructional efficiency	One Way ANOVA	.05
Scaffold type pairs	Instructional efficiency	Tukey Post Hoc	.05
Scaffold type	Cognitive load, learning, reflection	Qualitative analysis of open-ended post test questions	--

### *Instructional efficiency graph*

Based on the ideas of mental efficiency and instructional efficiency described by Paas, Tuovinen, Tabbers, and Van Gerven (2003), the participant ratings of mental effort were combined with the learning measure to compute the mental efficiency of each participant. In their initial work on mental and instructional efficiency, Paas and van Merriënboer (1993) defined mental effort as the total amount of controlled cognitive processing in which a participant engaged. Paas, et al. (2003) further clarified mental effort to explain that it reflected the actual cognitive load of a participant. Performance is the combined learning score from the exit survey. The participant mental efficiency was calculated for each scaffold type, and the group mean of mental efficiency was calculated for each scaffold type to determine instructional efficiency. The instructional efficiency

of the scaffolds was also graphed following the format in Figure 2. The mental efficiency for each participant was calculated using the following formula:

$$E = \frac{Z_{performance} - Z_{mental\_effort}}{\sqrt{2}}$$

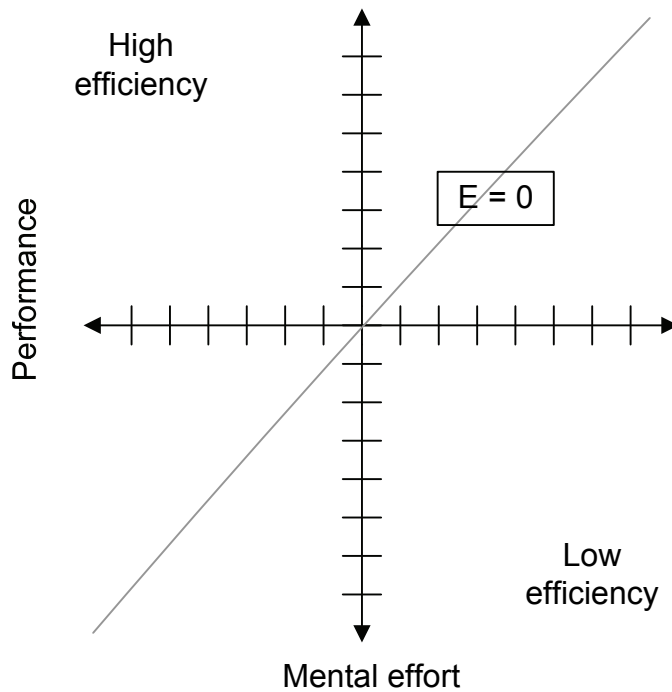


Figure 2. Graph for displaying mental and instructional efficiency (Paas, Tuovinen et al, 2003)

#### *Qualitative data analysis from open-ended question*

Using a content analysis approach to qualitative data analysis, the answers to the open-ended survey questions were analyzed (Patton, 2002). The process began with open coding to identify initial categories. Next, the data was assembled in new ways to reflect a more logical representation of the categories and their relationships. Finally, a storyline for the data was developed with selective coding that integrated the findings from the thematic coding.

### *Procedures*

After being screened and consenting, participants took the entry survey. After entry survey completion, they were randomly assigned via computer algorithm to either the Sexpulse course/intervention or a waitlist null control condition. Participants randomly assigned to the Sexpulse intervention were randomly assigned again via computer algorithm to receive one of the three pictorial graphic organizer scaffolds (see Figure 2). At the Sexpulse entry/welcome screen, participants were required to open up the scaffold file before they could continue, and launch the course/intervention. Participants received a link to their scaffold category in their Sexpulse enrollment confirmation e-mail, and the scaffold was available at the entry screen each time they closed and launched the course.

Participants were reminded to finish via e-mails at 7 and 14 days. A week after the second e-mail, participants were called and reminded to finish. If the participant could not be reached, a message was left after the third attempt. Upon completion of the course, the participant was presented with the exit survey. After 3 months, participants were e-mailed a link to the online 3-month follow-up survey. A protocol identical to that of the initial study phase was used to remind participants to complete the follow-up survey. Participants received \$20 for completing the 3-month follow-up survey.

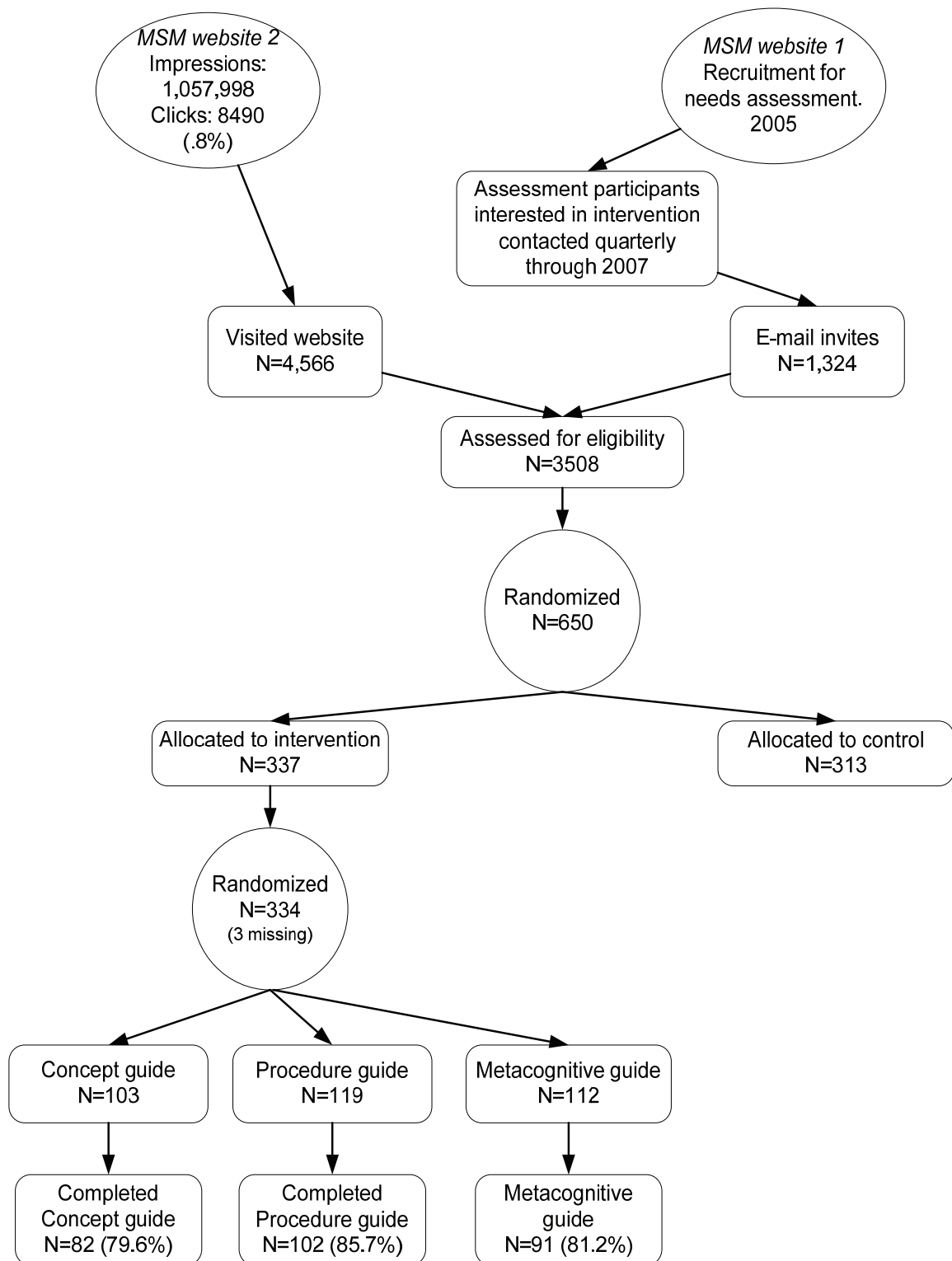


Figure 3. Participant recruitment



## CHAPTER 4

### RESULTS

The purpose of this study was to examine the relationship of pictorial graphic organizer scaffolds designed for three different purposes—procedural, conceptual, and metacognitive instruction—on self-perceived cognitive load in a self-regulated, self-study online brief health education course. Specifically, this research addressed the following questions:

1. To what extent did using the assigned scaffold affect learner perceived cognitive load (i.e. intentional mental effort (germane), stress (extraneous), and task demands (intrinsic))?
2. To what extent did using the assigned scaffold affect self-reported learning outcomes?
3. To what extent did using the assigned scaffold affect reflection or discourse about course content or ideas immediately after the course and at a 3-month follow-up?
4. To what extent did using the assigned scaffold affect sexual risk behavior at 3 months follow-up?
5. To what extent did learning outcomes affect sexual risk behavior at 3 months follow-up?
6. To what extent did using the assigned scaffold affect instructional efficiency of learners within the course?

This chapter includes the analysis of data collected during the investigation. First, demographic variables were analyzed to understand the composition of the participant

groups and to ensure that randomization resulted in demographically equivalent groups. A secondary demographic analysis was conducted between the group of participants who reported not using a guide, and the group that did report using a guide in order ensure there were no demographic differences or issues with differential attrition . Second, in order ensure the validity of the cognitive load and learning construct, correlations and a Cronbach reliability test of items were conducted to determine if the cognitive load measure could be treated independently and if the learning measures could be combined. Third, ratings of the usefulness of the pictorial graphic organizer scaffold were correlated with ratings for the individual cognitive load items, the combined learning item, reflection, discourse, and reflection and discourse at 3-month follow-up. Differences in rated usefulness among the three groups that used a guide were tested with a Kruskal-Wallis nonparametric analysis of variance. Fourth, a Kruskal-Wallis nonparametric analysis of variance was conducted to test for significant effects of the use of a pictorial graphic organizer scaffold on the dependent cognitive load variables (i.e. intentional mental effort, stress/annoyance, and task demands). Fifth, a binary logistic regression was conducted to determine the odds that use of a concept or procedure pictorial graphic organizer scaffold resulted in a lower learning level when compared to using the metacognitive scaffold. Sixth, binary logistic regression was used to determine the odds that use of a concept or procedure pictorial graphic organizer scaffold resulted in less reflection or discourse at exit survey and at 3 months follow-up when compared to using the metacognitive scaffold. Seventh, a binary logistic regression was conducted to determine if there was a significant relationship between the use of a pictorial graphic organizer scaffold and either having or not having sexual risk at 3 months follow-up.

Eighth, binary logistic regression was used to determine the odds that a higher learning outcome resulted in not having sexual risk at 3 months follow-up. Ninth, ratings of total mental effort were combined with learning outcome ratings to create a graph of the instructional efficiency of each pictorial graphic organizer scaffold, as outlined by Paas et al. (2005). Lastly, a qualitative examination of the open-ended survey questions was performed using a content analysis approach to qualitative data analysis (Patton, 2002).

#### Demographic characteristics of participants

This study used participants already enrolled for the National Institutes of Mental Health's grant, Men's Internet Study II (MINTS II) Sexpulse randomized control trial. The participants were all men, 18 years of age or older, who resided in the United States and have had sex with at least one man in the last 3 months. Additionally, the trial oversampled men who engaged in sexually risky behavior. All the men who finished the Sexpulse brief health education course and the Sexpulse exit survey except one were included in this study. One participant encountered an error in the pictorial graphic organizer assignment process and the organizer type was not recorded in the database; and 31 participants reported not using their organizer and were excluded from the analysis. Thus the total number included in the study was 244. The 244 participants completed the course in 1 hour and 41 minutes, on average, with a standard deviation of 2 hours and 13 minutes. Because it appeared that several men remained logged in for extended periods while in an activity module, eight extreme values were removed and the average completion time was recalculated. The remaining 236 men completed the Sexpulse course in 1 hour 21 minutes, on average, with a standard deviation of 38 minutes. The range minimum time was 29 minutes and the maximum time was 4 hours

48 minutes. The average age of the participants was 34, they averaged 16 years of education from first grade, and they earned \$48,617 on average. The majority of participants were White/Caucasian (72.5%). However, 11.5% were Hispanic/Latino/Spanish, 10.2% were multi-racial or of other race, and 5.7% were African-American/Black. Racial categories did not equal 100% due to rounding. In addition, 27.9% of participants were currently students and 17.3% were HIV-positive.

The results of one-way ANOVAs and chi-square tests across demographic variables indicated that randomization was successful; there were no significant differences in those variables among the three pictorial graphic organizer scaffold groups. Because some of the participants opted out of using a pictorial graphic organizer scaffold, further *t*-tests and chi-square tests were conducted on the demographic characteristics to analyze if there were differences between those who used an organizer scaffold and those who did not use an organizer scaffold; there were no significant demographic differences between groups who used an organizer and the group that did not nor was there differential attrition by organizer type. The Asian, Native American, and Pacific Islander racial categories were incorporated into a multi-racial/other category because the small number of participants in those categories resulted in extremely small analysis cell sizes for the randomization analysis. One cell had a value of zero and 27% of the cells had less than five participants. When conducting chi-square tests, if more than 20% of the cells have a value less than 5, or if any cells have a value of zero, Field (2005) recommends combining categories to increase cell sizes. For the analysis of demographic differences by guide usage, race was divided into White/Caucasian and Other in order to eliminate extremely small analysis cell sizes. Results are summarized in Table 3 and Table 4.

Table 3.  
Demographic Characteristics of Participants Who Completed Post-Intervention Survey and Who Used Guide (N=244)<sup>a</sup>

	Concept Guide (n=76)	Procedure Guide (n=88)	Metacognitive Guide (n=80)	
	$\bar{x}$	$\bar{x}$	$\bar{x}$	<i>p</i>
Age (in years)	34	34	34	0.984
Educational Attainment (years completed)	16	16	16	0.511
Annual Income (\$)	45,386	46,664	53,656	0.412
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>p</i>
Annual Income Refuse to Answer	3 (3.9)	5 (5.7)	1 (1.2)	
Race/Ethnicity				0.749
White/Caucasian	52 (68.4)	66 (75.0)	59 (73.8)	
Black or African American	3 (3.9)	5 (5.7)	6 (7.5)	
Latino/Hispanic/Spanish	10 (13.2)	9 (10.2)	9 (11.3)	
Multi-racial/Other	11 (14.5)	8 (9.1)	6 (7.5)	
Current Student Status				
Yes, Currently Student	22 (28.9)	28 (31.8)	18 (22.5)	0.392
Not Currently Student	54 (71.1)	60 (68.2)	62 (77.5)	
HIV Status (1 refused to answer)				0.103
HIV-positive	19 (25.0)	13 (14.8)	10 (12.7)	
HIV-negative	57 (75.0)	75 (85.2)	69 (87.3)	

<sup>a</sup>Counts vary due to refusals to answer.

Table 4.  
Demographic Characteristics of Participants Who Completed Sexpulse Exit Survey by Guide Usage  
(N=275)<sup>a</sup>

	Used Guide (n=244)	Did Not Use Guide (n=31)	<i>p</i>
	$\bar{x}$	$\bar{x}$	
Age (in years)	34	33	0.621
Educational Attainment (years completed)	16	17	0.317
Annual Income (\$)	48,617	48,285	0.967
	<i>n</i> (%)	<i>n</i> (%)	<i>p</i>
Annual Income Refuse to Answer	9 (3.7)	1 (3.2)	
Race/Ethnicity (1 refuse to answer)			0.383
White/Caucasian	177 (72.5)	24 (80.0)	
Other	67 (27.5)	6 (20.0)	
Current Student Status			
Yes, Currently Student	68 (27.9)	13 (41.9)	0.106
Not Currently Student	176 (72.1)	18 (58.1)	
HIV Status (1 refuse to answer)			0.247
HIV-positive	42 (17.3)	8 (25.8)	
HIV-negative	201 (82.7)	23 (74.2)	
Guide Type			0.376
Concept	76 (31.1)	6 (19.4)	
Procedure	88 (36.1)	14 (45.2)	
Metacognitive	80 (32.8)	11 (35.5)	

<sup>a</sup>Counts vary due to refusals to answer, less than 1% of total, excluding income.

### Reliability tests of cognitive load and learning outcome measures

Two tests were conducted to determine if each item in the cognitive load measure could be treated as independent subscales. The results of the test for the reliability of the cognitive load scale (Cronbach's  $\alpha = 0.63$ ,  $n = 243$ ) was less than 0.70, an accepted cut-off for determination if the three items represented one scale. A Kendall tau- $b$  test was conducted to test for correlations between the items. Two of the three pairs of correlations between the items, though significant, were less than 0.30, and the third was below 0.40 (see Table 5). These two tests together indicate the acceptability of treating the three items as distinct subscale measures (Field, 2005).

A reliability test for items and a Kendall tau- $b$  correlation test were also conducted to determine if the two items used to rate participants' learning could be combined. The Cronbach's alpha of the test for reliability was 0.70, and the correlation statistic between the two items was significant, above 0.30 and close to 0.50 ( $\tau_b = 0.49$ ,  $p < 0.01$ ). Thus, the two learning outcome items could be reliably combined.

Table 5.  
Intercorrelations Between the Three Cognitive Load Items (N=244)<sup>a</sup>

	Effort to Understand	Stress/Annoyance	Mental/Physical Activity
	Kendall's $\tau_b$	Kendall's $\tau_b$	Kendall's $\tau_b$
Effort to Understand	1.00	0.26*	0.35*
Stress/Annoyance	0.26*	1.000	0.22*
Mental/Physical Activity	0.35*	0.22*	1.00

<sup>a</sup>Counts vary due to refusals to answer.

\*Significant at  $p < 0.01$ .

Correlations of overall usefulness of a pictorial graphic organizer scaffold  
and cognitive load, learning, reflection, and discourse  
and the difference in usefulness ratings of the scaffolds

Kendall tau-*b* correlation tests for nonparametric data were conducted to explore the relationship between the reported overall ratings of usefulness of a pictorial graphic organizer scaffold (guide) with this study's outcome measures (see Table 6). Guide usefulness was weakly negatively correlated with one cognitive load measure, stress/annoyance (extraneous cognitive load) ( $\tau_b = -0.13$ ). However, guide usefulness was not correlated with the other cognitive load measures. Among the other post-intervention outcomes, guide usefulness rating was only weakly positively correlated with the learning rating ( $\tau_b = 0.12$ ). The usefulness rating was not significantly correlated with the reflection or discourse ratings. At the 3-month follow-up in MINTS, the 3-month discourse rating was weakly correlated with the user guide usefulness rating ( $\tau_b = 0.12$ ). However the user guide usefulness rating was not significantly correlated with the 3-month reflection rating.



Table 6.  
Correlations of guide usefulness and cognitive load, learning, reflection, and discourse (N=244)

	Effort to Understand	Stress/Annoyance	Mental/Physical Activity	Learning
	Kendall's $\tau_b$	Kendall's $\tau_b$	Kendall's $\tau_b$	Kendall's $\tau_b$
Rated usefulness	-0.06	-0.13**	-0.056	0.12*
	Reflection	Discourse	Reflection 3 months	Discourse 3 months
	Kendall's $\tau_b$	Kendall's $\tau_b$	Kendall's $\tau_b$	Kendall's $\tau_b$
Rated usefulness	0.08	0.03	0.08	0.12*

Note: Refusals to answer equaled less than 1% of total.

\*Significant at  $p < 0.05$ .

\*\* Significant at  $p < 0.01$ .

Further exploration was conducted to distinguish differences in usefulness among the pictorial graphic organizer types. The median rating of the procedure guide was 4, and the median ratings of the concept and metacognitive guides were 3 (Table 7). The Kruskal-Wallis test for significance of differences among user reported usefulness of the guides was significant ( $H= 6.32, df=2, p=0.042$ ). An analysis of the mean ranks resulting from the Kruskal-Wallis test indicated that only two post-hoc analyses were needed. The post hoc analysis comparing the procedure guide with each of the other two guides with a Bonferroni correction for significance at  $p < 0.025$  was conducted. The results of the two Mann-Whitney  $U$  post hoc analyses showed that the procedure guide's usefulness was rated significantly higher than the concept guide's usefulness ( $U = 2673, Z = -2.26, p = 0.023$ ). However, there was no difference between the rated usefulness of the procedure guide when compared to the usefulness ratings of the metacognitive guide ( $U = 3025, Z = -1.62, p = 0.105$ ).

Table 7.  
 Summary and Distribution of Responses to Question Rating Pictorial Graphic Organizer Usefulness  
 (N=244)

	Concept Guide (n=76)	Procedure Guide (n=88)	Metacognitive Guide (n=80)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Not at all helpful	12 (15.8)	8 (9.1)	2 (2.5)
Slightly helpful	19 (25.0)	11 (12.5)	16 (20.0)
Somewhat helpful	17 (22.4)	19 (21.6)	31 (38.7)
Mostly helpful	12 (15.8)	30 (34.1)	20 (25.0)
Very helpful	16 (21.0)	20 (22.7)	11 (13.8)
Percentiles	Score	Score	Score
25	2	3	3
50 (Median)	3	4	3
75	4	4	4
	Mean Rank	Mean Rank	Mean Rank
Kruskal-Wallis nonparametric analysis of variance*	108.82	135.74	120.93

\*Significant at  $p < 0.05$ .

#### Test of significance for pictorial graphic organizer and cognitive load

Three Kruskal-Wallis tests were conducted to evaluate differences among the four pictorial graphic organizer conditions (guides; Concept, Procedure, and Metacognitive) on median change in user ratings for each of the three cognitive load items (Effort to Understand (Germane), Stress/Annoyance (Extraneous), and Mental/Physical Activity (Intrinsic)). None of the tests were significant. In addition, the median ratings of the cognitive load items among the four conditions differed little; the median rating was

either 2 or 3 in each instance. Table 8 summarizes the median, mean rank and the resultant *p* significance value for each of the Kruskal-Wallis tests.

Table 8.  
Nonparametric Analysis of Variance for Cognitive Load by Pictorial Graphic Organizer Type (N=244)

	Concept Guide ( <i>n</i> =76)		Procedure Guide ( <i>n</i> =88)		Metacognitive Guide ( <i>n</i> =80)		<i>p</i>
	Median	Mean Rank	Median	Mean Rank	Median	Mean Rank	
Effort to understand materials (GCL)	3.0	128.85	3.0	120.30	3.0	118.89	0.627
Stress/annoyance in Sexpulse (ECL)	2.0	126.13	2.0	116.26	2.0	124.32	0.613
Physical/mental activity to complete (ICL)	3.0	125.13	3.0	120.11	3.0	122.63	0.899
	25%	75%	25%	75%	25%	75%	
Effort to understand materials (GCL)	2.0	6.0	2.0	6.0	2.0	5.0	
Stress/annoyance in Sexpulse (ECL)	1.0	4.0	1.0	4.0	1.2	3.8	
Physical/mental activity to complete (ICL)	2.0	5.0	2.0	5.0	2.0	5.0	

Note: Counts vary due to refusals to answer. Differences in mean rank not significant.

### Binary logistic regression of pictorial graphic organizer and learning

A binary regression of the learning score levels on the pictorial graphic organizer was adjusted for race, education level, and HIV status. Because the scores did not have a wide range of variability and to avoid having cells with zero values or more than 20% of the cells with less than five values, the score was dichotomized (Field, 2005; McCullagh

& Nelder, 1989). The combined scores of 2 through 6 were categorized as 0 (less), and values of 7 through 10 were categorized as 1 (more). However, there was no significant difference in the amount of learning reported among the groups of participants using their assigned pictorial graphic organizer. Because of small cell sizes in the adjusted model, race was dichotomized to White/Caucasian or Other, and education was collapsed into categories (High School or Less, Some College or Associate Degree, Four Year Degree, Post-Four Year Degree).

#### Binary logistic regressions of pictorial graphic organizer and reflection and discourse

Binary logistic regressions were conducted to determine if use of a pictorial graphic organizer was likely to explain greater reflection or discourse at either the exit survey or at the 3-month follow-up. As with the test for learning significance, the outcome measures were collapsed into two categories due lack of variability and cells sizes of zero or the presence of more than 20% of cells will less than five observations. Ratings from 1 through 3 were categorized as 0 (less), and values 4 and 5 were mapped to a value of 1 (more). Racial categories and years of education were collapsed to increase analysis cell sizes. Because prior research literature has suggested that metacognitive ability is an important aspect in online leaning (Azevedo & Hadwin, 2005; Winne, 2005), the metacognitive organizer was set as the reference group against which to compare the other two organizers. Analysis results indicated that the use of a concept or procedure pictorial graphic organizer did not explain any likelihood in engaging in more or less discourse at the time of the exit survey when compared the group using the metacognitive organizer. In addition, the use of a concept or procedure pictorial graphic organizer did

not explain any likelihood in engaging in more or less discourse at the 3-month follow-up when compared to those using the metacognitive organizer. However, the group who used the concept organizer did have a 3.62 greater odds of agreeing that they reflected less about the course at the exit survey than the participants using the metacognitive organizer (OR=3.62, 95%CI: 1.15, 11.3,  $p<0.05$ ). There also was a trend towards significance (OR=2.64, 95%CI: 0.84, 8.04,  $p=0.088$ ) in the likelihood of the amount of reflection between participants using the procedure organizer and those using the metacognitive organizer. In addition to the concept organizer participants having a greater odd of reflecting less at the time of the exit survey, this same group also had a 2.19 greater odds of agreeing that they reflected less about the course over the 3-month follow-up period when compared to the participants using the metacognitive organizer (OR=2.19, 95%CI: 1.09, 4.42,  $p<0.05$ ). There was no significant difference between participants using the procedure organizer and those using the metacognitive organizer at 3-month follow-up. The confidence intervals in the significant results are wide indicating poor precision. Often the lack of precision results from inadequate sample sizes (Agresti, 1984). Although the results are not precise, minimally there is a 15% and 9% difference respectively in the reflection odds at the exit survey and at 3-month follow-up. Also, all of the Hosmer and Lemeshow tests were not significant ( $p>0.05$ ), indicating that the data fit the models. Table 9 summarizes the results of the binary logistic regression.

Table 9.  
Binary Logistic Regression Assessing Reflection, Discourse (N=244), 3-Month Reflection, and 3-Month Discourse (N=235) by Pictorial Graphic Organizer

	Concept Guide (n=76)	Procedure Guide (n=88)	Metacognitive Guide (n=80)
Reflection (More, Less)	3.62 (1.15, 11.3)*	2.64 (.87, 4.85)	Ref.
Discourse (More, Less)	.86 (.44, 1.70)	.88 (.46, 1.69)	Ref.
	Concept Guide (n=70)	Procedure Guide (n=85)	Metacognitive Guide (n=77)
3Mo. Reflection (More, Less)	2.19 (1.09, 4.42)*	.94 (.48, 1.87)	Ref.
3Mo. Discourse (More, Less)	1.16 (.60, 2.27)	.89 (.48, 1.68)	Ref.

Notes: Counts vary due to refusals to answer. Missing values account for 1% or less of total. Models adjusted for race, education category, and HIV status. Odds ratios indicate likelihood of reflecting less than the reference group.

\* $p < 0.05$ .

#### Use of pictorial graphic organizer, learning and sexual risk at 3 months

Analyses were conducted to determine the relationships between use of a pictorial graphic organizer, learning, and sexual risk reduction, the primary outcome goal of Sexpulse. The use of Sexpulse resulted in a marginally significant reduction of sexual risk at 3 months (Rosser et al., 2010), and the mechanism for risk reduction was hypothesized to be critical self-reflection (Wilkerson, Danilenko, Smolenski, Meyer, & Rosser, in press). Since Wilkerson et al. found that reflection and discourse at the 3-month follow-up significantly explained belonging to the "Sexpulse-using no sexual risk at 3 months" group, this analysis more narrowly examined those participants belonging to either the "no risk" group or the "still at risk" group at 3 months follow-up. A binary logistic regression test was used to determine if using a procedure or concept organizer resulted in differences in the odds of participants belonging to the "no risk" or "still at risk" groups when compared to participants using the metacognitive organizer. Adjusted

for HIV status, race category, and education category, the odds of belonging to either of the risk groups did not differ by use of the concept or procedure pictorial graphic organizers when referenced against those who used the metacognitive organizer ( $p > 0.05$  for each organizer,  $N = 235$ )

To determine if learning had any significance on sexual risk at 3 months, the 3-month risk category was regressed on the dichotomized learning score. The higher learning category significantly increased the odds of belonging to the group of participants who had no risk at 3 months follow-up (OR = 4.48, 95%CI: (1.87, 10.3),  $p < 0.01$ ,  $N = 235$ ) when adjusted for race, education category, and HIV status. The Hosmer and Lemeshow test was not significant ( $p > 0.05$ ), indicating that the data fit the model. Although the confidence interval is again wide indicating poor precision, men who reported learning more were minimally 87% more likely to be in the group without risk at 3 months follow-up. Wilkerson et al. (2010) reported the results of regressing risk group category on reflection and discourse ratings from the exit survey and at the 3-month follow-up. They report that the higher 3-month discourse and reflection ratings, but not the exit survey discourse and reflection ratings, significantly explain belonging to the "no risk" group.

Instructional efficiency of the pictorial graphic organizer conditions

Using the framework described by Paas, Tuovinen et al. (2003), the mental efficiency of each participant was calculated using the following formula:

$$E = \frac{Z_{performance} - Z_{mental\_effort}}{\sqrt{2}}$$

Performance is the combined learning rating from the exit survey, and total cognitive load (GCL + ECL + ICL) is used for mental effort (Paas and van Merriënboer, 1993). Standardized z-scores were used in order to compare the different instructional conditions. Because of a high level of skew, the natural log of the mental effort ratings was used to calculate the mental effort z-score (Field, 2005). Although the performance rating also had a high level of skew, a natural log transformation of the rating increased skewness, so the z-score was calculated on the untransformed performance rating. After the z-scores were calculated, the mental efficiency for each participant was calculated using the formula above. The instructional efficiency for each organizer condition (cognitive, procedure, metacognitive) was calculated as the mean of all of the participant mental efficiency scores for that condition. Instructional efficiency was graphed (Figure 4) following Paas and van Merriënboer's example.



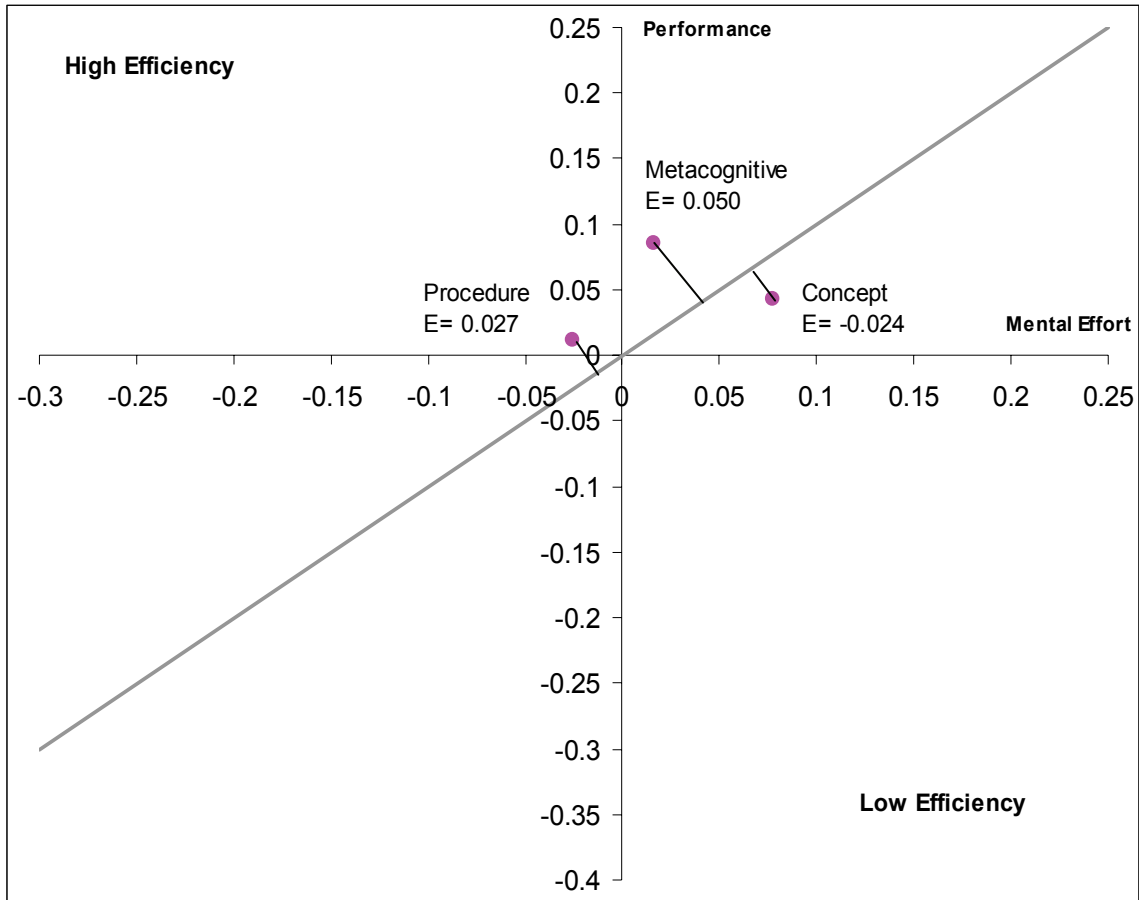


Figure 4. Instructional efficiency plot of pictorial graphic organizers

Although there is a difference in instructional efficiency between the use of the metacognitive guide the other two guides, visualized through the graph, a one-way ANOVA test on the effect of used pictorial graphic organizer on mental efficiency was not significant  $F(2, 244)=0.129, p>0.05$ .

#### Qualitative analysis of open ended questions

In the exit survey for the MINTS-II randomized control trial testing Sexpulse, participants were asked to provide feedback using four open ended questions. The questions asked participants about what they found helpful, what they found least helpful, what they would improve in Sexpulse, and what was most memorable about Sexpulse. A

total of 1,214 responses to the four questions were analyzed using a content analysis approach to qualitative data analysis (Patton, 2002). Most comments were approximately a long phrase or short sentence in length, and responses varied from one word to four sentences. The process began with open coding to identify initial categories. Next, the data were assembled in new ways to reflect a more logical representation of the categories and their relationships. At this stage, categories that were not relevant to this study were removed from further consideration. Finally, a storyline for the data was developed with selective coding that integrated with the themes that emerged as relevant to this study. Because responding to the questions was voluntary and because the questions were general to usage of Sexpulse and not specific to this study, determining statistical differences in number and quality of responses among the different pictorial graphic organizer groups was not possible. However, it was possible to conduct broad reporting themes and reporting examples of themes. A summary of the themes with number of comments grouped by pictorial graphic organizer are presented in Table 10.

Table 10.  
Summary of Coded Responses to All Open-Ended Questions Based on Cognitive Load and Performance (N=244)

	Concept Guide ( <i>n</i> =76)	Procedure Guide ( <i>n</i> =88)	Metacognitive Guide ( <i>n</i> =80)	Total ( <i>N</i> =244)
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
Navigation disorientation	15 (19.7)	13 (14.8)	16 (20.0)	44 (18.0)
Task or purpose disorientation	25 (32.9)	12 (13.6)	15 (18.8)	52 (21.3)
Easy to use/navigate	6 (7.9)	14 (15.9)	12 (15.0)	32 (13.1)
Ease of tasks or activities	16 (21.1)	9 (10.2)	16 (20.0)	41 (16.8)
Learned new information skill	11 (14.5)	21 (23.9)	17 (21.3)	49 (20.1)
Reflected on sexual health or behavior	26 (34.2)	37 (42.0)	34 (42.5)	97 (39.8)

Notes: Counts do not add up to 100% due to multiple responses, removal of nonrelevant responses, and refusals to answer. Cell % equals number of comments divided by Guide *n* or Total *N*.

Both positive and negative comments on the usability and usefulness of Sexpulse were made by participants in each of the pictorial graphic organizer groups. One common theme that arose was a feeling of disorientation in navigating the software. Participants used straightforward language to express their thoughts. For example, one procedure organizer-using participant commented, “Improve navigation . . . initially it took some getting used to.” Another procedure organizer-using participant felt disorientation because there was “a bit too much on the screens at times—too many options to choose from.” Disorientation was also expressed by comments that Sexpulse was not user-friendly. For example, one metacognitive organizer-using participant suggested to “make it more user friendly. Make it easier to access.”

Although navigation disorientation was an issue for some participants, others thought that Sexpulse was easy to navigate and easy to use. Comments in this theme were

all essentially similar across all organizer use groups. Typical responses were, “It was easy to use and navigate through,” written by a metacognitive organizer-using participant, or that it was “easy to maneuver [sic] through the different sections,” written by a participant using the procedure organizer.

Another theme that arose from the negative comments concerned disorientation surrounding the purpose of Sexpulse or some of the tasks within the course. For example, one participant who used the metacognitive guide expressed “some of the games seemed confusing. had to read instructions a couple times to understand, and i still don’t think i understood some of it, like the calculator.” A concept guide-using participant expressed confusion about the purpose of the portrait of sexual health commenting, “I’m not sure of the purpose of the patchwork thing in the center. I guess it kind of tied everything together, but it doesn’t really tell me anything.” One participant, who used the concept guide, summed up many other participants’ brief responses by commenting at length about the vague nature of the purpose of activities and the course:

Throughout, I continued to wonder what the point of the site is. It states that I would be creating a sexual portrait. But to what end? Is it just to learn more about myself and my awareness and attitudes? Was it to teach me something? Was it just for fun? I wanted to know who this site is being targeted to? Doing the modules felt perfunctory on some ways. I had to complete them but I wasn’t inspired to want to keep going after a while. The tone was consistent throughout which was fairly bland. Perhaps the curse of an online experience.

While some participants struggled with the purpose of the Sexpulse or some of its component activities, others commented favorably on the ease of the activities. For

example, a participant who used the metacognitive organizer commented that Sexpulse “was very easy to use. Instructions were very clear. Scenarios were very real-life and current. Entertaining yet educational at same time.” Another participant, who used the concept organizer, wrote appreciatively about the “simple one thought process per module unlike many sites who blast too much information at one time.” Although most comments about the easy-to-do activities were favorable, some participants thought the activities were too easy. A concept organizer-using participant provided an example by responding that “some exercises felt trivial (for instance, the module about goals seemed a bit tacky).” In another example, a participant who used a metacognitive organizer commented that “The modules seemed fun but kind of superficial.”

Since the goal of Sexpulse was to influence a reduction of sexual risk behavior through learning and reflection, the themes of learning and reflection were reflected by many participant comments. Some participants responded that they learned factual or declarative knowledge, such as this metacognitive guide-using participant who wrote that he learned that, “precum contains hiv. rimming is risky. a healthy sex life is compatible w/ high self-esteem.” Other participants commented about learning an idea or concept that could also develop into a skill. For example, a participant that used the procedure guide responded about learning the importance of “the concept of making and having a plan—in advance—of risk situations. A realistic understanding that some onlien [sic] hookups are a waste of time.” Many participants reflected on their past sexual behaviors, the causes of these behaviors, and how they might be associated with sexual risk. Typical of briefer comments, this metacognitive organizer-using participant wrote that Sexpulse, “made me stop and think about past behavior and why.” In a more substantive example, a

procedure organizer-using participant wrote that, “I thought a lot about my past experiences and past relationships with men. I think I was consciously evaluating and comparing those experiences to the information I was presented, which was very helpful and inspiring in some cases.” A few participants wrote detailed comments that indicated that they deeply reflected on their behaviors and thought about the concepts in Sexpulse. These in-depth responses were exemplified by the following comment, written by a metacognitive organizer-using participant who reflected:

For me, reading about unsafe practices and the risks and consequences made me remember that I had done some of those same things. This brought back memories of that feeling of dread waiting for an HIV test to come back, and made me think more on changing some of my attitudes/habits. These memories caused me to ask myself the same question I asked myself when I was waiting for test results before: “Would it really have been worth it if I got HIV from that experience?”

## CHAPTER 5

### DISCUSSION

The purpose of this study was to examine the relationship between pictorial graphic organizer scaffolds designed for three different purposes—procedural, conceptual, and metacognitive instruction—and self-perceived cognitive load, learning, and reflection in an online self-study, brief health education course. This chapter discusses and interprets the findings of this study, describes the limitations of the research, and suggests areas for future research in cognitive load and self-regulated (self-directed) online learning. This research was guided by the following questions:

1. To what extent did using the assigned scaffold affect learner perceived cognitive load (i.e. intentional mental effort (germane), stress (extraneous), and task demands (intrinsic))?
2. To what extent did using the assigned scaffold affect self-reported learning outcomes?
3. To what extent did using the assigned scaffold affect reflection or discourse about course content or ideas immediately after the course and at a 3-month follow-up?
4. To what extent did using the assigned scaffold affect sexual risk behavior at 3 months follow-up?
5. To what extent did learning outcomes affect sexual risk behavior at 3 months follow-up?
6. To what extent did using the assigned scaffold affect instructional efficiency of learners within the course?

## Findings and discussion

The following sections discuss (a) the correlations between reported usefulness of a used pictorial graphic organizer type and the outcome measures; (b) the effects of the use of a pictorial graphic organizer on cognitive load, self reported learning, reflection and discourse at exit survey, reflection and discourse at the 3-month follow-up, and on sexual risk behavior at 3 months; (c) the effects of learning on 3-month sexual risk behavior; and (d) the instructional efficiency of the three pictorial graphic organizer scaffolds.

The first interesting significant finding is that participants' rating of the usefulness of an organizer was weakly and negatively correlated with stress or annoyance (ECL) experienced in Sexpulse. This potentially confirms that participants who rated their organizer as more useful experienced a bit less stress or annoyance. Alternatively participants who rated their stress or annoyance less potentially thought their organizer was a little more useful. A greater feeling of utility or less stress or annoyance may be explained through an orienting effect of the organizer resulting in a minor weakening of a sense of disorientation (Niederhauser et al., 2000). However, an alternate explanation could be that lower feelings of annoyance result in overall greater satisfaction with the experience, including use of an organizer. There also was a weak positive correlation between usefulness of an organizer and the learning rating, indicating a relationship between participants' feeling of the usefulness of scaffolding and how they rated their learning. Overall, the participants who used a procedure pictorial graphic organizer felt it was more useful than the participants who used a concept pictorial graphic organizer. Procedure organizers, which help orient the learner to features and navigation, are



commonly represented by process flows or path models in navigating hierarchies. These representation styles are more straightforward to interpret when compared to a concept map. Participants who have never been exposed to or worked with a concept map may thus have difficulty in using it and interpreting the representations of the concepts (O'Donnell et al., 2002). These participants would naturally find a concept map less useful since they would have difficulty in understanding its use and purpose. There was no difference in the rated usefulness between participants using the procedure organizer and participants using the metacognitive organizer. Although the organizer targeted different instructional strategies, participants found these organizers equally useful for their purposes.

Although the procedure pictorial graphic organizer was rated more useful than the concept organizer, and although there was a weak negative correlation between the organizer usefulness rating and the cognitive load rating for stress or annoyance, there were no significant differences in the use or lack of use of an organizer and any of the three cognitive load ratings. The medians across each rating by organizer group were identical. Overall, the median scores of the three cognitive load measures were very low; the medians were either 2 or 3 on a 9-point ordinal scale. Notwithstanding some of the comments expressing disorientation, the low stress/annoyance (ECL) median score and low score at the 75<sup>th</sup> percentile provide some evidence that the majority of the participants, regardless of organizer used, found Sexpulse relatively easy to navigate and use. Not only did participants indicate easy navigability through the low ECL ratings, participants also rated their intrinsic cognitive load very low. The low ICL might be indicative that the activities in Sexpulse were very easy with little challenge. A few of the

comments volunteered by participants in the opened-ended questions in the exit survey illuminate the ideas that “some exercises felt trivial” or that the modules were “kind of superficial.” The final cognitive load measure, germane cognitive load, measured by the “mental effort” question, also received low ratings by participants. Although extraneous and intrinsic cognitive load ratings were low, thus theoretically making more cognitive resources available for intentional learning, the low GCL ratings might indicate that participants did not intentionally apply many additional cognitive resources to the learning tasks presented in Sexpulse. Because participants were compensated \$80 to finish regardless of learning or behavior outcome, the study provided incentive for participants to finish quickly and to not spend extra time with Sexpulse activities. Although research has shown that compensation is necessary to obtain acceptable completion rates in online surveys and online health studies (Cook, Heath, & Thompson, 2000; Göritz, 2006; Pequegnat et al., 2007), research on incentives, motivation, and behavior in business and education environments (Bransford, Brown, & Cocking, 1999; Griffin & Moorhead, 2009; Ormrod, 2004) suggest that people will exhibit behaviors that tie directly to the rewards they expect to receive. Thus, in the case of the Sexpulse randomized control study and from an extrinsic motivation viewpoint, it is possible that participants may have considered that they were rewarded for completing as quickly as possible without regard to their own learning or behavior outcome at the end of the course or at 3 months follow-up. It is unknown how intrinsic motivation may have played a role in participant completion of Sexpulse. The visual design and the reflective activities were two instructional design strategies used to try and support intrinsic motivation and engagement with the course. The visual design and the activity strategies

that were developed to try to motivate and keep participants involved were in conflict with the extrinsic reward to complete quickly. Persistence and mental effort seem to be important learning-related motivation indicators in multimedia environments (Clark & Feldon, 2005); however, the low ICL and GCL participant ratings lend some evidence that fostering intrinsic motivation within Sexpulse was not entirely successful. The lack of significant results in this study for organizer use affecting cognitive load is consistent with other research that indicates that organizers perform best when multimedia environments are confusing or disorganized, concepts and material are unfamiliar, and learning materials are challenging (Brinkerhoff et al., 2001; Luiten et al., 1980; Mayer, 1979a; Stone, 1983). The low participant ratings on stress/annoyance (ECL) and physical/mental activity (ICL) provided evidence that participants experienced a straightforward multimedia environment with minimally challenging materials. Similar to other studies (Morozov, 2009; Waniek & Ewald, 2008), just because ECL and ICL were low, it did not mean that learners would voluntarily apply greater amounts of free cognitive resources (GCL) to the learning tasks. Because the study did not contain measures of prior knowledge, it is not possible to accurately assess how familiar participants were with the materials. However, within the field of HIV prevention research, experts believe that MSM have sufficient prior knowledge of the biological risks and mechanisms of HIV transmission and that a majority of MSM now “tune out,” “gloss over,” or are not exposed to more detailed, conventional HIV prevention education (Wilkerson et al, in press; Rosser et al., 2010). It is less likely, however, considering that the participants reported risky sexual decisions, that all participants understood the details of emotional, psychological, and environmental conditions that might be impacting their

sexual decision-making. In particular, the Sexual Health Model, upon which the Sexpulse curriculum is based, is a fairly recent development and has not been widely deployed. It is unlikely then that all the participants would be familiar with a majority of the concepts covered in the curriculum. Thus, some participants potentially entered Sexpulse under a possibly false assumption that they had nothing new to learn, encountered an easy to use interface with minimally challenging activities, and thus did not fully utilize the organizers since they did not fully understand their purpose or utility (Quintana et al., 2005; Sharma & Hannafin, 2004).

In addition to the lack of significant results of organizer usage on cognitive load, there were no significant results with organizer usage and the self-reported learning score. This result indicates the organizers all performed equally with respect to supporting participant learning. The results of this analysis also agree with the outcome of the analysis on instructional efficiency. Although the graph (Figure 4) shows the metacognitive organizer as the most efficient, with the largest gap with the concept organizer condition, this difference did not reach statistical significance. The instructional efficiency of each condition did not vary far from zero, as all results were clustered within an area where the z-scores for performance and cognitive load were less than 0.1, indicating small variations. Since there was no control condition, conclusions about the usefulness of instructional organizers in general to support learning cannot be made.

Despite the lack of significant results with cognitive load and learning, this study did find that participants who used the concept organizer were more likely to reflect less about the course ideas than those participants using the metacognitive organizer. This finding was true immediately after completing Sexpulse and also at 3 months follow-up.

The impact of organizer usage on reflection persisted over 3 months. This result generally confirms some of the other findings with an organizer's effect. The impact of an organizer is usually seen around 6 weeks or more after a course and may or may not have a measurable effect immediately after the course (Ausubel, 1978; Mayer, 1979a). There were no other significant results related to organizer scaffold usage and the outcome measures. In order to be confident in the significance of the results, the explanatory model of the ordinal logistic and all the binary logistic regressions were adjusted for race/ethnicity and HIV status, often significant covariates in HIV prevention research. In addition, all the explanatory models were adjusted for education level, often a significant covariate in both learning research and HIV prevention research.

Taken together, the findings that the participants using the concept scaffolds had greater likelihood of reflecting less at two time points over 3 months on presented concepts than those using the metacognitive organizer suggests the metacognitive scaffolding might be beneficial in online self-regulated learning environments designed in a similar fashion and for a similar purpose, such as those presented in this study. An interesting contrast in participant ratings of usefulness with actual reflection outcomes is presented by this study. Although there was no significant difference in how participants rated the usefulness of concept organizer compared to the metacognitive organizer, the concept organizer promoted less reflection when compared to participants using the metacognitive organizer. Also, when comparing the procedure organizer with the concept organizer, the procedure organizer was rated more useful. These results are difficult to compare with Zydney's (2005), since all of her groups, including control, used the procedure scaffold, the outcome measures were measured differently, and her scaffolds

were not advance organizers. However, while she found the procedure plus concept scaffold produced the best specific short-term learning outcome, this study found that the metacognitive scaffold likely produced the best outcome with respect to reflection. This difference in results is likely due to her scaffolds being embedded in the software and not designed as organizers. Concept maps often help short-term retention and recall (Lee & Nelson, 2005; Novak & Gowin, 1984; O'Donnell et al., 2002), and Zydney's measures were more immediate and specific than the ones used in this study. As with all advance organizers, the effects, if any, seem to appear in transfer and in less immediate or exact measures of declarative knowledge. There is potential agreement in scaffolding for reflection as her metacognitive plus procedure scaffold produced the most balanced and integrative results across the different perspectives, and this study's metacognitive scaffolding had the best results for encouraging short-term and longer term reflection. Similar to the more effective generic prompting in Davis' (2003) study, the guiding reflective questions in this study's metacognitive organizer scaffold were broad and at a higher level of abstraction rather than being specific or prescriptive.

The lack of a significant result for the discourse outcome is not surprising. Sexpulse was a self-study course with no interaction with other humans. The participants did not have an opportunity to discuss the course's concepts with other participants. Thus, they could only engage in a reflective dialogue with nonparticipant friends or colleagues. This additional step of reaching out to nonparticipants, many of whom might not be familiar with Sexpulse concepts, was likely too large a barrier for participants to overcome on their own. Also, the lack of significant findings for reflection or discourse after 3 months indicated that any effect that might be attributed to differences in

scaffolding with organizer use diminished over time without reinforcing instruction or tasks. In addition to the lack of significance for discourse and for reflection at 3 months, the use of an organizer scaffold did not have an effect on men's sexual risk taking at 3 months. Again, this is not a surprising outcome, as the mechanisms for long-term behavior change do not directly link to theory in scaffolding or theory in advance organizers. Thus, the organizers were designed to support learning and reflection while minimizing cognitive load and not to directly influence changes in behavior. Although learning is necessary for people to begin making changes in problematic behavior, it is not considered solely sufficient for lasting, long-term changes (Bandura, 2001). Results from this study suggest that men's higher reported learning level did contribute to some of the participants reducing their risk to zero though there is no direct link to risk reduction. However, since Wilkerson et al. (in press) found that reflection possibly explained risk reduction, there is some indirect support that the use of the metacognitive scaffold might contribute to the risk reduction goals of Sexpulse.

#### Limitations

There are several limitations to this study, and the findings of this investigation must be interpreted cautiously in light of these limitations. First, the study consisted of a convenience sample of men recruited through banner advertisements on two websites targeted to men who have sex with men. Thus, the sample might not represent the broader population of Internet-using MSM, non-Internet using MSM, or a broader population of learners. Since the entire sample consisted of adult men residing in the United States, results cannot be generalized to youth, women, or cultures with a different learning paradigm. Since the sample was collected online without meeting any participant

face to face, it is possible that a participant might have been untruthful about some aspects of the study including age, race, or gender.

Second, the study used self-reported data for cognitive load, learning, reflection, and sexual risk. Accurate recall requires correct reconstruction of details and sequence of events (Thompson, Skowronski, Larsen, & Betz, 1996), which was even more difficult 3 months after the course was completed. In addition, cognitive load is best measured as the activities occur. That is, reports of cognitive load should take place either during or immediately after an activity. In this study, cognitive load was measured at a single time point after the participant had completed the entire course. Since a participant, on average, spent 1 hour and 21 minutes in the course, had several questions to answer before he came to the cognitive load questions, and actually might have completed the course in multiple sessions, his recall on aspects of annoyance, activity, and effort might not have been completely accurate. In addition, it is possible that the wording of the cognitive load constructs had differing meanings for the participants. It is also possible since cognitive load measurement is still a fairly new construct that the used measures were either not reliable or valid. This point will be discussed further in the section on *Implications and recommendations for future research*. Not only were the cognitive load measures self-reported, but the learning and reflection measures were also self-reported, a limitation since objective measures of performance are usually used. However, use of self-reported estimates of learning is valid, though the use of objective measures is suggested since it can result in more accurate data (Gonyea, 2005). The measures of sexual risk could also be confounded by a social desirability bias, though using computer-based collection methods appear to lessen this bias (Turner et al., 1998).



Third, this study did not contain a control group. Thus, conclusions are weaker since analyses were only contrasts of three treatment groups. A control group consisting of participants who randomly did not receive an organizer would allow conclusions on the actual impact of organizers in general along with the impact of a specific organizer. A control group would help explore whether instructional organizers are worthwhile in self-directed environments such as the one used in this study.

Fourth, the proxy used for determining use for the organizer, the rated usefulness measure, did not contain a dimension of time. Thus it was not possible to determine how much time a person spent using the organizer in advance of starting the Sexpulse activities or the amount of time the participants used the scaffold as they were completing the course. Although the usefulness measure gives an indication of whether a participant used an organizer, it does not provide information if the organizer was used as intended. Generally, in advance organizer studies, the participants are given instruction in how to use the organizer, with the expectation that the organizer is reviewed before the start of activities. Participants were notified that they needed to open and review the organizer before starting Sexpulse, and the software ensured that they at least opened the link with the PDF. However, additional detailed information was not available as to how the organizer was used.

Fifth, this study collected qualitative data via an online survey, so there was no opportunity to ask participants clarifying questions; the analysis was limited to the survey data. In addition, the qualitative questions were structured for the overall goals of the main MINT-II study, and not this substudy. Thus the open-ended questions were more general in nature and not specific to research questions in this study. Because the primary

purpose of the MINTS-II Sexpulse RCT was to evaluate the effectiveness of Sexpulse as an intervention to reduce risky sexual behavior, there was limited opportunity to assess objective learning, detailed reflection, in-activity cognitive load, or embed organizer or scaffolding strategies directly within Sexpulse.

Sixth, participants completed the study under highly controlled conditions and as an evaluation study. The participants were required to complete all modules, some were reminded on multiple occasions to complete, and they were compensated for completing the Sexpulse course. Because this was a compensated evaluation study, results cannot be generalized from this evaluation to how learners may use organizers in self-regulated learning in a higher education setting, secondary school setting, or in the real world.

#### Implications and recommendations for future research

The results of this study suggest that in an online self-regulated learning environment, a metacognitive-designed pictorial graphic organizer might be beneficial to support reflection. In addition, when used with an online brief sexual health education course, a metacognitive pictorial graphic organizer might indirectly support a short-term effect on sexual risk behavior. The results of this study also lend support to the potential of using a pictorial graphic organizer or other scaffolding in online learning without first orienting the learner to its use. In addition, this study also confirms other research where an instructional organizer or other scaffold did not have an effect on cognitive load due to an online learning environment that was easy to use and navigate or when learning tasks were minimally challenging.

There are several avenues to consider in order to strengthen the potential effects seen in this study. First, the organizer should be included within the course, a strategy

recommended by current research in scaffolding in technology-based environments (Azevedo & Jacobson, 2008; Puntambekar & Hubscher, 2005; Shapiro, 2008; Sharma & Hannafin, 2007). Learners who need the most support are less likely to use nonintegrated instructional support (van Merriënboer et al., 2003). Additionally, by incorporating the organizer within the learning environment, it should cause less disorientation as learners work with the organizer. The organizer would also seem a more integral part of the learning experience, and its utility might thus be better perceived. As part of the overall software environment, usage of an organizer could also be tracked. In addition, since most studies provided learners with an overview of using an organizer or a scaffold, a brief overview of using an instructional organizer could be programmed into the beginning of the course.

Additional research on pictorial graphic organizers in online self-regulated environments should also focus on supporting metacognition. Building and supporting metacognitive capabilities in self-regulated online learning environments is important for the success of the learner (Azevedo & Hadwin, 2005; Kollar & Fischer, 2006; Winne, 2005). A learner's weak ability to plan the learning process, monitor progress, and evaluate comprehension is linked to poorer performance in instructorless learning environments. Another factor linked to weaker performance is the amount of prior knowledge a learner brings to a course. Individuals with lower amounts of prior content knowledge or weaker metacognitive skills tend to choose learning strategies that allow them to complete activities more easily or quickly rather than trying to learn more (Ertmer & Newby, 1996; Kopcha & Sullivan, 2007). However, instructional strategies for low level content knowledge or low level metacognitive skill learners often do not work

for individuals with high levels of prior knowledge or expert level learning skills. In fact, learners with high levels of expertise often perform poorly with too much guidance due to conflicts with their expert level schemas, the additional cognitive load needed to process redundant information, or lack of attention to already familiar information (Kalyuga, 2007b). Thus, assessing both prior content knowledge and prior metacognitive knowledge and skills is needed to both assess studies and design instructional support.

Additional research is also needed in measuring the components, that is, extraneous, intrinsic, and germane, of cognitive load. Although research in the last decade has used self-reported cognitive load measures that are generally considered reliable, single item measures for complex psychological constructs are generally not recommended by psychometricians. These single items measures can be unstable or have poor reliability due to large amounts of variability in attempting to approximate the complex psychological construct (Nunnally, 1978). Although earlier measures of self-reported cognitive load were validated with physical measures such as heart rate or pupil dilation, the physical responses could also be confounded by other learning, psychological, or physical discomfort issues. Additional corroboration using newer physical measures such as eye tracking or more objective, direct methods using brain neuroimaging techniques would therefore help build valid, reliable self-report scales for the components of cognitive load (Brunken, Plass, & Leutner, 2003).

The results of the study also offer several possible areas in which to improve the Sexpulse health education course. First, in order to better engage the learner and to increase the possibility of increasing learning achievement, the modular activities within Sexpulse should be made more challenging. Learners tend to focus on the superficial

details and on achieving the desired activity or course results rather than understanding the ideas and principles underlying the learning process or content domain (Reiser, 2004). In this study, the participants were possibly focused on achieving the result of fast completion in order to obtain their compensation. Thus, properly guided activities that focus the learner on the more important and difficult aspects of the learning domain while simultaneously slowing the learning process will help support the learner to better achieve understanding in the underlying principles of the course (Reiser).

A second suggestion for improving Sexpulse is to strengthen the amount and quality of learner self-reflection. Participant reflection on the concepts in Sexpulse was a significant outcome in this study and was found to be significant in reducing men's sexual risk at 3 months (Wilkerson et al., in press). In addition, Wilkerson found that discourse at the 3-month follow-up was also significant. Discourse or articulation in learning environments are often included with reflective activities in order to deepen meaning and strengthen relationships with related principles (Masui & De Corte, 2005). Reflection and discourse activities can also work cooperatively in supporting online learning (Cheung & Hew, 2004; Hawkes, 2001). Thus, adding components that allow for discourse or articulation of ideas, such as asynchronous communication or reflective comment blogs, might assist in strengthening the effects of reflection and thus the overall goal of the Sexpulse course.

The final suggestion for improving Sexpulse is to tailor the course content and activities by a participant's HIV status. Although not a research question for this study, the investigator noted that several of the adjusted logistic regression tests had a significant effect attributed to participant HIV status, even when there was no significant

main effect. In the cases where HIV status was significant, being HIV negative contributed to explaining greater learning, reflection, or discourse in Sexpulse. The result of the importance of HIV status in the outcomes of using Sexpulse is confirmed by another analysis conducted by Smolenski, Wilkerson, and Rosser (2010). In their study, Smolenski et al. found that the intentions to practice safer sex by HIV negative men explained all of the observed reduction in sexual risk, and they did not find an effect for men who were HIV positive. Taken together, these two analyses suggest that tailoring the educational messages and content by HIV status could strengthen the outcomes for HIV negative men and attempt to have a significant impact on the outcomes for HIV positive men.

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## APPENDIX A

### PICTORIAL GRAPHIC ORGANIZER SCAFFOLDS

One of three pictorial graphic organizers were randomly assigned to participants in the Sexpulse brief health education course. The three organizers were designed for either a concept, procedure, or metacognitive instructional scaffolding purpose.



## Your Concept Guide

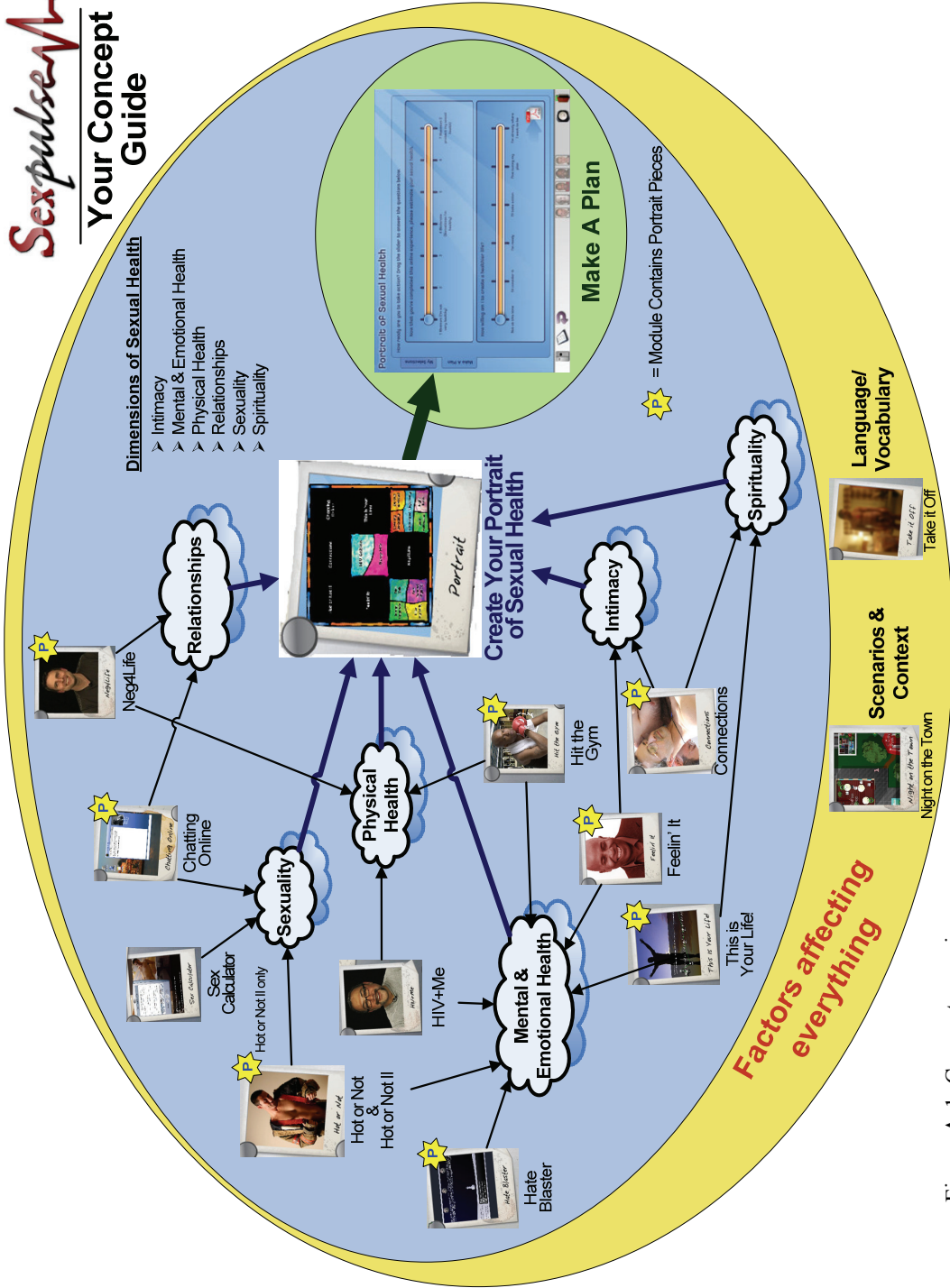


Figure A-1. Concept organizer

# Sexpulse

## Your Navigation Guide

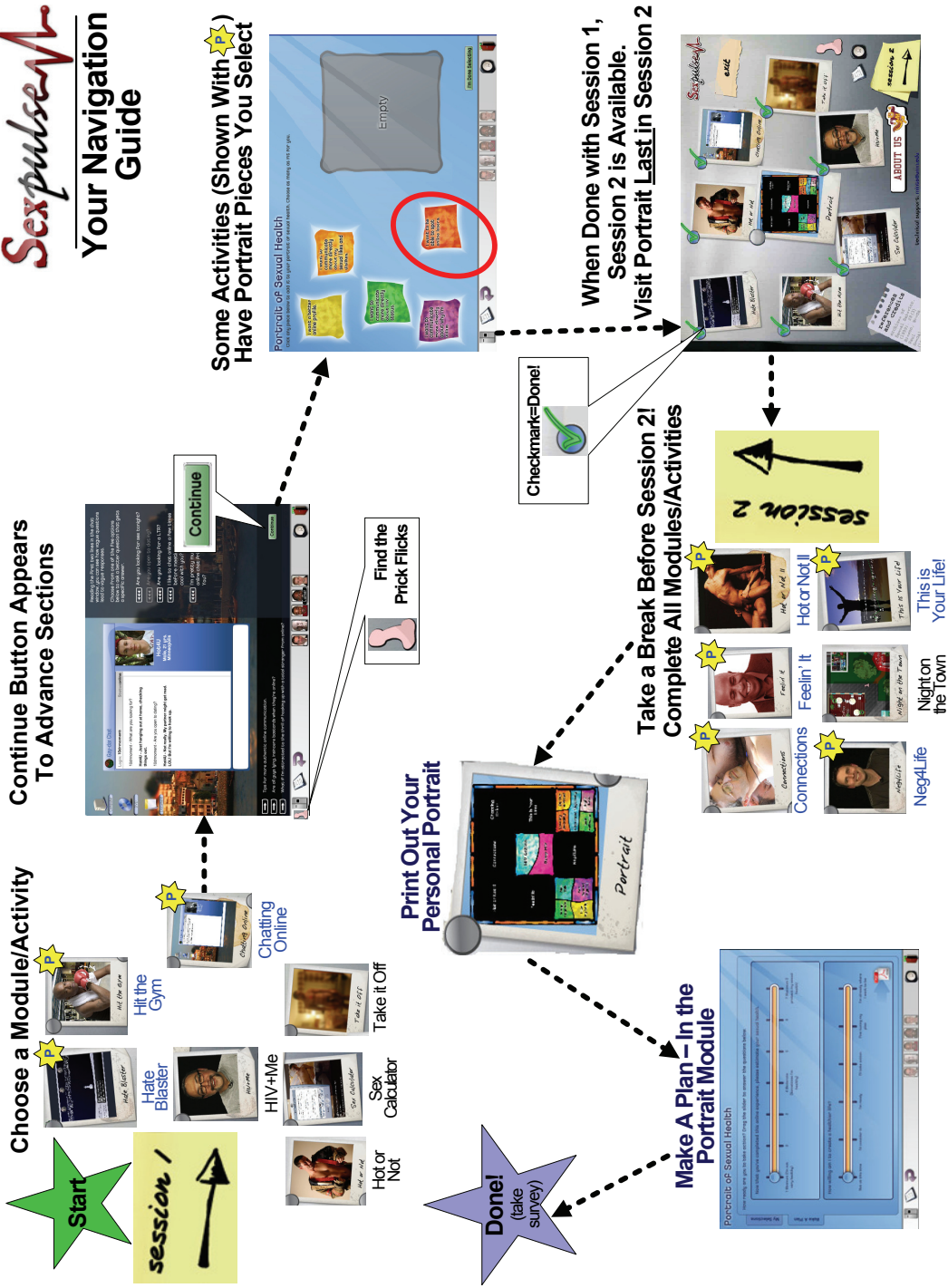


Figure A-2. Procedure organizer

# Sexpulse

## Your Guide for Use



- Where do I start?
- What is my goal?
- How do I organize my time?
- How should I think about Sexpulse?



Hate Blaster

Hit the Gym

Chatting Online

Take it Off

Sex Calculator

Hot or Not



Session 2 is available after completing Session 1. Visit Portrait module last.

Connections

Feelin' It

Night on the Town

Neg4Life

This is Your Life!

Hot or Not II

Each Module/Activity is about dimensions of sexual health:

- Intimacy
- Mental & Emotional Health
- Physical Health
- Relationships
- Sexuality
- Spirituality

### Goal:

- ✓ Build Your Portrait of Sexual Health
  - Modules with **P** have portrait pieces
- ✓ Visit Portrait module last
- ✓ Print out your Portrait
- ✓ Make your plan



### Time for Sexpulse:

- ✓ 3-4 hours to complete
- ✓ Have a quiet, interruption-free location
- ✓ Take a break between Session 1 & Session 2
- ✓ Return to Sexpulse using link in e-mail
- ✓ Finish it all up within a week



### Thinking About Sexpulse:

- Relate the activities to your own experience.
- What past experiences contribute to what you know?
- How would you like your life to be?
- As you go through Sexpulse, how does your view of yourself and your attitudes change?
- Keep notes about your experiences as you go through the modules/activities.

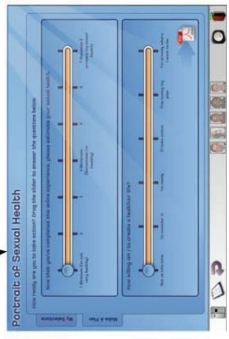


Figure A-3. Metacognitive organizer

## APPENDIX B

### ENTRY SURVEY QUESTIONS

1. How would you describe the town or community where you live?
  - a. Rural, basically farms and small towns, under 5,000 people
  - b. Small town (5,001 to 50,000 people)
  - c. Medium sized city (from 50,001 to 200,000 people)
  - d. Suburb of a large size city (more than 200,000 people)
  - e. Downtown or in the central district of a large size city (more than 200,000 people)
  - f. Other [response box]
  - g. Refuse to Answer
  
2. How many years of school have you completed, starting from grade 1 (Example: Enter "14" for 2 years of college)?
  - a. [Open ended response box with 2 values]
  - b. Refuse to Answer
  
3. What is your primary occupation?
  - a. Technical profession
  - a. Business profession
  - b. Human services profession
  - c. Sales/clerical
  - d. Student (skip Q4 if checked)
  - e. Skilled worker
  - f. Unskilled worker
  - g. House person/Homemaker
  - h. Unemployed
  - i. Retired
  - j. Refuse to answer
  
4. Are you currently a student?
  - a. Yes
  - b. No
  - c. Refuse to answer
  
5. What is your annual income? (Annual income is defined here as the amount of gross, pre-tax income you earned in 2006. Example: Enter \$20,000.00 as 20000):
  - a. [Open ended response box with 9 values]
  - b. Refuse to answer

6. Are you Spanish/Hispanic/Latino?
- No
  - Yes, Mexican, Mexican American, Chicano
  - Yes, Puerto Rican
  - Yes, Cuban
  - Other
  - Refuse to answer
- Other, please specify \_\_\_\_\_
7. What is your race? Mark one or more races to indicate what you consider yourself to be.
- American Indian or Alaska Native American
  - Asian American
  - Black or African American
  - Native Hawaiian or other Pacific Islander
  - White
  - Other
  - Refuse to answer
- Other, please specify \_\_\_\_\_
17. Have you been diagnosed with HIV?
- Yes, within the last 3 months
  - Yes, but not in the last 3 months
  - No, I have never been diagnosed with HIV
  - Refuse to answer
23. In the last 3 months, of the [Question22] male(s) you met online and then had anal sex with, with how many did you have unprotected anal sex (no condom) at least once? (Enter 0, if none.)
- [Open ended response box with 4 values] [if 0, skip to 25]
  - Refuse to answer
28. In the last 3 months, of the [Question27] male(s) you met OFFLINE and had anal sex with, with how many did you have unprotected anal sex (no condom) at least once? (Enter 0, if none.)
- [Open ended response box with 4 values] [if 0, skip to 30]
  - Refuse to answer

APPENDIX C

EXIT SURVEY AND 3-MONTH FOLLOW-UP SURVEY QUESTIONS

6. The activities I did in Sexpulse changed my ideas about sexual health and HIV.
- |                   |   |                            |   |                |                  |
|-------------------|---|----------------------------|---|----------------|------------------|
| 1                 | 2 | 3                          | 4 | 5              | X                |
| Strongly disagree | → | Neither disagree nor agree | → | Strongly agree | Refuse to answer |
8. I learned ideas in Sexpulse about sexual health and HIV that I could use to understand aspects of my life.
- |                   |   |                            |   |                |                  |
|-------------------|---|----------------------------|---|----------------|------------------|
| 1                 | 2 | 3                          | 4 | 5              | X                |
| Strongly disagree | → | Neither disagree nor agree | → | Strongly agree | Refuse to answer |
9. After completing Sexpulse activities, I found my self thinking about the ideas contained in these activities.
- |                   |   |                            |   |                |                  |
|-------------------|---|----------------------------|---|----------------|------------------|
| 1                 | 2 | 3                          | 4 | 5              | X                |
| Strongly disagree | → | Neither disagree nor agree | → | Strongly agree | Refuse to answer |
10. I talked about the ideas and activities in Sexpulse with at least one other person.
- |                   |   |                            |   |                |                  |
|-------------------|---|----------------------------|---|----------------|------------------|
| 1                 | 2 | 3                          | 4 | 5              | X                |
| Strongly disagree | → | Neither disagree nor agree | → | Strongly agree | Refuse to answer |
12. How would you rate the downloaded one-page user guide?
- Not at all helpful
  - Slightly helpful
  - Somewhat helpful
  - Mostly helpful
  - Very helpful
  - Don't Know/Unsure/Didn't download it
  - Refuse to answer
18. How much effort did you have to use to understand the materials in Sexpulse?
- |                       |   |   |   |   |                        |   |   |   |                  |
|-----------------------|---|---|---|---|------------------------|---|---|---|------------------|
| 1                     | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | X                |
| Very, very low effort |   |   |   | → | Very, very high effort |   |   |   | Refuse to answer |

19. How much stress, annoyance, discouragement or irritation did you feel during the modules/activities in Sexpulse?
- |                       |   |   |   |   |                        |   |   |   |                  |
|-----------------------|---|---|---|---|------------------------|---|---|---|------------------|
| 1                     | 2 | 3 | 4 | 5 | 6                      | 7 | 8 | 9 | X                |
| Very, very low stress |   |   |   | → | Very, very high stress |   |   |   | Refuse to answer |
20. How much mental and physical activity did you have to use to complete the tasks in the Sexpulse modules/activities as opposed to understanding the content (readings) in the Sexpulse activities?
- |                         |   |   |   |   |                          |   |   |   |                  |
|-------------------------|---|---|---|---|--------------------------|---|---|---|------------------|
| 1                       | 2 | 3 | 4 | 5 | 6                        | 7 | 8 | 9 | X                |
| Very, very low activity |   |   |   | → | Very, very high activity |   |   |   | Refuse to answer |
35. What were the 3 most helpful aspects or things you really liked about the Sexpulse site?
- [Open ended response box with 250 characters]
  - [Open ended response box with 250 characters]
  - [Open ended response box with 250 characters]
36. What were the 3 least helpful aspects or things you disliked about the Sexpulse site?
- [Open ended response box with 250 characters]
  - [Open ended response box with 250 characters]
  - [Open ended response box with 250 characters]
37. What suggestions do you have to improve the site?
- [Open ended response box with 250 characters]
  - [Open ended response box with 250 characters]
  - [Open ended response box with 250 characters]
42. Thinking of your experience using Sexpulse, please describe which aspects of that experience evoked the strongest memories or feelings. [Text box for open response 2000 characters]

*3-Month Follow-Up Survey*

4. In the last 3 months, of the [Question3] men you met online and then had anal sex with, with how many did you have unprotected anal sex (no condom) at least once? (Enter 0, if none)
- a. [Open ended response box with 4 values] [if 0, skip to 6]
  - b. Refuse to answer
9. In the last 3 months, of the [Question8] male(s) you met OFFLINE and had anal sex with, with how many did you have unprotected anal sex (no condom) at least once? (Enter 0, if none)
- a. [Open ended response box with 4 values] [if 0, skip to 11]
  - b. Refuse to answer
31. Over the last 3 months, how has Sexpulse influenced your thoughts, attitudes, or behavior? These can be positive or negative, such as talking more openly about sex, or not feeling as good about your body image.  
[Open ended response box with 2000 characters]
29. Over the last 3 months, I thought about the ideas contained in Sexpulse (the online games and activities).
- |                   |   |                               |   |                |                  |
|-------------------|---|-------------------------------|---|----------------|------------------|
| 1                 | 2 | 3                             | 4 | 5              | X                |
| Strongly disagree | → | Neither disagree<br>nor agree | → | Strongly agree | Refuse to answer |
30. Over the last 3 months, I talked about the ideas and activities in Sexpulse with at least one other person
- |                   |   |                               |   |                |                  |
|-------------------|---|-------------------------------|---|----------------|------------------|
| 1                 | 2 | 3                             | 4 | 5              | X                |
| Strongly disagree | → | Neither disagree<br>nor agree | → | Strongly agree | Refuse to answer |