The role of experience and active learning in web-based training for applying knowledge

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THE ROLE OF EXPERIENCE AND ACTIVE LEARNING 
IN WEB-BASED TRAINING FOR APPLYING KNOWLEDGE

A Dissertation

Submitted to the Graduate Faculty of the 
Louisiana State University and 
Agricultural and Mechanical College 
in partial fulfillment of the 
requirements for the degree of 
Doctor of Philosophy 

in 
The Department of Psychology

by 
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December 2001
Acknowledgments

I would like to acknowledge the support of the Louisiana State University Faculty in the Department of Psychology. Of special recognition is my advisor, Dr. Robert C. Mathews, for his wisdom, inspiration and guidance throughout my graduate experience. I am also eternally grateful to Dr. Jason L. Hicks, Dr. James H. Wandersee, Dr. John Northup and Dr. Andrea L. Houston for their invaluable comments and discussion.

Immensely helpful for contributing to my emotional stability is my spouse, Jeffrey L. Dunaway, who has so graciously endured countless late nights and lost weekends that inevitably accompany completing a doctoral degree. In addition, I would like to thank my friend, Susan G. Thomason for her solace and continued support. I am also especially grateful to my parents, Frank and Juanita D. LoCicero, my sister, Rose L. Stern, my late grandparents, Jose and Juana U. Davis, and my constant companions, Bubbles, Rainbow and AngelBaby. Finally, I would like to thank David and Maria D. Bydaleck, Rosa D. Drake, Vicente and Dora Davis, Dolores D. Loyacano and Luis and Toni D. Pettus for their love and support.
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Abstract

The purpose of this study was to test a new method for presenting information on the internet in a format that enhances adaptive learning and transfer to real-world applications. This web-based training method, called Cognitive Toolboxes (Mathews, 2001) involves analyzing course content into goal-based categories (toolboxes) linked to sets of knowledge facets (tools) and applications (cases). Three experiments examined the effects of internet access to different aspects of toolbox content (tools, toolbox names and cases) on subsequent application of the material to real-world problems. Results show that access to the organizational aspects of the method (tools organized into toolboxes) facilitated transfer for class members. Upper level undergraduate students not enrolled in the course demonstrated high levels of far transfer only when they were exposed to all of the cognitive toolbox contents (tools, toolbox names and cases) and were required to apply the material to solve their own personal problems. Memory of the knowledge facets (tools) was equivalent whether students developed their own organizational scheme or used the one provided by the course instructor (toolbox names).
Introduction

The transfer of knowledge or the process of how experience in one task has an effect on performance in a different task has been an important area of study in psychology and education. Common ways of organizing this research is in terms of near and far transfer (Detterman, 1993). Near transfer occurs in situations that are identical except for a few important differences. For example, if a person learns to draw a three-inch line and returns two weeks later to learn how to draw a five-inch line; the advantage of learning to draw a five-inch line could be attributed to near transfer from learning to draw a three-inch line. In other words, near transfer occurs when there is a similarity between the learning situation and the new situation. However, if a person in a list-learning experiment memorized a poem faster as the result of participation in a list-learning experiment, the transfer would be referred to as far transfer. In this case, far transfer occurs when there is a difference between the original and new situation.

Gick & Holyoak (1983) found that students often fail to transfer what they have learned to a similar problem when the transfer problem is presented immediately after training. Surprisingly, these same results were found even when the solution strategy was explained during training (Gick & Holyoak, 1983) and in particular when the training and transfer problems differed in surface features (Holyoak & Koh, 1987). Many researchers have also found that when much of what an individual has been taught becomes inert, that knowledge may not be used or transfer to real-world situations where it should ultimately be applied (Caramazza, McCloskey, & Green, 1980; Towbridge & McDermott, 1981; Wandersee, Mintzes, & Novak, 1994).
One major reason transfer does not occur is due to the failure of people to retrieve the relevant information (Atkinson, 1975; Levin, 1981). Mnemonic strategies are referred to as techniques or devices that serve to enhance the storage and retrieval of information contained in memory. Specifically, organizational mnemonics are described as knowledge structures in memory that mediate learning similar to certain types of schemas (Bellezza, 1987). Thus, the use of mnemonics has had a long history in that they have been utilized in Western civilization since at least the times of the Greeks. A good example of using an organizational mnemonic may be the use of a linguistic schema for comprehending a sentence or a cultural schema for interpreting a myth or even a means-end schema for solving a logical problem.

While there has been considerable research on mnemonics to enhance learning, these theories and results have not been applied to transfer. The difficulty in applying mnemonics to far transfer is that by definition the retrieval cues will be quite different in the target situation because the source and target problems are very different. Dr. Mathews’ (2001) Cognitive Toolbox method attempts to solve the problem by reorganizing course content into general purpose, goal-based categories (e.g., knowledge used to persuade, create, reason) and demonstrating their application in several cases. It is hypothesized that by training in analyzing the source problem into these common sub-goals to solve different problems, the learner can notice and retrieve the relevant information in far transfer situations. The purpose of this dissertation was to test the effectiveness of this toolbox format for enhancing far transfer.

Teaching for Transfer

Basically, psychologists and educators suggest that the phenomenon of transfer is what connects expertise, theories of intelligence and education. It is generally believed that learning a skill or subject area can help an individual learn a related one. Thus, if knowledge from Task A
transfers to Task B, individuals who have learned A should be able to learn B more rapidly than people who did not first learn A and we should be able to determine when transfer occurs (Bruer, 1995; Butterfield & Nelson, 1989; Ford, Smith, Weissbein, Gully & Salas, 1998; Osman & Hannafin, 1993; Larkin, 1989). For example, if we initially learn tennis, we should be able to easily learn ping pong. In other words, old skills or knowledge are being used in a novel situation where new things also have to be learned.

To this end, a challenging goal in education and job training involves developing effective instruction that will transfer to real-world problems. If teaching to promote transfer of knowledge is key to achieving this goal, what types of knowledge and skills transfer between tasks? Interestingly, although theories differ in their assertions on what, whether and when knowledge transfers from one task or domain to another, three components have been implicated in the transfer and mnemonic literatures as methods for enhancing transfer, namely, schema induction, active learning and organizational mnemonics.

Schema Induction and Analogical Reasoning

A schema is defined as a cluster of knowledge that represents a particular generic procedure, object, percept, event, sequence of events or social situations (Gick & Holyoak, 1980, 1983; Guberman & Greenfield, 1991; Rumelhart & Norman, 1978). Generally, there are five characteristics of schema models that are shared by theorists who propose these models, namely, abstraction, instantiation, prediction, induction and hierarchical organization. For instance, abstract schema representations are considered crucial to generalized transfer. According to Guberman and Greenfield (1991), conditions that foster abstract schemas include: (a) the use of a tool or procedure in a variety of problem-solving contexts, (b) reflection on the structural
similarity of problems and their solutions from diverse domains, and (c) exploration of problems and their solutions under conditions of low goal specificity.

Transfer sometimes depends on noticing an analog between the target and source problems. Problem solving by analogy involves solving a problem while using a solution to a related problem (Gick & Holyoak, 1983). This requires being able to understand that the basic structure of the two problems are similar and inferring the appropriate solution for the current problem from the analogous problem. The more a person has thought about the underlying ideas of an analogous problem(s), the more likely it is going to be used. Gick and Holyoak (1983) refers to this concept as the abstraction of schemas or schema induction. They found that if you give learners multiple problems and force them to infer the general, underlying patterns of the analogies across the problems, they are more likely to use the analogies.

Gick & Holyoak (1983) presented participants with a General / Fortress problem (source) presented below:

A small country was ruled from a strong fortress by a dictator. The fortress was situated in the middle of the country, surrounded by farms and villages. Many roads led to the fortress through the countryside. A rebel general vowed to capture the fortress. The general knew that an attack by his entire army would capture the fortress. He gathered his army at the head of one of the roads, ready to launch a full-scale direct attack. However, the general then learned that the dictator had planted mines on each of the roads. The mines were set so that small bodies of men could pass over them safely, since the dictator needed to move his troops and workers to and from the fortress. However, any large force would detonate the mines. Not only would this blow up the road, but it would also destroy many neighboring villages. It therefore seemed impossible to capture the fortress. However, the general devised a simple plan. He divided his army into small groups and dispatched each group to the head of a different road. When all was ready he gave the signal and each group marched down a different road. Each group continued down its road to the fortress so that the entire army arrived together at the fortress at the same time. In this way, the general captured the fortress and overthrew the dictator.
Upon completing this scenario, participants were given the x-ray / tumor problem (target) below and asked to find a solution:

Suppose you are a doctor faced with a patient who has a malignant tumor in his stomach. It is impossible to operate on the patient, but unless the tumor is destroyed the patient will die. There is a kind of ray that can be used to destroy the tumor. If the rays reach the tumor all at once at a sufficiently high intensity, the tumor will be destroyed. Unfortunately, at this intensity the healthy tissue that the rays pass through on the way to the tumor will also be destroyed. At lower intensities the rays are harmless to healthy tissue, but they will not affect the tumor either. What type of procedure might be used to destroy the tumor with the rays and at the same time avoid destroying the healthy tissue? (Gick & Holyoak, 1983, p. 3).

Remarkably, only 30% of the participants were able to spontaneously produce a convergence solution (e.g., splitting up a single force into multiple, smaller forces to converge on a central target) to the x-ray / tumor problem without the benefit of a hint (Gick & Holyoak, 1980, 1983; Holyoak & Koh, 1987; Ross, 1987, 1989a). Initially, participants were given the source as well as multiple source analogues with instructions to outline the similarities that were shared by the multiple examples. By participating in this exercise, the participants were more likely to notice the structural appearance of the problems while ignoring the surface features that were dissimilar. Moreover, the process of comparing two problems in the exercise may also enable participants to induce schemas in order to apply it to a novel, structurally similar problem.

In another experiment, for example, subjects were tested on their abilities to induce a schema from a verbal description of the underlying concept behind the convergence solution (i.e., If you need a large force to accomplish some purpose, but are prevented from applying such a force directly, many smaller forces applied simultaneously from different directions may work just as well.) when it was presented with a single version of a convergence problem (e.g., General / Fortress problem). Unfortunately, there were no differences in the rate of transfer
between the story plus concept, concept alone or story alone conditions. In the next experiment
the convergence solution was presented visually which included a diagram with arrows
converging on a central location rather than a verbal description. However, this manipulation
also did not have an effect on the rate of transfer. The same researchers conducted three
additional experiments that investigated the formation of schemas with two source analogs. In
each condition, the subjects had to describe how the two stories were similar and upon
completion, they were given the radiation problem. The data indicated that two source analogues
significantly provided the convergence solution more often than one source analogue.
Interestingly, the quality of the schemas induced by participants predicted success in producing
the convergence solution (90% of participants who failed to produce the convergence solution
also produced poor schemas) (Gick & Holyoak, 1983).

In summary, previous research suggests that schema induction or abstracting essential
elements from one or more applications of analogous solutions to problems may be extremely
beneficial in enhancing transfer. Moreover, they found a significant increase in transfer when
the verbal statements used in the study were paired with two analogs as compared to a single
analog. Thus, it seems that any device that will highlight the causally relevant correspondences
between problem analogs will facilitate abstraction of an effective schema. Schema induction
has been shown to increase the probability that not only will an analogy be noticed, but that a
problem schema will aid in simplifying the process of mapping prior information with the new
problem in order to generate the analogous solution.

In addition to using examples or cases for schema induction, the use of cases in general
as part of training has been shown to benefit transfer. Using cases in training contextualizes
knowledge and shows students how to think about problems in expert ways (Kleinfeld, 1991). Proponents of using cases in education argue that it helps students learn to apply research and theory to practical situations, increases situational knowledge in professional domains and develops more realistic attitudes (Christiansen, 1987; Shulman, 1991; Masoner, 1988). The researchers also found that the use of cases was successful with both young undergraduate students as well as nontraditional students with greater life experience.

Schema Training

Schema training has been identified as involving the development of cognitive structures that provide a conceptual framework for comprehension (Gordon & Braun, 1985). This type of training has been shown to help learners generate perspectives that can be reconciled, rejected or reconstructed as new knowledge is acquired. Schema knowledge is important in acquiring learning strategies, understanding their utility and identifying their range of application.

Hannafin and Rieber (1989) found that schema knowledge helps to create a “need to know” that must be resolved to promote understanding. Thus, an activated schema generally enhances comprehension and provides the background structures necessary for meaningful understanding. Simultaneously, schemata may supply the scaffolding needed by some students to make informed metacognitive assessments. Therefore, schema training may be important to both meaningful learning and successful self-regulation.

Three types of training may help to generate both schema and metacognitive knowledge, namely blind, informed and self-control training (Brown, Campione & Day, 1981). Blind training involves inducing a particular strategy without explaining why and when to use that strategy. For example, learners trained to use a category grouping strategy for retrieval of a
randomly ordered list of words, without being given a rationale for the strategy, do not include support for how to apply it. Consequently, blind training has been found to be effective for near transfer tasks, but has failed in maintaining or promoting strategy use. On the other hand, informed training has been shown to improve both learning and strategy maintenance as students are persuaded to use a strategy with an understanding of its significance. The learner’s awareness of the strategy seems to promote continued use without the necessity of prompting. However, the transfer and maintenance of the strategy use may be a function of the efficiency and precision of the strategy training. The data supports the notion that students who master the strategy during training are most likely to maintain it (Brown, Day & Jones, 1983).

Finally, in self-control training learners are instructed on strategy use as well as on how to independently employ, monitor and evaluate the strategies. Self-control training includes developing an awareness of one’s mental processes and the tools in which they can be effectively and independently used and monitored. Therefore, this type of training has been shown to be effective in promoting self-sufficiency and improving the learner’s performance. As such, learners develop less dependence on explicit prompting mechanisms that are embedded in instruction and greater reliance on their own use of strategies.

To sum, schema training has been shown to be effective in improving learner comprehension and self-sufficiency. The emphases on training learners in “what to do” as well as “how to do it” are important components of strategy use. Simultaneously, the learner may become less dependent on explicit prompting while relying on internalized comprehension monitoring strategies.
Active Learning

Ball’s (1995) paper on enriching student learning through innovative real-life exercises emphasized the importance of learning rather than teaching, moving from the transfer of knowledge toward the acquisition of knowledge, the significance of deep learning, the development of skills and the value of real-world learning experiences. Specifically, traditional teaching methods have not facilitated deep learning which has gained increased support in recent years. The important components of deep learning that are crucial to transfer include understanding and the application of knowledge as well as the development of problem-solving skills. Therefore, the development of transferable skills may be enhanced by broadening the learning environment and lessening passive teaching styles. As such, an emphasis on active learning has been shown to facilitate the process of “learning how to learn.”

A good example of active learning is group work in which students are given the opportunity to work together in groups for the interchange of ideas, theories and insights. Group work has also been identified as beneficial to both problem-solving and the ability to work effectively as part of a team. Thus, designing group activities that include real-life experiential learning situations with applications to real-world problems may be immensely valuable to students and employees in the workforce. These skills have been shown to facilitate the development of deep learning since students are exposed to a learning environment that includes a dynamic, collaborative and interactive process (Graham & Stewart, 1994).

Understanding the underlying mechanisms in the process of transfer may identify key factors influencing the nature and outcome of each state. Separating the “how” of transfer from the “what” of transfer may explain how previously acquired knowledge is transferred and may
prove useful as a tool for enhancing the understanding of transfer (Gick & Holyoak, 1987; Salomon & Perkins, 1989). One body of literature on mnemonic strategies that seem most useful to transfer is the use of organizational processes.

Organizational Mnemonic

Bellezza (1987) argues that organizational mnemonics are basically knowledge structures in memory that mediate learning similar to certain types of schemas. In this way, a schema has been described as a plan, outline, structure, framework or program with the assumption that they are abstract cognitive, mental plans that serve as guides for action. Although schema-based learning has often been considered a natural form of learning while using mnemonics has been referred to as an unnatural form of learning, both are similar in their manner of operations. As mentioned above, both enhance learning by a process of proactive facilitation or the use of old associations and relations. In addition, organizational mnemonics and schema-based learning have also been described as involving the activation of an organized knowledge structure in memory which provides mental cues for an association of new information.

Nevertheless, an important question that has been addressed by researchers is whether schemas and organizational mnemonics are the same type of memory structure exhibiting the same type of learning. Bellezza (1996) argues that the answer to this question is no, however, a number of similarities exist between them. As such, the similarities and differences between schemas and organizational mnemonics have been described in four characteristics of knowledge structures, namely, acquisition, structure, activation and function.

First, the concept of acquisition as a knowledge structure is similarly represented as sets of declarative knowledge that are acquired over time resulting from repeated exposure or study.
Generally, the links established by schemas and organizational mnemonics are strengthened as a subassembly in a larger associative network. On the other hand, mnemonic devices differ from schemas as the former is typically the result of deliberate learning while the latter are not. Hence, the memory of a schema is often abstracted from the experience of similar events whereas organizational mnemonics are typically learned as a stereotyped set of mental cues (Brewer & Nakamura, 1984; Galambos, Abelson & Black, 1986).

Second, schemas and organizational mnemonics both share an organized hierarchical structure. However, schemas differ in that they may be dual-purpose structures while organizational mnemonics function solely as organizational mnemonics. For example, a cognitive map can function as a schema to represent the structure of the environment as well as an organizational mnemonic. The knowledge of one’s home may function as either a schema or a source of locations in the method of loci (Bellezza & Hoyt, 1992). In addition, schemas vary in their level of abstraction whereas mnemonics usually include visual imagery of physical items or locations.

Third, only a single structure can be active at any time due to the capacity limitations of conscious memory. For instance, a restaurant schema and a house schema cannot be active in memory at the same time. Similarly, only one set of mnemonic cues can be active at a time in conscious memory. The differences lie in how schemas and mnemonic devices are activated in memory. The former is automatically activated by events in the environment or by language communicated to the learner and the subsequent top-down processing is also unintentional. In contrast, the implementation of a mnemonic device is the result of a learning strategy such that activation depends on the learner’s continuing intent (Galambos, Abelson & Black, 1986).
Finally, activation of a schema consists of components that provide *mental cues* in which new information can be associated. Thus, a schema can act as an organizational mnemonic when the components have the properties of mental cues for the schema to be retrieved. For example, visiting a novel restaurant activates an individual’s generic restaurant schema such that a novel restaurant becomes associated with components within the restaurant schema. The differences occur in the way that schemas and mnemonic devices function. For instance, some schemas which are also referred to as scripts enable a person to comprehend events as well as guide behavior when participating in these events. On the other hand, a mnemonic device is not a guide for motor or social behavior. Moreover, organizational mnemonics have broad bandwidths in that they can be used to store a wide variety of information while schemas process a semantically restricted range of information.

Bellezza (1988) also investigated the reliability of retrieving script information from memory. The participants were given an example of a script including 20 typical activities involved in attending a disco on Saturday night. All participants were then given 4 min to write down the activities that were involved for each of 10 common scripts. The results indicated that knowledge from scripts that are repeatedly retrieved tend to be retrieved in the same order. However, the more actions a participant gave for a script, the greater the reliability of retrieval. Since script actions tend to be experienced together, it is probable that each experience improves memory for both the actions and their order.

To summarize, research has demonstrated that schema induction as well as elaborations of how information can be applied to specific cases (refinement) enhance transfer. In addition, developing a deeper understanding about the underlying forces and causal relationships enhance
ability to successfully apply the knowledge to new situations. Presenting information in a way that highlights what it is good for (goal-based) and abstracting common elements from analog problems (schema induction) are powerful methods for achieving transfer.

In conclusion, a challenging goal in education and job training involves developing effective instruction that will transfer to real-world problems. A recent study conducted by Dr. Robert C. Mathews and this author (Mathews & Dunaway, 2001) tested an application of the combined effects of these ideas to teaching thinking and decision making skills. A format was developed to present knowledge in a way that should enhance far transfer using schema induction, exposure to cases, active learning, application refinement and elaborate encoding for a deeper understanding of the material. This format was based on an earlier approach of Christopher Alexander (1977, 1985) for developing a pattern language in architecture.

Ultimately, our goal was to develop an optimal format for packaging knowledge on the World Wide Web such that it could be learned and applied generatively to new situations.

**Toolbox Format**

The toolbox format incorporates all of the above aspects into web pages developed for use in hypermedia that presents knowledge in a way to enhance transfer. Alexander’s (1977, 1985) pattern language has been successful in preserving and communicating effective knowledge in architecture. His pattern format consists of a title, a context that conveys where the information is useful, an analysis of the underlying forces to be resolved, an optimal solution, and an archival example or case where the solution is applied. For example, the pattern provides associations related in various ways such as patterns for siting windows with patterns for
designing entrance ways. Specifically, Alexander’s pattern language includes abstraction of the underlying schema for solutions and connecting the schema with a detailed application.

Based on the above findings from the transfer and memory literature, Alexander’s (1977, 1985) pattern language was modified into a toolbox database to incorporate enhancements to transfer. The toolbox database contains the following components:

1. **Title:** The title is goal-based and explains what the toolbox is for.

2. **Tools:** The tools are pieces of knowledge used to design the solution. They are also general and can be applied in a variety of situations and may be used in more than one toolbox.

3. **Case Journal:** The case journal is a method for applying the toolboxes and the specific tools to a personal problem situation.

The *toolbox database website* (Mathews & Dunaway, 2000a) included four toolboxes, a case journal, a case journal follow-up and case database.

Briefly, this study consisted of four toolboxes (i.e., create, persuade, change, solve) that focused on key lessons from lectures presented to the class. The create toolbox is presented below as an example:

1. **Toolbox Title:** Create

2. **Tools:**

   a. Notice opportunities

   b. Directed remembering

   c. Seek criticism

   d. Create playful environment

   e. Persistence
f. Mesh with the experts

3. **Case Journals:**

   a. Teacher trying to stimulate creativity in children

   b. Scientist

   It is important to note that each of the tools was applied to each one of the two case journals separately. For example, in the case journal of a teacher trying to stimulate creativity in children, the first tool corresponds to the first application in the case journal and so forth. Thus, an example of applying each of the tools to the teacher case journal is presented below:

   a. **Teacher trying to stimulate creativity in children**

      1. Do not insist that they follow the assignments verbatim.

      2. Practice brainstorming as a group and get everyone to generate ideas including wild ones.

      3. Show how criticism can make an idea better and encourage kids to seek feedback to improve their work.

      4. Create a fun, error tolerate atmosphere. Encourage risk taking.

      5. Encourage reworking projects to make them better. Tell stories about persistence paying off.

      6. Get talented children to enter work in adult competitions. Explain how knowledge can hinder new discoveries.

   In a between-subjects design, students either volunteered to participate in the experiment (toolbox condition) or declined to participate (control). A baseline measure consisted of the midterm exam scores in the course and all of the students were given the same transfer test
during the final exam. In the toolbox condition, the students attended three sessions in a computer lab on campus and had to score at least 90% on a memory test. In session 1, the students accessed a website via computers that presented the toolboxes as a series of web pages. Each student browsed the toolboxes and was instructed to memorize the tools in each of the four toolboxes for a memory test to be given at the beginning of session 2.

The goal of session 2 was to reproduce from memory all of the tools from the toolboxes with a score of at least 90%, to apply each of the toolboxes to case journals from a given domain on forms provided on the website and a group activity. The group activity included students who were assigned to small groups of 2 to 3 students as a practice session for creating a new toolbox. The goal of session 3 was to apply each of the toolboxes to case journals from a different domain of their choice, individually create a new toolbox and post the new toolbox in the discussion board included on the website. The discussion board included a search engine as well as hyperlinks in a table of contents that listed each of the newly created toolbox titles. Thus, the participants were able to post, view, search and reply to each of the new toolboxes via the website.

A transfer test was administered as part of the midterm and final exam. The results indicated that there was not a significant difference between the two groups for the midterm which was before the toolbox intervention. However, the toolbox condition was significantly different from the control condition for the final exam. The data suggested that the degree of transfer on the transfer test in the toolbox condition resulted in significant evidence for facilitating transfer.
Although the transfer literature is clear that transfer may be enhanced by implementing a retrieval plan with an organized set of cues or a good organized plan such that cues are organized so that no cue is likely to be forgotten, how can this be the case if our primary goal for enhancing transfer generally occurs in *unpredictable* domains. In other words, in our attempt to apply organizational mnemonic strategies for enhancing transfer, is the use of a retrieval system beneficial to transfer? Since the mnemonics literature emphasizes the use of mnemonic strategies that provide the use of a retrieval system, a method for self-cuing, organizing and encoding operations, the use of organizational mnemonics based on links, how can the goal of transfer best utilize organizational mnemonics?

The answer may lie in the toolbox format since it includes a method for organizing and applying information that is goal-based in origin. That is, even though we can’t predict the specific retrieval domain, if our knowledge structure has been organized on the basis of general goals such as those established in the toolbox format, we may be able to retrieve the tools when we need it for transfer. In another recent study (Mathews & Dunaway, 2001), the toolbox format was modified such that the tools for the specific toolbox and the total toolboxes for the class were increased from 4 to 10 toolboxes. In addition, the two case journals that were *provided* for the students were replaced by a case journal that consisted of a real-life problem that the student was presently experiencing. In this way, the participants had access to the toolboxes and their case journals were created into a *case journal database* (Mathews & Dunaway, 2000b) that each of the participants could also access on the website. An example of a case journal submitted by one of the participants that now also included website forms for describing the problem situation, a goal statement and a topic are as follows:
**Problem:** My boyfriend is naturally pessimistic. He is going to graduate in August and is beginning to doubt the possibility of his acceptance to medical school.

**Goals:** I want to figure out the best way to motivate him to think more positively about things. To see mistakes as an opportunity to grow, rather than something that decreases self-esteem. I want him to understand that it is never bad to keep your options open, without making him think that he should give up on the idea of medical school.

**Topic:** Motivating an individual to see occurrences from a more proactive and positive perspective. Example: the possibility of not getting accepted to medical school.

**Tools:**

1. Notice opportunities
2. Evaluate evidence
3. Be flexible
4. Examine different perspectives
5. Analyze validity of sources
6. Motivation
7. Appeal to instincts
8. Persistence
9. Make it stick with stories
10. Recognize goals
Case Journal:

1. Explore the idea that maybe he wouldn't be happy being a doctor anyway. This may be an opportunity for him to explore other career options. Options that may allow more time for him, less time on call, less stress, etc.

2. Evaluate the basis of his doubts. Is there real evidence of a possibility for rejection? Or is this just based on his pessimistic nature?

3. Help him to see that nothing is definite at this point in time. It is a good idea to keep his options open, without totally giving up on the idea. Even if he doesn't get accepted this year, it doesn't mean that he can't begin grad school and reapply next year.

4. Maybe there is a way he can speak to professors, doctors, nurses, therapists, etc. Talk to them about their perspectives on the positive and negative aspects of their careers. This can help him see that he has many options to think about. What is good for one individual is not necessarily good for the next.

5. Find out what it is that is making him have doubtful feelings about acceptance, and analyze whether these are valid concerns. Ex. If he thinks his MCAT score is not high enough, research to find out from the source itself (the med schools) what their average score is. Did he get his information through the grapevine or straight from the horses mouth?

6. I need to motivate him to think positive about all aspects of his life, to not let this situation bog him down.

7. When discussing ideas for alternate plans for the future, suggest carriers in
the medical field (besides physician) that offer a nice salary.

8. Be persistent with feedback. I can't let him doubt himself or his abilities. Whether or not he gets accepted to med school he needs to be aware that he is an extremely intelligent individual. At this point all he can do is be "persistently" patient.

9. My mother has so many real life stories about friends of hers (she works in a hospital) who wanted to go to med school, but didn't get accepted; nurses who decided afterward to go to med school; doctors who hated their jobs; etc....Next time he and I go home to visit our parents, I can get my mom to tell relevant stories.

10. I can get him to think about why he wanted to be a doctor in the first place...to help cancer patients and their families. By remembering his original goal, maybe he will realize that there are more ways to reach this goal. You don't have to be a doctor to reach this goal.

In this study, the participants were instructed to select the relevant toolboxes for their real-life problem and for each relevant toolbox to select the tools that might apply via forms provided on the website (Mathews & Dunaway, 2000b). Thus, the total amount of tools selected to be applied to their problem in the case journal were open-ended.

The results suggest that there was not a significant difference between the toolbox condition and the control for the final exam. The data indicated that a lack of an effect between the two groups on the application transfer test may have been due to the existence of a ceiling effect. The failure to observe any improvement in performance may have resulted because all of
the students in the class, regardless of whether they participated in the experiment, were exposed to lectures on the toolbox format and the ten toolboxes. In addition, all students were also allowed access to the toolbox website regardless of whether they participated in the study. It is possible that exposing all of the students in the course to both the toolbox lectures and the toolbox database website may have contributed to everyone earning high scores on the application transfer test.

The three experiments conducted in this dissertation attempted to replicate and extend the findings of the toolbox database studies while addressing some of the problems with the second study discussed above. Experiment 1 investigated browsing cases and being given the 10 toolboxes with both students enrolled in a thinking and decision making course and a subject pool not enrolled in the course. The second experiment evaluated the degree to which developing case journals enhanced transfer. Experiment 3 focused on the effect of tool organization on transfer of knowledge.
Experiment 1

Experiment 1 attempted to discriminate and experimentally separate the effect of presenting knowledge in a toolbox format from exposure to cases. The three groups that were investigated include: (1) exposure to toolboxes, (2) exposure to cases, and (3) exposure to both toolboxes and cases. In addition, the participants in the study were enrolled in either an undergraduate thinking and decision making course (members) or they were not enrolled in the course (non-members).

The purpose of the toolbox format was to summarize and reorganize the most useful knowledge from the lectures in terms of a small number of general purpose goal-based categories (the toolbox names). The purpose of the cases was to demonstrate how the tools could be adaptively applied in more than one domain which should facilitate schema induction (Gick & Holyoak, 1983). It might be expected that the mnemonic aspect of the toolboxes would be most helpful for the members because they already received in depth examples of applications in lectures. As such, non-members might require the cases to understand how to apply the tools.

Method

Participants

The participants were 61 junior and senior students enrolled in the Psychology of Thinking and Decision Making (members) course (n = 20) and non-members (n = 41) undergraduate students in psychology courses at Louisiana State University. One member participant in the exposure to cases condition withdrew from the study after dropping from the course. Four non-member participants were dropped for failing to follow instructions: two participants in the exposure to toolboxes, one participant in the exposure to cases and one
participant in the exposure to both conditions. All students were recruited to voluntarily participate in return for extra course credit.

Materials and Design

This experiment was a 3 (content: toolboxes vs cases vs both) x 2 (participants: members vs non-members) between-subjects design, which is illustrated in Figure 1. Students were randomly assigned to one of the six conditions and were run in groups of 6 to 14 students. The primary dependent variable was the application transfer test given to all of the students during the final session.

<table>
<thead>
<tr>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
</tr>
<tr>
<td>--------------</td>
</tr>
<tr>
<td>Toolboxes</td>
</tr>
<tr>
<td>Cases</td>
</tr>
<tr>
<td>Both</td>
</tr>
</tbody>
</table>

Figure 1. Design of Experiment 1

The materials included three different versions of the Toolbox Database\(^1\) website with three different website addresses (Appendix A). The browse only / toolboxes website included exposure to the ten toolboxes. The browse only / cases website consisted of exposure to a case

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\(^1\)A complete set of the 10 toolboxes and 35 cases in the case database is included in Appendix A in the browse only / toolboxes and browse only / cases websites, respectively.
database with 35 case journals from recent toolbox studies. The browse only / both condition included a website with exposure to 10 toolboxes and the case database.

Procedure

All participants were given an informed consent form and an instruction handout (Appendix B) that included the website address. In three sessions, the students were instructed to browse the 10 toolboxes and/or case database. All participants completed the same application test during the final session. To ensure that the participants read the cases, students in the cases and both conditions were required to rate each of the cases in the case database on a scale of 1 (lowest) to 5 (highest) for a quality rating. In addition, each participant was required to write a short comment on each case.

The concepts included in the toolboxes were covered in lectures, but the material was not organized in this way. In some cases, tools in a particular toolbox came from different lectures.

Toolbox Database Websites

The three versions of the Toolbox Database website (Dunaway & Mathews, 2001a, 2001b, 2001c) included a scrolling marquee with the following introduction statement:

Problem solving methods have been developed into a toolbox database. The toolboxes are a way of preserving and communicating effective knowledge that has been developed from problem solving techniques.

The browse only / cases website included the identical introduction except that the words toolbox database and toolboxes were replaced with case database and cases.

In addition, a mission statement included the following message:

Participating in this exercise will help you in preparing for the application test to be given during the last session.
Depending on the condition, each website included a variation of the same series of web pages with the following menu items: 10 toolboxes, what is a toolbox?, instructions, case database and feedback form. The feedback form was solely provided for any comments the participants may have had regarding the website and was not used as data in this experiment.

Application transfer test

All participants completed the identical application transfer test during the final session in the lab. A description of the 5 application situations and the corresponding tools that were targeted is presented in Table 1. The Target tools were identified by Dr. Robert C. Mathews, an expert in tool application. An identical application test scored by him was administered to students at the final exam who were enrolled in the course during the previous semester. Thus, the Target tools were identified as those most likely to be useful in the situation. An example of a scored application in the first situation (e.g., Evaluate arguments about hand counting ballots in Florida.) using the targeted “mesh with experts” tool included: Confer with legal and political analysts about existing laws concerning voting. An example of an inappropriately applied tool and application in the same situation included: (1) Using a tool not included in any of the toolboxes (e.g., Anxiety) and (2) Applying it to the situation (e.g., Life of two men hang in the balance based upon one states outdated balloting system).

Each application test (Appendix C) was scored by this author while being blind to participant information and conditions. The scoring was based on the total number of unique and appropriate knowledge facet-action pairs that were listed for each of five problem situations in different domains. A non-target tool was scored as correct if it was properly applied to the situation. However, duplicate knowledge facet-action pairs per situation did not count in the
total score. Each knowledge facet was based on the material that was learned from the website. The action included the potential for solving the problem or making the outcome of the situation

<table>
<thead>
<tr>
<th>5 Situations</th>
<th>Targeted Tools</th>
</tr>
</thead>
</table>
better. Each participant was instructed to write their name and title for the situation they were solving on the top of each page. In addition, they were told that each knowledge facet and each action could only be used once in each situation. Each knowledge facet was to be listed on the left side of the page and the appropriate action was to be listed directly across from the knowledge facet on the right side. Each student was instructed to complete as many knowledge facet-action pairs as possible in the allotted time. A $25.00 monetary prize was awarded to the student with the highest score.

Results

In this experiment, 2 hypotheses were tested. First, exposure to both toolboxes and cases would be better than just toolboxes or just cases for members and non-members. Second, it was predicted that exposure to cases would benefit non-members more than members.

These hypotheses were analyzed in a 3 (content: toolboxes vs cases vs both) x 2 (participants: members vs non-members) ANOVA. The means and standard deviations for the current experiment are displayed in Table 2.

<table>
<thead>
<tr>
<th>Participants</th>
<th>Toolboxes</th>
<th></th>
<th>Cases</th>
<th></th>
<th>Both</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>n</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Members</td>
<td>7</td>
<td>15.57</td>
<td>(10.92)</td>
<td>6</td>
<td>1.67</td>
<td>(.82)</td>
</tr>
<tr>
<td>Non-members</td>
<td>13</td>
<td>5.54</td>
<td>(4.27)</td>
<td>14</td>
<td>3.79</td>
<td>(3.89)</td>
</tr>
</tbody>
</table>

Transfer Rates

The primary dependent measure was the total number of applied tools on the application test. There was a significant main effect for content, $F (2, 55) = 6.71, p = .002$ which accounted for 19.6% of the variance in test scores.
There was also a significant main effect for participants, $F(1, 55) = 9.55, p = .003$ which accounted for 14.8% of the variance in test points.

In three planned comparison analyses conducted for *members*, there were significant differences between exposure to toolboxes and exposure to cases, $F(1, 17) = 6.43, p = .021$, and marginal differences between exposure to cases and exposure to both, $F(1, 17) = 3.17, p = .093$. However, there were no significant differences between exposure to toolboxes and exposure to both, $F(1, 17) = .618, p = .443$.

![Content by Participants: Browse Only](image)

**Figure 2.** Mean for Content by Participants: Browse Only

In three planned comparison analyses conducted for *non-members*, there were no differences between exposure to toolboxes and exposure to cases, $F(1, 38) = 1.41, p = .242$, exposure to cases and exposure to both, $F(1, 38) = .120, p = .731$, and exposure to toolboxes and exposure to both, $F(1, 38) = 2.34, p = .135$. 

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The data indicated a significant content by participants interaction, $F (2, 55) = 4.6$, $p = .014$ which accounted for 14.3% of the variance in test scores. The data is presented in Figure 2.

**Summary and Discussion**

This experiment was designed to accomplish several goals. The primary goal was to test the effectiveness of exposing students to toolboxes and cases on their ability to apply this knowledge in new domains. As such, the lecture materials from a Psychology of Thinking and Decision Making course were presented via a computer on the internet. Second, this study demonstrated the advantage of presenting knowledge in a toolbox format for enhancing transfer with participants enrolled as members. Thus, exposure to knowledge in this format was successful in enhancing transfer. The data suggest that the degree of transfer for members was greater with exposure to toolboxes only or with both toolboxes and cases than with cases only.

It was predicted that exposure to the toolbox format would show a higher rate of transfer than exposure to cases on the application test. For members, the data indicated that exposure to cases did not result in levels of transfer comparable to exposure to toolboxes or exposure to both toolboxes and cases. Although non-members performed best in the exposure to toolboxes condition, their level of performance was not significantly better than when they were exposed to cases or both. These data also suggest that members exposed to cases only did not benefit from the cases as they transferred the least on the application test. Therefore, it may be that enrollment in the course as well as exposure to knowledge in the toolbox format is most important for enhancing transfer. Thus, it appears that the toolbox format may be sufficient in packaging knowledge for transfer when the material was learned in a classroom but not when experiencing cases only.
The data suggested that members exposed to cases only resulted in poor performance on the application test. It is plausible that members may have become confused by exposure to cases only since information from the lectures was used in each case. For non-members, exposure to the case information was novel regardless of the way it was used. Thus, exposure to cases only for non-members does not appear to have interfered with their performance on the application test. It also appears that exposure to toolboxes for members may have overcome this problem due to its powerful organizational scheme (e.g., the toolboxes).
Experiment 2

The performance of non-members on the transfer test was quite low compared to members in Experiment 1. Experiment 2 explored whether transfer for non-members could be enhanced by stimulating a deeper understanding of the material. It was hypothesized that a more active exposure to the material during study would lead to a deeper understanding and primarily benefits the non-members. This is expected to benefit non-members most because members are already actively exposed to the material in class. It was also expected that active learning would elevate transfer for non-members to approximately the level of members. As such, active learning should enhance transfer by learning at a deeper level (Bransford, Brown & Cocking, 2000).

Finally, it was hypothesized that implicit or blocked exposure to the toolbox format in the cases condition would facilitate transfer for non-members. In this condition, the knowledge facets or tools were presented in the case development form in the same order. However, the toolbox names were not included on the form and the participants were not given any information about the toolbox format. Similar to Brown, Campione & Day’s (1981) blind training, it involves inducing a particular strategy without being given a rationale for the strategy. Thus, exposure to tools presented in the cases of the case database may enhance transfer by implicitly providing a structural organization of the information on the website (Bower, Clark, Lesgold & Winzenz, 1969). That is, if participants implicitly learn a retrieval plan or mnemonic for the tools without seeing the toolbox names or definitions, it may be sufficient for enhancing transfer.
Method

Participants

The participants were 77 junior and senior students enrolled in the thinking and decision making course (members) (n = 41) and non-members (n = 36) enrolled in psychology courses at Louisiana State University who voluntarily participated for extra course credit. Two member participants were dropped from the study: one participant in the exposure to cases withdrew from the study due to a family emergency and one participant in the exposure to both condition dropped the course. Nine non-member participants were dropped for the following reasons: three participants in the exposure to toolboxes (one for failure to follow directions, one due to a skiing accident and one was involved in a car accident), two participants in the exposure to cases (one dropped the psychology course and one had a death in the family) and four participants in the exposure to both conditions (two dropped the psychology course, one resigned from the university and one had work obligations).

Materials and Design

The materials and design were identical to those used in the previous experiment. However, in addition to the ten toolboxes and case database included in the Toolbox Database websites, three additional website versions (Dunaway & Mathews, 2001d, 2001e, 2001f) (Appendix D) were developed with the addition of a case journal and case journal follow-up. The case journal consisted of a series of form boxes for developing a plan for the problem situation. Similarly, the case journal follow-up included form boxes for describing the overall

\[\text{The case journal and case journal follow-up is included in Appendix D in the browse + case development / toolboxes website.}\]
results after implementation of the plan. The case database consisted of the same 35 case journals used in Experiment 1.

Procedure

The participants accessed websites that were identical to those used in each of the six conditions in the previous experiment except for the inclusion of a case journal and case journal follow-up forms. The experimental groups participated in six sessions and all participants were also given the same application transfer test used in Experiment 1. The students were instructed to browse the 10 toolboxes or the case database, complete three case journals and three case journal follow-ups.

In six sessions, the students completed three case journals and three case journal follow-ups on forms provided on the websites. In sessions 1, 3 and 5, each participant described a personal problem situation that they were presently experiencing, described the goals for the problem situation, selected the toolboxes that may be relevant to their problem, selected the tools for each relevant toolbox, made a plan by applying each tool, indicated whether they were going to use the plan and indicated if their case journal may be posted on the website. All students were given two weeks to implement each of the three problems described in their plan and completed each case journal follow-up for a total of six sessions.

During alternating sessions (i.e., sessions 2, 4 and 6), all participants completed the case journal follow-up by indicating on a likert scale an option that best rated their results, described their overall results as well as which tools were useful and how they were used, indicated whether they used any items not captured by their selected tools and if their case journal follow-up...
up may be posted on the website. All students completed each of the six sessions to earn extra credit. A $25.00 monetary prize was also awarded to the student with the highest score.

The participants in the cases (implicit) and both (explicit) conditions were also required to rate and evaluate each of the cases included in the case database. In addition, the participants in the cases condition were not exposed to the toolbox format. They were only exposed to the tools that were used in the cases presented in the case database.

Results

This experiment tested two hypotheses. First, it was predicted that active learning would result in greater transfer of knowledge for non-members. If this hypothesis was correct, then active learning should significantly increase performance for non-members on the application test. Second, another prediction was that non-members in the exposure to cases condition (implicit) may facilitate transfer if they implicitly learned a retrieval plan while being blocked from the toolbox format.

These hypotheses were also tested in a 3 (content: toolboxes vs cases vs both) x 2 (participants: members vs non-members) ANOVA. All data for the second experiment are displayed in Table 3.

Transfer Rates

The primary dependent measure was also the total number of applied tools on the application test. There was a significant main effect for content, \( F(2, 71) = 5.01, p = .009 \) which accounted for 12.4% of the variance in test scores.

There was also a significant main effect for participants, \( F(1, 71) = 13.29, p = .001 \) which accounted for 15.8% of the variance in test scores.
Table 3. Results of Experiment 2

<table>
<thead>
<tr>
<th></th>
<th>Toolboxes</th>
<th>Cases</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n  M     SD</td>
<td>n  M  SD</td>
<td>n  M  SD</td>
</tr>
<tr>
<td>Members</td>
<td>15  17.6  (7.75)</td>
<td>12  16.42  (9.46)</td>
<td>14  22.07  (2.25)</td>
</tr>
<tr>
<td>Non-members</td>
<td>12  7.67  (2.87)</td>
<td>13  15.15  (7.79)</td>
<td>11  15.64  (8.56)</td>
</tr>
</tbody>
</table>

In four planned comparison analyses conducted for members, there were no differences between exposure to toolboxes and exposure to cases, $F (1, 38) = .181, p = .673$, and between exposure to toolboxes and exposure to both, $F (1, 38) = 2.80, p = .102$. However, there were marginal significant differences between exposure to cases and exposure to both, $F (1, 38) = 4.00, p = .053$. There were also no differences between both exposure to cases (implicit) and both (explicit) conditions contrasted with exposure to toolboxes, $F (1, 38) = .497, p = .485$. 

![Figure 3. Mean for Content by Participants: Browse+CD](image)
In four planned comparison analyses conducted for non-members, there were significant differences between exposure to toolboxes and exposure to cases, $F(1, 33) = 7.44, p = .010$, and between exposure to toolboxes and exposure to both, $F(1, 33) = 7.76, p = .009$. However, there were no significant differences between exposure to cases and exposure to both, $F(1, 33) = .030, p = .865$. There were also significant differences between both exposure to cases (implicit) and both (explicit) conditions contrasted with exposure to toolboxes, $F(1, 38) = 10.14, p = .003$.

Finally, the data indicated a marginally significant content by participants interaction, $F(2, 71) = 2.47, p = .092$ which accounted for 6.5% of the variance in test scores. These data are presented in Figure 3.

Summary and Discussion

Contrasting Experiment 1 in which students did not participate in active learning using a case journal on the website, this experiment was designed to accomplish several goals. The primary goal was to demonstrate the advantage of active learning on knowledge presented in a toolbox format for enhancing transfer. This attempt to establish the advantage of case development was successful for increasing transfer on the application test. The data indicated that in Experiment 1, the transfer rates for members in the exposure to cases ($M = 1.67$) and exposure to both ($M = 11.43$) conditions were much lower when compared to Experiment 2 ($M = 16.42$ and $M = 22.07$), respectively. Moreover, the level of transfer for non-members in Experiment 1 in the exposure to cases ($M = 3.79$) and exposure to both ($M = 3.29$) conditions increased when compared to performance in Experiment 2 ($M = 15.15$ and $M = 15.64$), respectively. Most important, the data suggest that facilitating transfer by presenting knowledge in the toolbox format may not be contingent upon being enrolled in the course.
As in Experiment 1, it was predicted that exposure to the toolbox format would facilitate a higher rate of transfer as opposed to exposure to cases. However, the data does not support this hypothesis as both members and non-members exposed to cases performed almost equally as well on the application test. This finding can be explained by participants in the cases condition being implicitly exposed to the same organizational mnemonic. Interestingly, members exposed to toolboxes only and cases only performed almost equally as well on the application test while non-members exposed to toolboxes only scored the lowest. These data suggest that case development as a form of active learning may be especially important for facilitating transfer without exposure to a course.

Another crucial finding of this experiment was that exposure to cases and exposure to both toolboxes and cases for non-members is nearly equivalent to being enrolled in the course. Therefore, it appears that enrollment in the course may not be a requirement for enhancing transfer on the application test. The present study was consistent with respect to the transfer literature which suggests that the components incorporated into the toolbox format (i.e., schema induction, schema training, cases, active learning and organizational mnemonic) work in enhancing transfer. Previous studies have found that active learning is a potent method for enhancing memory retrieval of the to-be-remembered material since it contributes to deeper processing. It was predicted that active learning would show a higher rate of transfer and the data supported this hypothesis. Therefore, it appears that presenting knowledge in the toolbox format as well as providing a case journal for case development may be sufficient for facilitating transfer.
Finally, the data suggest that non-members in the exposure to cases only (implicit) condition enhanced transfer on the application test. It appears that when non-members are exposed to cases and implicitly learn a retrieval plan without being exposed to the toolbox format, transfer may still be effective. In addition, the data indicate that the exposure to both toolboxes and cases (explicit) condition for non-members was also successful in enhancing transfer. Thus, it may be that participants exposed to both toolboxes and cases deeply understand the information they used to solve their own problems.
Experiment 3

Experiment 3 focused on the effect of tool organization on transfer of knowledge. This experiment attempted to determine the importance of different methods for organizing the tools from the 10 toolboxes. It was hypothesized that self-organization should enhance transfer. The process of active learning may result in greater transfer on the application test. The two groups that were investigated included: (1) organized toolboxes, and (2) self-organized toolboxes.

Method

Participants

The participants were 25 students enrolled as non-member junior or senior undergraduate students in psychology courses at Louisiana State University who voluntarily participated for extra course credit.

Materials and Design

This experiment was an organized toolboxes (n = 12) vs self-organized (n = 13) toolboxes between-subjects design. Participants were randomly assigned to one of the two conditions. The primary dependent variable was the same application test administered to all of the students in Experiment 1 and Experiment 2.

The materials included the same ten toolboxes presented in the Toolbox Database website (Dunaway & Mathews, 2001a) used in Experiment 1 and 2 described above. The organized toolboxes condition included the identical ten toolboxes. The self-organized toolboxes consisted of an identical list of the tools included in the ten toolboxes that were individually organized into groups (Appendix E).
Procedure

Within each condition, the participants were randomly assigned to one of the two conditions. All participants were given an informed consent and completed the study in one session. Regardless of condition, the participants performed two tasks: (1) study, and (2) an application test.

Study

In each condition, all participants were given a handout of their respective tools or toolboxes to study for 30 minutes. During this phase, the participants in the self-organized toolbox condition organized the tools into toolboxes by grouping the tools using paper and pencil while the students in the organized toolbox condition were instructed to write the tools from memory. Both groups were then given the identical 2 cases\(^3\) to study for 15 minutes. Finally, the self-organized group reorganized the tools for an additional 15 minutes and the organized group wrote the tools from memory for 15 minutes.

Application Test

After the study session, all participants completed the identical application test. The participants were given 30 minutes to complete this test. A $25.00 monetary prize was also awarded to the student with the highest score.

Results

In this experiment, one hypothesis was tested. It was predicted that self-organization may result in greater transfer of knowledge. If this hypothesis was correct, then self-organization

\(^3\)The two cases studied by both groups consisted of the “getting accepted into medical school” and “anger management” cases from the case database portion of the Toolbox Database websites.
should increase performance on the application transfer test. A two sample t-test was conducted for the application test scores. An alpha level of $p < .05$ was chosen for the interpretation of significant results.

**Transfer Rates**

The mean transfer scores in each condition are shown in Figure 4. The results indicated that there was not a significant difference between the two groups for the application test, $t(23) = .289$, $p = .775$. The data suggest that the self-organized group did not result in a higher degree of transfer. The self-organized group ($M = 14.92$) scored slightly less than the organized group ($M = 15.58$). A data chart compiled from the frequencies of each tool used by participants showed that the self-organized group used 85% of the total amount of possible tools for applications on the transfer test while the organized group used 73% (Appendix G). The data chart numbers
indicate the frequency of each tool used in each of the 10 toolboxes. In addition, a data chart of the total amount of toolbox groupings\(^4\) created in the self-organized condition on the first attempt (n = 66) compared to the second attempt (n = 68) suggest that they created nearly the same number of toolbox groupings (Appendix H). The data chart numbers indicate the specific tools that were grouped together by each participant. For example, each of the tools included in the first grouping were labeled number 1 and each of the tools included in the second grouping were labeled number 2 and so forth. Interestingly, the groupings in the second attempt increased only slightly after the participants studied the two cases before the second attempt. It is plausible that self-organizing the tools in a meaningful way may be as important as providing students with organized toolboxes for facilitating transfer.

Summary and Discussion

The purpose of this study was to investigate the effect of tool organization on the transfer of knowledge. This attempt to demonstrate the advantage of self-organization was not successful in facilitating transfer. The data suggest that the degree of transfer for the self-organizing group on the application test was not significantly different from the organized condition. These data suggest that students who self-organized the tools performed slightly less than those who were given organized tools to study for the application test.

\(^4\)Participants in the self-organized condition grouped the tools in two attempts. The first attempt represents the total amount of toolbox groupings for each participant before studying the two cases. The second attempt represents the total amount of toolbox groupings for each participant after the study session of the two cases. The total amount of toolbox groupings for all participants on the first attempt was compared to the total amount of toolbox groupings for all participants on the second attempt.
General Discussion

This dissertation included two experiments that were conducted to study transfer of knowledge following experience to two types of material on the web: (a) sets of goal-based categories (toolboxes) for useful knowledge facets (tools), and (b) cases in which the knowledge was applied to real-world problems. A third experiment examined the effect of tool organization on transfer of knowledge. This study focused on the importance of organized vs self-organized methods for organizing the tools from the ten toolboxes.

In Experiment 1, the participants were randomly assigned to one of three groups (toolboxes, cases, or both) and were instructed to browse the ten toolboxes and / or case database via a website on the internet. In addition, to ensure that the participants in the exposure to cases and both conditions read the cases in the case database, they were required to rate and evaluate each case. Three different versions of the Toolbox Database website included: (a) exposure to the ten toolboxes, (b) exposure to cases which consisted of a case database with thirty-five real-world case journals from recent toolbox studies, and (c) exposure to both toolboxes and cases which consisted of the ten toolboxes and the case database.

In Experiment 2, the participants accessed identical websites except for the addition of a case journal and case journal follow-up forms. Each participant browsed the ten toolboxes and / or case database, completed three case journals and three case journal follow-ups. As in Experiment 1, participants in the exposure to cases and both conditions were required to rate and evaluate each case. The case journal and case journal follow-up forms were added to the websites as an active learning component to stimulate a deeper understanding of the material.
Both experiments included students who were exposed to the same material in class lectures, but were not organized in the toolbox format and participants who never had the course. Transfer was measured by the same application test given to all participants during the final session.

The findings for *members* suggested that in the browse only study transfer may be enhanced by presenting knowledge in a toolbox format. The degree of transfer was greater in the exposure to toolboxes and exposure to both conditions. However, members exposed to cases only did not appear to benefit from the cases as they scored the least on the application test. These data suggest that an important component may consist of presenting members lecture materials in the toolbox format for increasing scores on the application test. In other words, enhancing transfer on the application test may be contingent upon enrollment in the course plus exposure to knowledge in the toolbox format. Interestingly, when the active learning component was included by adding case development to the websites, members performed almost equally as well in both exposure to toolboxes and exposure to cases. The data also indicated that performance on the application test was the highest when participants were exposed to both toolboxes and cases. Thus, it is probable that case development as a form of active learning may be crucial for facilitating transfer.

The findings for *non-members* in the browse only experiment indicated that enrollment in the course may be critical for enhancing transfer. The participants in the exposure to toolboxes condition resulted in the highest performance on the application test. Interestingly, exposure to cases only does not appear to have interfered with performance for non-members. It is plausible that since the information was novel regardless of the way it was organized, exposure to cases
did not interfere with their performance. Most important, when non-members were exposed to cases and participated in active learning, they performed almost equally as well as members. However, when non-members were exposed to toolboxes, they performed the lowest on the application test. Finally, the data suggested that exposure to cases and exposure to both toolboxes and cases was nearly equivalent to being enrolled in the course. This crucial finding indicates that enrollment in the course may not be a requirement for facilitating transfer on the application test.

In Experiment 3, the participants were randomly assigned to one of two groups: (a) organized toolboxes, or (b) self-organized toolboxes. The stimuli for the organized condition consisted of the same ten toolboxes while the self-organized condition consisted of an identical list of the tools included in the ten toolboxes. Both groups performed two tasks: study and the same application test given in Experiment 1 and 2. Although it was predicted that the self-organized group should perform highest on the application test, the data suggested a nearly identical performance for both groups.

This dissertation was designed as an attempt to replicate and extend the findings of previous toolbox database studies. The primary goal was to develop an effective format for packaging knowledge on the World Wide Web. To this end, the lecture materials from the Psychology of Thinking and Decision Making course were developed into a toolbox format which was presented via computer on the internet. Second, it demonstrated the advantage of active learning for enhancing transfer in real-world situations. This attempt to demonstrate the advantage of exposure to knowledge in this format with case development was successful in enhancing transfer in both members and non-members. The data suggest that the degree of
transfer on the application test in the exposure to both toolboxes and cases condition resulted in significant evidence for facilitating transfer.

The study was consistent with respect to the transfer literature which suggests that the components incorporated into the toolbox format (i.e., schema induction, schema training, cases, active learning and organizational mnemonic) work in enhancing transfer as our study did show this effect. Previous studies have found that active learning is a potent method for enhancing memory retrieval of the to-be-remembered material as it contributes to deeper processing. In the browse only study, it was predicted that exposure to toolboxes for members should show a higher rate of transfer than exposure to cases and the data supported this hypothesis. Therefore, it appears that the toolbox format may be sufficient in packaging knowledge to facilitate transfer for those enrolled in the course. The data indicated that members exposed to cases did not result in levels of transfer comparable to the exposure to toolboxes or both conditions.

In the browse plus case development study, the evidence also supports the notion that incorporating active learning as an exercise for real-world applications was found to be an effective method for deep learning (Ball, 1995; Butterfield, Belmont & Peltzman, 1971; Jacoby, 1973). Thus, the combination of presenting the material in a toolbox format with active learning strategies may result in effective learning methods for teaching material via the World Wide Web. Likewise, the use of cases in general as part of training has been shown to benefit transfer (Kleinfeld, 1991). Most important, exposure to cases was found to be a powerful component for enhancing transfer in both members and non-members when combined with either toolboxes (Experiment 1) or tools and case development (Experiment 2). It is surprising to note that cases alone were not effective. Previous research has also found that using cases in training
contextualizes knowledge and shows students how to think about problems in expert ways.

Proponents of using cases in education argue that it helps students to apply research and theory to practical situations, increases situational knowledge in professional domains and develops more realistic attitudes (Christiansen, 1987; Masoner, 1988; Shulman, 1991). The combination of toolboxes and case development enhances transfer because it clearly illustrates how specific target concepts are woven into a case.

In addition, schema training has been identified as involving the development of cognitive structures that provide a conceptual framework for comprehension (Gordon & Braun, 1985). This type of training has been shown to help learners generate perspectives that can be reconciled, rejected or reconstructed as new knowledge is acquired. The purpose of the cases in this dissertation was an attempt to facilitate schema induction by demonstrating how the tools could be applied to real-world problems. Recent studies have found that schema knowledge may be important in acquiring learning strategies, understanding their utility and identifying their range of application. Hannafin and Rieber (1989) argue that schema knowledge helps to create a “need to know” that must be resolved to promote understanding. Thus, an activated schema generally enhances comprehension and provides the background structures necessary for meaningful understanding. Simultaneously, schemata may supply the scaffolding needed by some students to make informed metacognitive assessments. Therefore, schema training may be important to both meaningful learning and successful self-regulation.

Guberman and Greenfield (1991) proposed the development of a model that integrated structural accounts of individual development with cultural and situation-bound functionalism. As such, abstract schema representations are seen as crucial to generalized transfer. The
conditions that foster abstract schemas included: (1) the use of a tool or procedure in a variety of problem-solving contexts, (2) reflection on the structural similarity of problems and their solutions from diverse domains, and (3) the exploration of problems and their solutions under conditions of low goal specificity. When these conditions were not present, transfer was less likely to occur which was the case for both school-based learning and everyday cognition. In this study, the toolbox format summarized and reorganized the most useful knowledge from the course in terms of general purpose goal-based categories or toolbox names. Since the tools within each toolbox are general and may be applied in a variety of problem solving domains, they provide a method for developing solutions to real-world problems. The cases showed how the tools could be applied in more than one way.

Finally, these data support Quinones & Ehrenstein’s (1997) notion that in addition to providing the ideal learning situation (i.e., materials, media and procedures) to facilitate learning and transfer, additional instructional events are necessary. In this way, the authors found that providing extensive practice, overlearning and spacing of training session material enhances transfer. Consequently, incorporating these additional treatments in Experiment 2 may have led to better transfer (i.e., six sessions, three case journals, three case journal follow-ups). Moreover, having participants develop case journals of their own personal problems may have stimulated and fostered more metacognitive control needed for successful transfer. In this way, participants were able to be aware of, to monitor and to control their mental processes during problem solving which has been shown to add a vital dimension of flexibility and adaptiveness to their learning (Flavell et al., 1993). Recent studies on metacognition suggest that this form of cognitive development may be essential to developing problem solving skills, strategy selection
and modification in memory, language use and social cognition. The most beneficial aspect of metacognition in education is that research supports the notion that it is possible to teach students metacognitive skills (Butterfield & Nelson, 1989; Osman & Hannafin, 1993).

The use of new technologies for developing a web-based learning environment in education or training may provide new opportunities for facilitating transfer. As such, four implications for web-based learning are specifically noted from this dissertation: (a) abstract key useful concepts, (b) organize them into goal-based categories, (c) have students use tools to solve (their) problems, and (d) have students see other solutions.

Two limitations of this study that were related to one another was the attrition rate of the participants and the six-week time period for completing it. Since six sessions were required, several students were not able to complete it due to unforeseen circumstances. In addition, a few students dropped the psychology course and were no longer able to earn extra credit. The number of members enrolled in the course was limited in that it was not filled to capacity and students participated on a volunteer basis. Moreover, there was a lower rate of junior and senior psychology students who were available to participate in this experiment.

In conclusion, since this dissertation has demonstrated the advantage of exposure to knowledge in the toolbox format, future research should be conducted to explore the time delay between training and the transfer test. A future study investigating whether a two-week delay produces the same transfer effect may prove fruitful in addition to a one week delay (Brown, Day & Jones, 1983). Finally, it may also be interesting to vary the amount of sessions to ascertain whether similar results are observed with one or two case journals as opposed to developing three case journals. If a body of reliable evidence can be accumulated on the benefit
of presenting knowledge in the toolbox format, perhaps researchers will be in a better position to enhance transfer in real-world situations.
References


Appendix A

Toolbox Database Websites: Browse Only

1a. Browse Only / Toolboxes: http://home.talkcity.com/oceanblvd/cogpsyc

2a. Browse Only / Cases: http://psycresearch.tripod.com

3a. Browse Only / Both: http://cogscience.tripod.com
Appendix B

Browse Only Instruction Handouts

1. Browse Only / Toolboxes

2. Browse Only / Cases

3. Browse Only / Both

1. Toolbox Database: Browse Only / Toolboxes

   Website:  http://home.talkcity.com/OceanBlvd/cogpsyc/
   e-mail:  cogpsyc@bellsouth.net
   Best viewed with:  Microsoft Internet Explorer
   Instructions:
   1. Browse & study 10 toolboxes:
      a. Browse each of the toolboxes
      b. Study the contents of each toolbox
   2. Application test:
      a. Given during last session
      b. Monetary prize awarded to student with highest score: $25.00

2. Toolbox Database: Browse Only / Cases

   Website:  http://psycresearch.tripod.com/
   e-mail:  psyc007@bellsouth.net
   Best viewed with:  Microsoft Internet Explorer
   Instructions:
   1. Browse & study 10 toolboxes:
      a. Browse each of the toolboxes
      b. Study the contents of each toolbox
   2. Browse & rate cases:
      a. Browse each of the cases in the database
      b. Rate each case on a scale of 1 (not helpful) to 5 (most helpful)
      c. Write a short comment for each case
      d. E-mail the rating scale & comments to the researcher
   3. Application test:
      a. Given during last session
      b. Monetary prize awarded to student with highest score: $25.00
3. Toolbox Database: Browse Only / Both

Website:  http://cogscience.tripod.com/
e-mail:  science3@bellsouth.net
Best viewed with:  Microsoft Internet Explorer

Instructions:

1. Browse & study 10 toolboxes:
   a. Browse each of the toolboxes
   b. Study the contents of each toolbox

2. Browse & rate cases:
   a. Browse each of the cases in the database
   b. Rate each case on a scale of 1 (not helpful) to 5 (most helpful)
   c. Write a short comment for each case
   d. E-mail the rating scale & comments to the researcher

3. Application test:
   a. Given during last session
   b. Monetary prize awarded to student with highest score: $25.00
Appendix C

Application Transfer Test

Instructions:

Your score is based on the total number of appropriate tool-action pairs that you list for each situation.

Each tool must be based on material you studied in this experiment and the action must have the potential for solving the problem or making the outcome of the situation better.

Write the title of the situation you are solving on the top of each page.

Each tool and each action can be used only once in each situation.

List each tool on the left side of the page with the appropriate action directly across from it on the right side of the page.

Please complete as many appropriate tool-action pairs as possible in the allotted time.

A monetary prize in the amount of $25.00 will be awarded to the student who completes the highest number of correct pairs. The winner will be notified via e-mail.

Real-world situations:
1. Evaluate arguments about hand counting ballots in Florida.
2. Advise a daughter about weaknesses of human thinking that could lead her to make bad decisions.
3. Advise a government panel on implementing a long-term program to increase use of public transportation.
4. Advise the Governor on how to convince people to support taxes to help education.
5. Help a depressed friend find more meaning in her life.
Appendix D

Toolbox Database Websites: Browse + Case Development

1b. Browse + Case Development / Toolboxes: http://deborahdunaway.tripod.com

2b. Browse + Case Development / Cases: http://psych007.tripod.com

Appendix E

Browse + Case Development Instruction Handouts

1. Browse + Case Development / Toolboxes

2. Browse + Case Development / Cases

3. Browse + Case Development / Both

1. Case Development / Toolboxes

Website:  http://deborahdunaway.tripod.com/
E-mail:  cogpsyc@bellsouth.net
Best viewed with:  Microsoft Internet Explorer

Instructions:

1. Case Journal
   a. Describe the problem situation
   b. Describe the goals for the problem situation
   c. Select the toolboxes that may be relevant
   d. For each relevant toolbox, select the tools
   e. Make a plan by applying each tool
   f. Indicate whether you are going to use the plan
   g. Select an option for posting your Case Journal on the web
   h. Must be completed by midnight:
      1. Case Journal #1
      2. Case Journal #2
      3. Case Journal #3

2. Case Journal Follow-up:
   a. Upon completing your plan, select an option that best rates your results
   b. Describe your overall results
   c. Describe which tools were useful & how they were used
   d. Indicate whether you used any items NOT captured by your selected tools
   e. Select an option for posting your Case Journal Follow-up on the web
   f. Must be completed by midnight:
      1. Case Journal Follow-up #1
      2. Case Journal Follow-up #2
      3. Case Journal Follow-up #3

3. Application test
   a. Monetary prize awarded to student with highest score: $25.00

2. Browse + Case Development / Cases

Website:  http://psych007.tripod.com/
e-mail: psych007@bellsouth.net
Best viewed with: Microsoft Internet Explorer
Instructions:
1. Case Journal:
   a. Describe the problem situation
   b. Describe the goals for the problem situation
   c. Select the toolboxes that may be relevant
   d. For each relevant toolbox, select the tools
   e. Make a plan by applying each tool
   f. Indicate whether you are going to use the plan
   g. Select an option for posting your Case Journal on the web
   h. Must be completed by midnight:
      1. Case Journal #1
      2. Case Journal #2
      3. Case Journal #3
2. Case Journal Follow-up:
   a. Upon completing your plan, select an option that best rates your results
   b. Describe your overall results
   c. Describe which tools were useful & how they were used
   d. Indicate whether you used any items NOT captured by your selected tools
   e. Select an option for posting your Case Journal Follow-up on the web
   f. Must be completed by midnight:
      1. Case Journal Follow-up #1
      2. Case Journal Follow-up #2
      3. Case Journal Follow-up #3
3. Browse & rate cases:
   a. Browse each of the cases in the database
   b. Rate each case on a scale of 1 (not helpful) to 5 (most helpful)
   c. Write a short comment for each case
   d. E-mail the rating scale & comments to the researcher
4. Application test:
   a. Monetary prize awarded to student with highest score: $25.00

3. Browse + Case Development / Both

Website: http://dunaway6.tripod.com/
e-mail: science3@bellsouth.net
Best viewed with: Microsoft Internet Explorer
Instructions:
1. Case Journal:
   a. Describe the problem situation
   b. Describe the goals for the problem situation
   c. Select the toolboxes that may be relevant
   d. For each relevant toolbox, select the tools
e. Make a plan by applying each tool
f. Indicate whether you are going to use the plan
g. Select an option for posting your Case Journal on the web
h. Must be completed by midnight
   1. Case Journal #1
   2. Case Journal #2
   3. Case Journal #3

2. Case Journal Follow-up:
   a. Upon completing your plan, select an option that best rates your results
   b. Describe your overall results
   c. Describe which tools were useful & how they were used
   d. Indicate whether you used any items NOT captured by your selected tools
   e. Select an option for posting your Case Journal Follow-up on the web
   f. Must be completed by midnight
      1. Case Journal Follow-up #1
      2. Case Journal Follow-up #2
      3. Case Journal Follow-up #3

3. Browse & rate cases:
   a. Browse each of the cases in the database
   b. Rate each case on a scale of 1 (not helpful) to 5 (most helpful)
   c. Write a short comment for each case
   d. E-mail the rating scale & comments to the researcher
   e. Must be completed by midnight

4. Application test
   a. Monetary prize awarded to student with highest score: $25.00
Appendix F

Organized vs Self-Organized Stimuli

-Organized Toolboxes:
  1. Create Toolbox:
     A. Notice opportunities
     B. Directed remembering
     C. Seek criticism
     D. Create playful environment
     E. Persistence
     F. Mesh with the experts
  2. Persuade Toolbox:
     A. Get attention
     B. Stimulate interest
     C. Make it stick with stories
     D. Fit in with schemas
     E. Appeal to instincts
  3. Change Toolbox:
     A. See from different points of view
     B. Be flexible
     C. Make good first impression
     D. Look far ahead
     E. Keep people involved
     F. Get all types of feedback
  4. Solve Toolbox:
     A. Generate ideas
     B. Assign roles
     C. Build on ideas
     D. Control the process
     E. Seek consensus
     F. Package ideas
  5. Complete Toolbox:
     A. Prioritize
     B. Organize
     C. Set limits
     D. Follow through
     E. Motivation
  6. Experience Toolbox:
     A. Notice opportunities
     B. Be flexible
C. Different points of view
D. Mesh with experts
E. Look far ahead

7. **Harmonize Toolbox:**
   A. Recognize goals
   B. Recognize similarities & differences
   C. Compromise / Consensus
   D. Keep lines of communication open

8. **Reason Toolbox:**
   A. Evaluate evidence
   B. Be flexible
   C. Examine different perspectives
   D. Analyze validity of sources
   E. Causal chain of events
   F. Probability

9. **Learning Toolbox:**
   A. Repetition / Memorization
   B. Trial & error
   C. Association
   D. Rewards
   E. Time management
   F. Organization
   G. Sensory stimulation

10. **Choose Toolbox:**
    A. Generate ideas
    B. Seek out info
    C. Notice opportunities
    D. Be flexible
    E. Reaction to scarcity
    F. Control the process
-Self-Organized Concepts:
Analyze validity of sources
Appeal to instincts
Assign roles
Association
Be flexible
Be flexible
Build on ideas
Causal chain of events
Compromise / Consensus
Control the process
Control the process
Create playful environment
Different points of view
Different points of view
Directed remembering
Evaluate evidence
Examine different perspectives
Fit in with schemas
Follow through
Generate ideas
Get all types of feedback
Get attention
Keep lines of communication open
Keep people involved
Look far ahead
Look far ahead
Make good first impression
Make it stick with stories
Mesh with the experts
Mesh with the experts
Motivation
Notice opportunities
Notice opportunities
Notice opportunities
Organize
Organization
Package ideas
Persistence
Prioritize
Probability
Reaction to scarcity
Recognize goals
Recognize similarities & differences
Repetition / Memorization
Rewards
See from different points of view
Seek consensus
Seek criticism
Seek out info
Sensory stimulation
Set limits
Stimulate interest
Time management
Trial & error
### Appendix G

**Organized vs Self-Organized Data Chart**

<table>
<thead>
<tr>
<th>Tools</th>
<th>Self-Organized Toolboxes</th>
<th>Organized Toolboxes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Notice Opportunity</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Directed Remembering</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Seek Criticism</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Create Playful Environment</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Persistence</td>
<td>6</td>
<td>1 0</td>
</tr>
<tr>
<td>Mesh with Experts</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2. Get Attention</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Stimulate Interest</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>Make it Stick with Stories</td>
<td>1 2</td>
<td>1 2</td>
</tr>
<tr>
<td>Fit in with Schemas</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Appeal to Instincts</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3. See from Different Points of View</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Be Flexible</td>
<td>1</td>
<td>1 3</td>
</tr>
<tr>
<td>Make Good First Impression</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Look Far Ahead</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Keep People Involved</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Get All Types of Feedback</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>4. Generate Ideas</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Assign Roles</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Build on Ideas</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>----------------</td>
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<td>---</td>
</tr>
<tr>
<td>Control the Process</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Seek Consensus</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Package Ideas</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5. Prioritize</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Organize</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Set Limits</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Follow Through</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Motivation</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6. Notice Opportunities</td>
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<td></td>
</tr>
<tr>
<td>Different Points of View</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Mesh with Experts</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Look Far Ahead</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>7. Recognize Goals</td>
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</tr>
<tr>
<td>Recognize Similarities &amp; Differences</td>
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<td></td>
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<tr>
<td>Compromise / Consensus</td>
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<td>3</td>
</tr>
<tr>
<td>Keep Lines of Communication Open</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>8. Evaluate Evidence</td>
<td>9</td>
<td>5</td>
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<tr>
<td>Examine Different Perspectives</td>
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<tr>
<td>Analyze Validity of Sources</td>
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<tr>
<td>Causal Chain of Events</td>
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<tr>
<td>Probability</td>
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<td></td>
</tr>
<tr>
<td>9. Repetition / Memorization</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Trial &amp; Error</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Association</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rewards</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Time Management</td>
<td>4</td>
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<tr>
<td>Organization</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Sensory Stimulation</td>
<td></td>
<td></td>
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<tr>
<td>---------------------</td>
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</tr>
<tr>
<td>10. Seek Out Info</td>
<td></td>
<td></td>
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<tr>
<td>Notice Opportunities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Be Flexible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reaction to Scarcity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control the Process</td>
<td></td>
<td></td>
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</tbody>
</table>
Appendix H

Self-Organized Data Charts

1. Self-Organized Toolboxes #1

<table>
<thead>
<tr>
<th>Tools</th>
<th>Non-Members</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td>1. Create Toolbox</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notice Opportunity</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Directed Remembering</td>
<td>3 2 3 7 6 3 4 3 1 7 5 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Seek Criticism</td>
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<tr>
<td>Create Playful Environment</td>
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<td></td>
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<td>Persistence</td>
<td>1 1 3 2 7 6 4 4 5 7 2 1</td>
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<td>6</td>
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<tr>
<td>Be Flexible</td>
<td>6</td>
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<tr>
<td>Reaction to Scarcity</td>
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<tr>
<td>Control the Process</td>
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Vita

Deborah L. Dunaway was born in New Orleans, Louisiana, on February 25, 1958. She earned a bachelor of arts degree in psychology at Southeastern Louisiana University in 1996 and graduated *Magna Cum Laude*, Departmental Honors: with High Distinction. In addition, she was elected on April 26, 1996, into the honor society of Phi Kappa Phi and in the same year was elected to Who’s Who Among Students in American Universities and Colleges. In spring of 1997, Deborah began graduate study in the Louisiana State University Department of Psychology doctoral program in the area of cognitive psychology. Upon completion of the requirements for the degree of Doctor of Philosophy, Deborah will begin employment as a research scientist in the Southern United States.