Creativity and Change Leadership Graduate Student Master's Projects

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Improving Transfer of Learning Through Analogical Thinking

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Improving Transfer of Learning Through Analogical Thinking

by

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An Abstract of a Project
in
Creative Studies

Submitted in Partial Fulfillment
Of the Requirements
For the Degree of

Master of Science

May 2019

Buffalo State
State University of New York
Department of Creative Studies

ABSTRACT OF PROJECT

Improving Transfer of Learning Through Analogical Thinking

This project focused on developing a method for teaching creative thinking tools in ways that enable learning transfer. In the process of defining and identifying stimulants and obstacles for learning transfer, the literature revealed that analogical thinking, a long-standing creative thinking mechanism, is analogous to learning transfer. Many cognitive psychology researchers suggest that since humans can only describe new concepts in terms of things that are already understood, analogical thinking is the basis for all learning. "It is not our senses that limit or liberate us, but our ability to illuminate the unknown by means of analogies to the known. Learning itself depends on analogizing." (Root-Bernstein & Root-Bernstein, 1999, p.142). A review of the literature on analogical thinking revealed common process steps for using analogical models in teaching. Accelerated learning concepts and components of the Torrance Incubation Model are used to outline a module for teaching analogical thinking. The use of concept maps for the structure mapping step of analogical thinking is recommended.

Keywords: analogical thinking, learning transfer, structure mapping, teaching with analogies

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Perry A. Broome

May 14, 2019

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Date

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Dr. Susan Keller-Mathers

Associate Professor, Creative Studies

May 14, 2019

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Acknowledgment

I would like to dedicate this project to all of the educators, past, present, and future, who embrace the opportunity to help others strengthen their creative capacity.

I would like to thank my original distance cohort, the Wizards of Osborn, as well as the many other students of creativity who supported me through my continuing pursuit of learning.

I would like to thank the leadership team at Fanshawe College who have supported my efforts to become an advocate and resource for creative thinking skills.

I would like to thank the faculty at the International Center for Studies in Creativity for modelling behaviors and attitudes that support creative teaching and learning. Special thanks to Dr. Gerard Puccio, Dr. Cyndi Burnett, and Dr. Susan Keller-Mathers, all of whom provided encouragement and direction throughout my time in the program.

Finally, I would like to thank my children, Jake and Alex, for their unwavering support for me as a life-long learner. And most of all, I would like to thank my wife Barbara, an extraordinary educator who enthusiastically joined me on this journey.

Table of Contents

List of Figures

SECTION ONE: BACKGROUND TO THE PROJECT

Purpose and Description of Project

The purpose of this project is twofold. First, I want to develop a workshop in which participants learn aspects of the creative problem solving (CPS) process. The workshop will focus on the clarification and transformation stages of the Thinking Skills Model. Tools for defining, framing, and reframing problems and generating ideas will be introduced and practiced during the workshop. The second goal of this project is to develop and test mechanisms that enable learners to practice and master the workshop tools after completion of the workshop. The focus here is for participants to extend their learning and demonstrate transfer of their new skills.

Rationale for Selection

Early in my career, I worked in a variety of roles in the financial services industry. About half of those 18 years were spent in leadership and management roles in various regions across Canada. Throughout my career in industry, I participated in a variety of professional training programs. Internal staff delivered some while external trainers and consultants facilitated others. I was fortunate to be working with a company that valued employee development.

Most of the training I participated in was very interesting and useful. There was, however, a common weakness in all of the programs. At the end of each professional development session, most participants, including myself, would usually return to our offices and regular responsibilities, file the course materials, and fail to extend the learning beyond the training workshop. Participants were not provided with tools to reinforce the training. The organization did not reinforce continued engagement with the training topics and did not include steps to measure learning transfer. I always felt that if I had been supported to continue engaging

with the material beyond the workshop, I would have learned and retained more and improved the prospects of achieving the outcomes originally intended by the training.

After leaving the financial services industry, I returned to school fulltime to complete an MBA program. During the program, I started teaching part-time at a community college and continued to do so after graduation. To improve my teaching skills, I enrolled in a train-the-trainer program. I never thought much about the lack of training follow-up until I completed a training evaluation course that included Kirkpatrick's four-level evaluation model (Horton, 2012). This model suggests that training should be measured at four levels. Participant reaction to the training should be measured during and at the end of a program to determine satisfaction with the training process, delivery and materials. Learning should be measured during and at the end of training to confirm participants understand and know how to apply the training material. Learning transfer should be measured months after completion of the training to determine if the training reflects in the behaviors and/or attitudes of the participants. Finally, organizations should attempt to determine if the planned outcomes from the training intervention have materialized, months or years after the training. For example, if the goal of a training program is to reduce customer service complaints, the frequency of complaints should be measured and compared before and after the training. I recognized that for most of the training that I participated in, measurement of effectiveness never went beyond the second level of learning. I also realized that for the college courses I was teaching, it was usually not possible to measure students' learning beyond the second level. The train-the-trainer program peaked my interest in providing training and development services to organizations and I began planning a training service company. My intention was to help clients measure training effectiveness at all four levels of Kirkpatrick's model.

After I was hired to teach full time at my college, I dedicated my efforts and focus to helping my students learn. This role has provided me with much exposure and experience to formal teaching practice. However, teaching college courses does not involve measuring learning at the transfer or outcome level.

When I was asked to develop a course on creativity, I discovered the programs at the International Center for Studies in Creativity at Buffalo State. After enrolling in the first phase of the Master's Program, I revised my course to focus on teaching the Thinking Skills Model and about 30 associated tools. I have found it difficult to motivate students to embrace the opportunity to learn as much as they can about creative problem solving. My failure to help students understand the value of creative thinking skills for their personal and professional development is a continuing frustration for me. This has resulted in my desire to provide creative thinking training to different target audiences.

A number of my colleagues at the college have expressed an interest in learning more about creative problem solving techniques and their potential application to teaching for creativity and teaching creatively. There is an opportunity for me to take advantage of this interest by providing some training. My earlier hope and belief that a creative thinking course would be included in many programs across my college has faded. Early in 2019, the revised vocational learning outcomes for college business programs in Ontario were announced. These are the first revisions in over 16 years. Although creativity was noted as an important skill for business graduates to possess, creative thinking skills were not included in the new vocational learning outcomes. Creativity was mentioned as a subset of critical thinking. I now see a better opportunity for introducing creative thinking skills through workshops for interested students and faculty.

One of the challenges I have faced in teaching creative thinking to students and explaining the creative thinking tools and CPS process to colleagues relates to the complexity of the process and the wide variety of tools available. One of the papers I reviewed in preparation for my Master's Project was by Glen Fayolle, a former classmate and project partner in my Buffalo State Organizational Creativity course. Glen wrote about these same difficulties and decided to focus his project on developing a straightforward process for CPS training. Glen's project resonated with my own experiences in teaching creative thinking and motivated me to consider the type of training that would be interesting for participants, easy to grasp and easy to practice and master. I tried to put myself in the shoes of individuals and organizations interested in strengthening creative potential through improvement of problem-solving skills.

For my initial foray into providing creative thinking professional development, I do not wish to attempt to create a workshop that addresses all the steps and numerous tools for CPS. My desire is to create a workshop that introduces participants to some aspects of creative problem solving, helps them learn the first steps in CPS, and uses tools that learners are motivated and able to practice beyond the workshop.

SECTION TWO: PERTINENT LITERATURE

Pertinent Literature or Resources

The major goals of this project are to identify, select, and develop curriculum and materials for a workshop on defining problems, and the development of prototypes for post-workshop tools for extending the learning. For my literature review, I will first provide an annotated bibliography for the resources that I am familiar with that I know will contribute to meeting the project goals. Most of these resources are books from the popular press that contain specific information regarding techniques for framing, reframing and defining problems. Some of the resources are specific to the development of tools for enabling self-practice and mastery of creative thinking concepts and others focus on curriculum development and facilitation techniques. Beyond these resources, I will include a list of textbooks and other materials I have used in my studies that may contribute to the completion of my project.

Annotated Bibliography

Csikszentmihalyi, M. (1997). *Creativity: Flow and the psychology of discovery and invention.*

New York, NY: HarperPerennial.

Csikszentmihalyi provides several suggestions for improving personal creativity through better problem finding approaches. For example, he describes the value of attacking problems from several approaches, ignoring appearances and assumptions, incubating and reflecting before deciding, and being open to reformulating problems.

de Bono, E. (2014). *Edward de Bono's thinking course: Powerful tools to transform your*

thinking. Essex, England: BBC Active. (Original work published 1982)

This book provides over one hundred ideas for helping people solve problems and make decisions. Some of the tools are useful for defining problems. De Bono goes into detail on the

role of perception in thinking and pattern generation. Patterned thinking can block our ability to frame problems in new ways. Many of de Bono's tools are designed to overcome pattern thinking and consider problems from different perspectives.

Horton, W. (2012). *E-Learning by design* (2nd ed.) San Francisco, CA: Pfeiffer.

Horton describes three types of activities that contribute to student learning. Absorb-type activities involve the consumption of content. Do-type activities involve the creation of knowledge by the learner. Practice, discovery, and games and simulations are included in these learning activities. Connect-type activities prepare participants to apply learning. Horton lists and describes hundreds of different activities that can be used enhance learning in an online environment. These activities, along with Horton's suggestions for games and simulations, social learning, and mobile learning will be useful as I develop ways to extend the workshop tools.

Kelly, T. & Kelly, D. (2013). *Creative confidence: Unleashing the creative potential within us all*. New York, NY: Crown Business.

The Kelly brothers are best known for their design thinking approach to work with IDEO and the design school at Stanford University. Sections of their book are dedicated to defining and reframing problems. Several anecdotes regarding proper and improper problem definition are included. They also provide information on prototyping that may be valuable when I develop my extending tools.

Liedtka, J. & Ogilvie, T. (2011). *Designing for Growth: A design thinking tool kit for managers*. New York, NY: Columbia Business School Publishing.

Liedtka and Ogilvie provide a process and tools for tackling problems and opportunities using a design thinking approach. Design thinking involves using empathy to understand a user's perspective and the use of iterative prototyping to develop, test, and revise products and services

that address problems. Two of the tools provided in this book are particularly relevant for my project. The chapter on mind mapping provides ideas for transitioning from a focus on "what is" to a future focus on "what if". This may be a useful tool for framing problems. The authors also provide a chapter on rapid prototyping that may be useful for the development of my extending tools.

Michalko, M. (2006). *Thinkertoys* (2nd ed.) New York, NY: Ten Speed Press.

Michael Michalko describes over one hundred tools and tips for approaching problems in unconventional ways. While many of the tools focus on idea generation, some are specific to problem formulation such as Michalko's chapter on using paradoxes to identify problems and opportunities.

Meier, D. (2000). *The Accelerated learning handbook: A creative guide to designing and delivering faster, more effective training programs*. New York, NY: McGraw-Hill.

Dave Meier provides tools and techniques for rapid development of learning materials. He describes many weaknesses of traditional curriculum development processes including the focus on generation of learning materials by the instructor. Traditional learning design is often materials-based rather than activity-based. He suggests that course developers typically spend 80 percent of their time developing course materials to be consumed by learners. Meier suggests that instructors should never do for learners what the learners can do for themselves or others. Learning is about creation, not consumption, and the process of having learners build their own artifacts both improves the amount of learning and reduces the time required to develop curriculum. Many of Meier's tools will be helpful as I develop my workshop. I will attempt to incorporate the SAVI approach to learning that incorporates somatic, auditory, visual and intellectual domains. I will use some of Meier's techniques for the preparation, presentation,

practice and performance phases of learning. Meier also provides tips for developing learning

games and for using technology to enhance and extend learning.

Nielsen, D. & Thurber, S. (2016). *The secret of the highly creative thinker: How to make*

   connections others don't. Amsterdam, Netherlands: BIS Publishers.

   Nielsen and Thurber focus on the role of associative thinking in the creative problem

solving process. They describe several tools and exercises designed to help readers make

connections.

   In addition to the practical tools provided, the authors describe the contributions of

creativity scholars studied in the Master of Science program such as Amabile, de Bono, Gordon,

Koestler, Mednik, Noller, Osborn, and Poincare. Many of these authors' works are referenced in

this project. Some of the tools described in the book may be candidates for inclusion in my

workshop and/or as development into extending tools.

Parnes, S. J. (1992). *Visionizing: State-of-the-art processes for encouraging innovation*

   excellence. Buffalo, NY: Creative Education Foundation Press.

   Sidney Parnes provides a comprehensive toolkit of instructional materials for teaching

imagery and analogy processes as part of the Creative Problem Solving Process. Parnes dedicates

a chapter to recognizing the real problem. Parnes describes techniques for defining problems by

asking "why?" by changing the verb in a problem statement, by broadening the problem and by

wording the problem more effectively. Visionizing includes examples for each technique.

Schwarz, R. (2002). *The Skilled facilitator – new and revised: A comprehensive resource for*

   consultants, facilitators, managers, trainers, and coaches. San Francisco, CA: Jossey-

   Bass.

This book provides suggestions for effectively managing group interactions. The audience for my workshop will be adult learners. Most of the learning I have facilitated in recent years have been college-aged students. I will need to remind myself of the different challenges faced by facilitators when the learners are mature with a variety of experiences and attitudes about learning. The book also provides guidance for improving the effectiveness of interactive group sessions. Although this book does not focus on creative problem solving, it may be valuable for the workshop development and delivery aspects of my project.

Shank, P. Ed. (2007). *The online learning idea book: 95 proven ways to enhance technology-based and blended learning*. San Francisco CA: Pfeiffer.

As the book title suggests, Shank provides a variety of suggestions for using technology to enhance learning. This book should be helpful for developing my extending learning tools. Chapter Four provides suggestions for online self-directed activities. Chapter 6 provides self-assessment ideas and tools including links to websites that facilitate the development of online games and puzzles. The book also provides many tips regarding the structure and usability of online learning tools and platforms.

Stewart, D. & Simmons, M. (2010). *The business playground: Where creativity and commerce collide*. Berkley, CA: New Riders.

Chapter Four 4 of this book is titled *The answer is in the question*. This notion reflects the importance of defining a problem using a question that invites solutions that actually solve the real problem. The authors note the important role of empathy in defining problems. They provide examples of the ways in which the framing of a problem leads to success or failure in CPS. Another chapter is devoted to changing perspectives during problem definition. Chapter Eleven focuses on deciding which problems deserve attention. The combination of Stewart's perspective

as an artist and Simmons' perspective as an advertiser contribute to a practical approach to problem definition and idea generation.

Weston, A. & Stoyles, B. (2010). *Creativity for critical thinkers* (Canadian ed.) Toronto, Canada: Oxford University Press.

  Weston and Stoyles provide a number of tools for supplementing critical thinking skills with different approaches to problem solving. The authors acknowledge that while critical thinking is useful for identifying the need for new ideas, it is not well suited for generating new ideas. Chapter 5 in the book focuses on reframing problems. Techniques such as lateral thinking, framing problems as opportunities, and focusing on preventing the problem are described.

Other Project Resources

  I have used the resources that appear in the following list throughout my course work in the Master of Science program. Many of them contain CPS tools and techniques that may be useful in the development of my workshop. The list is limited to resources that cover aspects of problem finding, idea generation, and creativity training.

Berkun, S. (2010). *The myths of innovation*. Sebastopol, CA: O'Reilly Media.

Davis, G. A. (2004). *Creativity is forever*. (5th ed.). Dubuque, IA: Kendal/Hunt.

Dawson, P. & Andriopoulos, C. (2014). *Managing change, creativity & innovation* (2nd ed.). London: Sage Publications Ltd.

De Bono, E. (1992). *Serious Creativity: Using the power of lateral thinking to create new ideas*. Toronto, Canada: HarperCollins.

Kaufman, J. C., & Sternberg, R. J. (2010). *The Cambridge handbook of creativity*. Cambridge: Cambridge University Press.

Kaufman, S. B. & Gregoire, C. (2015). *Wired to create: Unravelling the mysteries of the creative mind*. New York, NY: TarcherPerigee.

Koestler, A. (1989). *The act of creation*. London, England: Penguin Books. (Original work published in 1964)

Miller, B., Vehar, J., Firestien, R., Thurber, S., & Nielsen, D. (2011). *Creativity unbound: An introduction to creative process* (5th ed.) Evanston, IL: FourSight.

Osborn, A. (1960). *Applied imagination: Principles and procedures of creative problem solving* (Rev. ed.). New York, NY: Charles Scribner's Sons.

Pink, D. H., (2006). *A whole new mind: Why right-brainers will rule the future.* New York, NY: Riverhead Group.

Puccio, G. J., Mance, M., & Murdock, M. C. (2011). *Creativity leadership: Skills that drive change* (2nd ed.). Thousand Oaks, CA: Sage.

Puccio, G. J., Mance, M., Switalski, L. B. & Reali, P. D. (2012). *Creativity rising: Creative thinking and problem solving in the 21st century.* Buffalo, NY: ICSC Press.

Root-Bernstein, R. & Root-Bernstein, M. (1999). *Sparks of genius: The 13 thinking tools of the world's most creative people.* Boston, MA: Houghton Mifflin.

Sawyer, R. K. (2012). *Explaining creativity: The science of human innovation* (2nd ed.). New York, NY: Oxford University Press.

Scott, G., Leritz, L. E., & Mumford, M. D. (2004). The effectiveness of creativity training: A quantitative review. *Creativity Research Journal, 16*(4), 361-388.

SECTION THREE: PROCESS PLAN

Plan to Achieve Goals and Outcomes

My main goal is to prepare a four-hour workshop to introduce Creative Problem Solving techniques to a group of participants interested in learning about creative thinking skills. In order to meet this primary goal, I will have to create the curriculum for the workshop. I will need to identify the tools that are most appropriate for introducing learners to the tasks of defining problems and generating ideas. This will require an extensive review of the resources I have used in the Master's Program as well as addition resources investigated during the project. The additional resources will be from a literature review as well as through contact with faculty and current and former students from the Master's Program. I may also interview other people with expertise and experience related to the goals of my project. An outcome of this research will be a comprehensive list of candidate tools for inclusion in my workshop. Another outcome will be the results of my convergence and the mechanism and criteria I will use to select the tools.

I will need to create prototypes of the materials I will use to facilitate the workshop. These materials will form the basis of the resources that I plan to test and improve on based on the feedback and learning I gain from executing the workshop.

The second main goal of my project is to create mechanisms for participants to practice and master the workshop tools after the workshop is over. As I start the project, I have no clear vision of what these mechanisms will look like. I do know that the training sessions I have participated in as a student have lacked these tools for extending the learning. Achieving learning transfer is an equally important element in my project. I expect that the extending tools may be in a form that allows participants to access and practice them online. Some or all of the tools may also be in the form of a physical take-away that participants receive and practice during the

workshop. I expect that the tools will have elements of gamification that will motivate participants to practice and improve. As with the first goal outlined, the extending tools will require a literature review and possibly primary research in the form of interviews to identify and evaluate options. An outcome of this research will be a list and evaluation of creative thinking tools that lend themselves to self-practice. The selected tools will be the prototyped and published.

Project Timeline

Figure 1 shows the project tasks to be completed, the projected hours for each task, and the timing of completion for each task. The deadlines and dates for deliverables required by the instructor are noted within the weeks they are due.

Tasks to complete	Hours	Week Ending													
		Feb		Mar					Apr				May		
		17	24	3	10	17	27	31	7	14	21	28	5	12	19
Concept paper draft	20	11													
Concept paper feedback	2		■												
Research thinking tool options	20	■	■	■											
Class discussion on project concepts	3		23												
Concept paper final	10			25											
Class discussion on alumni projects	3			2											
List of tool options	5				■										
Evaluation of tools	10				■										
Sections 1 to 3	10					11									
Sections 1 to 3 feedback	2						■								
Class discussion on Sections 4 to 6	3							30							
Prototypes for extending tools	30						■	■	■	■					
Workshop outline	7									■					
Workshop curriculum finalized	10										■	■			
Feedback from cohort	6										■	■			
Sections 4 to 6	20												29		
Sections 4 to 6 feedback	2											■			
Master's Project final version	10													8	
Class presention of Master's Project	5													11	
Master's Project sign off	1														13
Upload Project to Digital Commons	1														16
	180														

Figure 1. Project Timeline.

Evaluation Plan

I will seek feedback from my Master's Project cohort on the novelty and usefulness of the workshop I create and the extension tools I develop. I will deem the project a success if I receive objective feedback that can inform my continuing development and delivery of workshops and extending tools.

I will also consider the project a success if the usefulness of the workshop and extending tools informs the curriculum I deliver for the creative thinking course I teach at my college. I am always looking for ways to improve my college course, and I hope that I can identify some changes to enhance my course.

Finally, I will measure success based on the extent of the key learnings I include in Section 5 of my final project report. I most look forward to creating tangible tools that others deem useful for helping people learn creative thinking skills. This will represent creativity, Bloom's highest level of learning.

With this project, I intend to create a starting point for the teaching of creative thinking tools in new ways to new audiences. I will consider progress towards those goals a success.

SECTION FOUR: OUTCOMES

Learning Transfer

Learning transfer is described in the learning and development literature as the generalization of knowledge and skills acquired in training back to the job, and the maintenance of learned material over time on the job (Kirwin, 2009). Learning transfer can be categorized in terms of distance, direction, and abstractness. *Near* transfer refers to situations where conditions in training are very similar to those in practice. *Vertical* transfer occurs when a new skill helps a learner acquire a wider skill or piece of knowledge. *Lateral* transfer refers to generalization of a skill over a broad set of situations having similar complexity. *Literal* transfer occurs when skill or knowledge is transferred to a new learning task while *figural* transfer involves applying skill or knowledge in other fields, such as the use of metaphor (Kirwin, 2009).

Holton, Bates and Ruona (2000) identified 16 factors that support learning transfer. The factors fall into three categories as shown in Figure 2.

Capability factors	Motivation factors	Work environment factors
Personal capacity	Performance self-efficacy	Resistance to change
Opportunity to use	Motivation to transfer	Personal outcomes
Transfer design	Learner readiness	Performance coaching
Content validity	Outcome expectations	Peer support
	Performance expectations	Supervisor sanctions
		Supervisor support

Figure 2. Factors that support learning transfer (Holton, Bates & Ruona, 2000).

These 16 factors can combine to produce measurable changes in training effectiveness as measured by learning transfer. The 16-factor model is used by training organizations in the form of a learning transfer systems inventory to predict whether training participants can transfer learning into performance.

It has been widely researched and accepted that only 15-20 percent of organizational training investments result in performance changes (Leimbach, 2010). Three of the four levels of learning described in Kirkpatrick's model (Horton, 2012) measure learning outcomes, not performance outcomes. Leimbach (2010) reviewed 32 training studies that examined the impact of 66 learning transfer activities and categorized the activities under learner readiness, learning transfer design, and organizational alignment. *Lerner readiness* activities include goal alignment, motivation to learn and self-efficacy. *Transfer design* activities include review, practice and modelling. *Organizational alignment* activities include peer and manager support/coaching, connection to the job, and learning culture. Leimbach (2010) found that learner transfer could be impacted positively by as much as 70%, 37%, and 79% respectively for the three categories.

Research by Saks and Belcourt (2006) showed that the use of new skills steadily declines after training with a 38 percent loss immediately after training and only 44 percent still in use after six months. The study noted training activities that occur before and after training interventions have a greater impact on transfer than the actual training session. Pre-training activities include supervisor support, materials preview and goal setting. Post-training activities include booster sessions, buddy systems, discussion of transfer progress and supervisor feedback and encouragement.

Many organizations rely on training participants to implement their own new learning. When this happens, learning transfer is achieved for only 10% to 30% of learning interventions (Hall, Smith & Dare, 2014).

It is beneficial for the corporate training industry to show the value and return on training efforts. Research shows that many training interventions are wasted because they do not result in behavior change in the workplace (Drake, 2014). Drake summarized some of the work of Dr. Brent Peterson who in a 2004 study on training programs concluded that only 25% of learning effectiveness came from the learning event. Preparation for the learning event accounts for another 25% and follow-up activities account for 50% of performance gains. A subsequent study revealed that, on average, organizations spend 85% of training budgets on learning events while only 10% is spent on preparation and only five percent on follow-up activities. Clearly, there is a disconnect between spending and effectiveness.

Drake (2014) suggested several mechanisms for improving learning transfer. Supervisors need to support both the learning and the participants in training interventions. Managers should be trained to support and coach the knowledge, skills and attitudes their employees are expected to learn and use in the workplace. Drake suggests that post-course follow-up is vital for achieving transfer. New learning needs to be applied and practiced quickly to avoid reversion to old, unwanted practices. According to the American Society for Training and Development, 70 percent of training failure is attributed to lack of training follow-up after training interventions (Drake, 2014). When there are no incentives, feedback, coaching and support from managers and/or peers, learning does not transfer. Post-course activities for overcoming these weaknesses include manager and peer group meetings and follow-up, coaching and learner accreditation only after post-course activities are completed. Drake suggests that organizations need to focus on

learning journeys rather than learning events. The journey needs to include preparation, learning and follow-up activities. Drake also notes the contribution of neuroscience in supporting learning and transfer. Building information in meaningful ways using repetition, stories, humor and good old-fashioned note-taking skills improves learning.

The global market for corporate training exceeded $140 billion in 2016 and is expected to grow at a compound annual rate of 9.79% between 2018 and 2022 (Global Corporate Training, 2018). Leaman (2014) noted that only 10 to 20 percent of learning from training interventions is transferred back to the workplace. According to Leaman, "The problem isn't the training, it's what comes afterward." Leaman notes activities at three stages of learning which contribute to successful transfer. Before training learners should be exposed to intended learning goals and business outcomes, practice activities and content reviews. During training learners should be provided practice time and feedback for relevant and memorable activities. After the training, learners should again be provided practice time as well as coaching, evaluation and feedback. Job aids which provide refresher and summary material can improve learning transfer. Many organizations do not plan for and provide these types of supports. As a result, learners return to their jobs and can easily revert to their pre-learning behaviors.

Thalheimer (2006) in describing the concept of a forgetting curve noted that knowledge is rapidly forgotten if not applied soon after learning. To improve transfer, some learning and development practitioners employ repetition in post learning activities such as recall tests, learning material chunking, reminders, and gaming activities (Leaman, 2014)

Many of the pre, post, and during activities identified in the learning and development literature align with aspects of the Torrance Incubation Model (TIM) (Murdock & Keller-Mathers, 2002). The model was originally designed for integrating creativity content into various

disciplines (Torrance, 1979). The model consists of 20 strategies, framed as metaphors, across

three stages as shown in Figure 3.
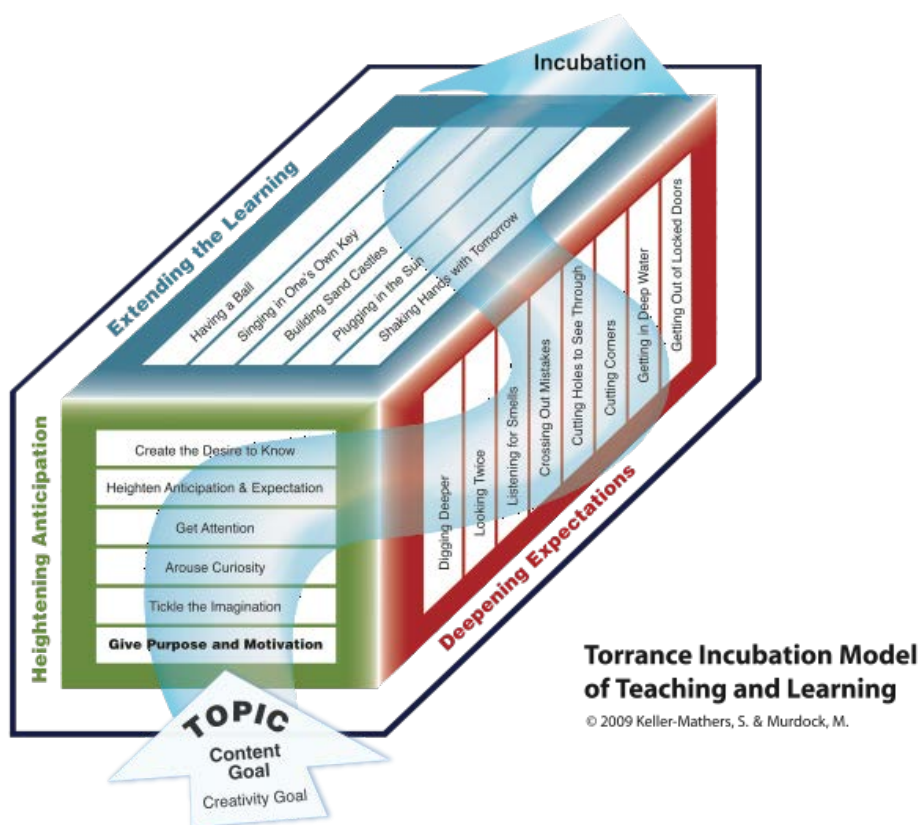
Figure 3. The Torrance Incubation Model.

The first stage of TIM, *heightening anticipation*, utilizes verbal, visual and kinesthetic

activities to create interest and purpose. The six metaphors for heightening anticipation are

creating a desire to know, heightening expectation, getting attention, arousing curiosity, tickling

the imagination, and giving purpose and motivation. These strategies relate to the "before

training" activities described by Saks and Belcourt (2006), and by Leimbach (2010) as learner

readiness.

The *deepening expectations* stage of TIM includes activities that promote exploration,

interaction and connecting to new information. The eight metaphors for deepening expectations

are: digging deeper, looking twice, making use of the senses, crossing out mistakes, getting to

the essence, targeting and focusing, getting in deep water, and getting out of locked doors. The *extending the learning* stage involves activities that have participants continue to engage with the learning in meaningful ways at the end of, or after, a training session. The six metaphors for extending the learning are having fun, giving information a personal meaning, imagining the ideal, using available resources and relating to the envisioned future. The strategies from TIM stages 2 and 3 coincide with Leimbach's learning transfer design.

Mayer (1989) noted that creative learning occurs when students use strategies to mentally represent new material in ways that lead to problem solving transfer. Mayer described learning as the acquisition of new knowledge and transfer as the effects of prior learning on new learning and problem solving. Creative learners are able to perform well on both retention and transfer questions. Retention questions resemble those presented during instruction. Transfer questions challenge students to solve problems that are not explicitly taught during instruction and require students to think beyond the information in the lesson. Mayer summarized the results of 16 experiments that showed that the use of analogical models in teaching helped foster problem solving transfer. Mayer found that students who learned with an analogical model performed more poorly on retention of specific information from lessons but better on solving transfer problems by an average of 64 percent.

Weisberg (1986) noted that associationism, a popular view on creative thinking, holds that solving new problems depends on transferring associations from familiar to new situations. Transfer is demonstrated by the use of prior learning to solve new problems. Analogical thinking is the ability to use ideas and solutions from one context in another context (Davis, 2004). Hence, analogical thinking represents a form of transfer. According to Mayer (1989), the use of analogical thinking in teaching facilitates and improves transfer of learning. Interestingly,

analogical thinking is analogous to learning transfer. In an effort to discover creative thinking tools that can be adapted to enhance or achieve learning transfer, I stumbled upon a creative thinking concept that represents transfer.

Analogical Thinking

The Oxford Dictionary defines analogy as a comparison between one thing and another, typically for the purpose of explanation or clarification (Analogy, 2019). Analogy is defined in the psychology literature as the perception of like relational patterns across different contexts (Gentner & Colhoun, 2010), reasoning and learning about a new situation by relating it to a more familiar situation that can be viewed as structurally parallel (Holyoak & Thagard, 1997), and a similarity in some respects between concepts otherwise dissimilar (Glynn, 1990). "Analogies recognize a correspondence of inner relationship or of function between two (or more) different phenomena or complex sets of phenomena" (Root-Bernstein & Root-Bernstein, 1999, p.142). Davis (2004) defines analogical thinking as the ability to borrow ideas and/or solutions from one context to another.

The term "analogy" is commonly used to connote a form of similarity between two concepts. Metaphors, synonyms, antonyms, similes, parables, formulas, euphemisms, proverbs and sports clichés are all forms of analogy. Many types of analogies are based on the relationship between the source and target concept such as:

- Action and the thing acted upon
- Cause and effect
- Classification or category
- Composition
- Effort and result

- Function

- Level of intensity

- Object and group

- Object and location

- Object and part of the whole

- Opposites

- Performer and action

- Problem and solution

- Rhyme

- Things that go together

- Tool and user

Analogies can be categorized based on shared attributes and objects, or based on shared relationships between concepts. In their simplest forms, analogies are expressed as a relationship (A:B::C:D) that can be verbalized as "A is to B as C is to D. For example, reading is to literature as listening is to music.

An analog is a familiar concept from which we can draw an analogy to another target concept. Analogical relationships can be powerful because they can comprise entire sets of relationships between features of the analog and target concepts. Good analogies reveal common structures between two domains and suggest further inferences (Gentner & Colhoun, 2010). A good analogy puts new concepts into familiar terms. "The critical part of interesting analogies is that they reveal not mere resemblances but inapparent relationships between abstract functions, one of which is understood, the other not" (Root-Bernstein & Root-Bernstein, 1999, p.143). The number, similarity, and conceptual significance of features compared between the analog and

target concepts determine how well an analogy serves to explain the target (Glynn, 1990). Analogs that prove difficult to map to the target are less useful.

Pollack (2015) describes analogies as comparisons that assert explicit or implicit parallels between two distinct things based on the perception of a shared property or relation. Humans develop abstract concepts by assigning them perceived qualities such as volume, direction, and smell using our five senses.

Pollack (2015) noted that analogical thinking is a foundation of learning and decision-making. Humans can only describe something new in terms of things that are already understood. "Were humans to lack this analogical instinct, all that we encounter would fail to trigger the rich networks of ideas, memories, and emotions that endow our experiences with contextual meaning and potential utility" (p.5). This assertion is supported many times in the literature. "Much of humankind's remarkable mental aptitude can be attributed to analogical ability- the ability to perceive and use relational similarity" (Gentner & Colhoun, 2010, p.1). "Analogies… help us make the leap from existing knowledge to new worlds of understanding that no other mental tool allows" (Root-Bernstein & Root-Bernstein, 1999, p.143). "It is not our senses that limit or liberate us, but our ability to illuminate the unknown by means of analogies to the known. Learning itself depends on analogizing." (Root-Bernstein & Root-Bernstein, 1999, p.142).

Associative theories on creativity are based on analogical thinking. Mednick's (1962) Remote Associates Test (RAT) involves mapping common relational systems between different concepts. Mednick described the creative thinking process as "the forming of associative elements into new combinations which either meet specified requirements or are in some way useful" (p. 221). Koestler's (1964) bisociation theory is based on the notion that routine thinking

occurs along a single plane while creative thinking occurs when associative contexts or frames of reference (planes) intersect.

Nielsen and Thurber (2016) provide analogies to explain the difference between conventional and creative thinkers. A traditional librarian's mode of operating represents the conventional thinker. Information is compartmentalized and accessed through a literal and linear structured process. Creative thinkers have a more figurative approach to retrieving information. Their process resembles that of an orchestra conductor who draws on and combines a variety of resources to create original sounds.

W. J. J. Gordon popularized the use of analogical thinking as part of the Synectics creative problem solving technique in 1960. Synectics methods involve deliberate use of analogies and metaphors to identify relationships between different elements or concepts. Gordon developed teachable strategies for using four types of analogies to help make the strange familiar (Davis, 2004). Using *direct analogies*, learners attempt to think of related problems and how they were solved. *Personal analogies* involve having the learner imagine that they are part of the problem. For example, to address the problem of traffic congestion, the learners could imagine themselves as an automobile, the roadway, or a traffic light to identify possible solutions. *Fantasy analogies* require the learner to imagine unrealistic, yet ideal, solutions that may act as stepping-stones to practical solutions. *Symbolic analogies* involve the use of paradoxes, oxymorons, and other self-contradictory terms to stimulate ideas for solving problems (Davis, 2004).

In scientific discovery, theories are constructed through a mix of inferences from existing knowledge, causal reasoning, induction, and deduction (Dunbar, 2000). Scientists use analogies to perform some or all of these steps at once. Scientists draw on analogies from distant domains

in order to restructure their knowledge in a gestalt-like manner (Dunbar, 1997). In a study of the goals of analogical thinking in scientific experiments, Dunbar found that analogies were used to formulate hypothesis, design and fix experiments, and explain results. Distant analogies were most useful for explaining results to others (Dunbar, 2000).

The literature on analogical thinking includes a variety of processes that possess common steps. Gentner and Colhoun (2010) describe a five-step process for analogical thinking. In the retrieval step, information from long-term memory that resembles a current situation is brought back into working memory. In the mapping step, representational structures are aligned to derive commonalities and project inferences from the source to the target analog. These inferences and the quality of the analogy are then assessed in the evaluation step. In the abstraction step, the structure common to both analogs is generalized. In the re-representation step, one or both analogs are adapted to improve the match between the source and target analogs (Gentner & Colhoun, 2010).

Holyoak and Thagard (1997) describe four distinct steps people go through when using analogies. The access or retrieval step invokes a recognized relationship between the source and target. The mapping step identifies the relations between objects as per Gentner's structure mapping theory (1983). The inference step involves a creative leap that allows the user to conclude something about the target domain based on the source domain. A fourth step, the learning step, results from new generalizations or abstractions based on commonalities between the source and target domains.

The mapping of the source concept to the target concept is the key step in analogical thinking. Gentner (1983) developed the structure mapping theory of analogical thinking. Structure mapping involves assigning knowledge from a conceptual base (source concept) onto a

target concept in a way that preserves the structural relationships within each concept while ignoring irrelevant differences (Pollack, 2015). An important feature of structure mapping is the mapping of relations between objects, rather than the similar attributes of objects (Gentner, 1983). "Common relations are essential to analogy; common objects are not" (Gentner & Markman, 1997, p.46). When alignment of structure exists, inferences can be made about the target domain. Better analogical matches occur when relations are interconnected by higher order connections. When multiple associations are produced through an analogy, the more systematic interpretation is most useful for understanding the target concept (Kao, 2014). This systematicity provides more causal predictive power (Gentner & Markman, 1997). The mapping process also identifies salient differences that paradoxically can be important when pairs of items are similar.

Using analogies, creative people in all disciplines juxtapose two phenomena and meld them into one. "Scientists and artists, technicians and craftspeople, all analogize in the same way and for the same reasons" (Root-Bernstein & Root-Bernstein, 1999, p.145).

Teaching with Analogies

Successful use of analogy requires students to construct the analogical relationships intended by the teacher (Wilbers & Duit, 2006). Analogical thinking relies more on the students' visualization and abstraction than propositionally based knowledge from the teacher. Analogical reasoning can be broken into the three sub-processes of access, mapping, and generalization. The propositional structure is accessed through similar but sometimes irrelevant attributes and relationships. Mapping involves a comparison of similarities. Successful use of analogy results when the learner builds new knowledge of the target by leaving aside irrelevant similarities and structural features. Success depends on the visual and mental representations of the base and target analogs (Wilbers & Duit, 2006).

In college and university business schools, analogical thinking is promoted through the case study method. Students are confronted with novel problems or opportunities and are asked to draw on prior settings deemed to be similar in order to transfer a solution to the new, less familiar context. The case method is used both to practice analogical thinking and to provide new analogs for addressing subsequent problems and opportunities. However, there is little evidence that management courses teach students to identify analogies and develop analogical thinking skills (Gavetti & Rivkin, 2005; Green & Smith, 2017). As a result, students make poor decisions because they fail to map and focus on the significant relationships between analog and target, bad analogies get anchored and overused, and students fall prey to confirmation bias. These problems can be overcome by properly recognizing the analogy and identifying its purpose, understanding the source, assessing similarity and translating and adapting a decision to the target analog (Gavetti & Rivkin, 2005).

In addition to Gordon's Synectics methods described earlier, several processes have been developed and used to teach learners to use analogical thinking skills in specific disciplines. The use of analogies appears to be the most prominent in the teaching of science. While the literature describes studies and examples of domain-specific use of analogical models, scholarly work on teaching analogical thinking skills across disciplines is lacking.

Glynn (1990) developed the Teaching With Analogies (TWA) model as a mechanism for textbook authors and teachers to guide their use of instructional analogies. The TWA model includes six operations:

1. Introduce the target concept
2. Recall the analog concept
3. Identify similar features of both concepts

4. Map similar features

5. Draw conclusions about the concepts

6. Indicate where the analogy breaks down

According to Glynn, the usefulness of an analogy can be judged by the number of features compared, the similarity of features compared, and the conceptual significance of features compared. "A good analogy puts new ideas into terms with which students are already familiar." "An analogy is considered bad if it is difficult to identify and map important features shared by the analog and target" (p. 197). Analogies can hinder learning when they lead students to associate irrelevant relationships and features between the analog and target, and as a result, draw the wrong conclusions. In addition, every analogy breaks down at some point, and learners need to understand this in order to avoid making incorrect inferences.

Glynn's TWA model focuses on in-class activities. Because typical classroom interruptions can cause some of the steps in the TWA model to be missed, Treagust, Harrison and Venville (1998) adapted the TWA model to include pre-lesson and post-lesson activities. This three-phase approach to teaching with analogies is known as the Focus-Action-Reflection (FAR) guide. Pre-lesson *Focus* activities exam the complexity of the concept and the knowledge and experience students already possess regarding the concept. In-lesson *Action* activities check students' familiarity with the analog, map features and relationships between the analog and the target, evaluate the complexity of relationships, and discuss ways that the target and analog are dissimilar. Post-lesson *Reflection* activities assess the usefulness and clarity of the analogy and plan for improving the exercise for future use.

In the context of analogical thinking, cognitive readiness refers to the extent to which a learner is prepared to transfer knowledge from the source analog(s) to a target (Holyoak &

Richmond, 2014). Strategies for using analogies to teach relational structure include guided comparison of examples, using visuals and principles to highlight relations, focusing on relations versus object features, and the ordering of examples to encourage progressive alignment. Holyoak and Richmond provided the following list of recommendations for using analogies to improve learners' cognitive readiness (2014):

1. Use a source analog with a causal structure that is well known to learners

2. Have learners compare multiple source analogs before transferring to the target

3. Use mapping tasks or explicit instructions to guide learners through comparisons

4. Foster progressive alignment by starting with easier mappings before more challenging mappings

5. Reduce processing load on working memory by using mental imagery and visual representations of source and target analogs

6. Design source and target visual representations that key on relationships and downplay irrelevant similarities and differences

Robert and Michele Root-Bernstein (1999) described the steps used for creating analogies in the Private Eye Project piloted in Seattle public schools:

1. Start with observation

2. Ask, "What does this remind me of?"

3. Draw it

4. Ask "What does this remind me of?" again

5. Generate lists of comparisons

6. Critique these visual analogies

7. Search for functional relationships

8. Theorize why it is like that

"Start with what you know or what the person you are teaching already knows, then find the functional analogy that bridges this known thing with the unknown one that needs to be understood" (Root-Bernstein & Root-Bernstein, 1999, p.156).

To summarize, the literature on teaching with analogies contains some common recommendations for teaching using analogical models. Teachers need to:

1. Confirm and/or develop students' familiarity with the source analog(s)

2. Use multiple source analogs for mapping to the target

3. Guide and encourage students to:

    a. Use visualization and mental representations of analog and target concepts

    b. Map source and target analogs

    c. Distinguish between relationships and attributes when identifying similarities and differences

    d. Discern between relevant and irrelevant relationships

My initial goals for this project were to identify creative thinking concepts for teaching creative thinking skills in a way that enables learning transfer. My initial research on transfer of learning led me to conclude that analogical thinking represents both a creative thinking method and a form of learning transfer. Hence, I selected analogical thinking as the creative thinking concept that will be the focus of my workshop development.

My research on analogical thinking broadened my understanding of the process of analogical reasoning and the importance of structure mapping skills. The literature revealed much about the use of analogies in sciences and the challenges associated with using analogical models in teaching. I was unable to find examples of curriculum on domain-neutral teaching of

analogical thinking or practical suggestions for creating good analogies. Methods for teaching

structure mapping also require further investigation, although concept mapping tools hold

promise. These areas of inquiry will be researched in the future. The general recommendations

found for teaching with analogical models can be applied to outline a workshop for teaching

analogical thinking in ways that extend the learning and enable transfer.

Framework for a Workshop on Analogical Thinking

The Torrance Incubation Model (TIM) and Accelerated Learning are two curriculum

development frameworks taught in the International Center for Studies in Creativity that will be

used to build the analogical thinking workshop.

Accelerated learning is a method for rapidly designing and delivering effective training

programs. The accelerated learning concept is based on the following guiding principles (Meier,

2000):

1. Learning involves the whole mind and body

2. Learning is creation not consumption

3. Collaboration aids learning

4. Learning takes place on many levels simultaneously

5. Learning comes from doing the work itself – with feedback. The real and the concrete are

    far better teachers than the hypothetical and the abstract – provided there is time for total

    immersion, feedback, reflection and re-immersion.

6. Positive emotions greatly improve learning

7. The image brain absorbs information instantly and automatically. The human nervous

    system is more of an image processor than a word processor

Traditional training design incorporates the Instructional Systems Design (ISD) model which

takes a behavioristic approach to learning and is viewed as "overly linear, analytical, verbal, left-

brained, academic, top-down, and prescriptive (Meier, 2000, p. 212). Accelerated learning

utilizes a Rapid Instructional Design (RID) model that is based on providing students with

opportunities to learn from experience with feedback rather than from materials and

presentations. "You learn how to swim by swimming, how to sell by selling, and how to manage

by managing. You don't learn a new skill by listening to someone talk about it, whether an

instructor, a book, or a computer" (Meier, 2000, p. 215).

There are seven principles associated with Rapid Instructional Design (Meier, 2000):

1. *Design with the 4-phase learning cycle*. The four phases include preparation (arousal),

presentation (encounter), practice (integration), and performance (application).

2. *Appeal to all learning styles*. The SAVI approach to learning (activity-based design)

includes somatic learning by moving and doing, auditory learning by talking and hearing,

visual learning by observing and picturing, and intellectual problem solving and

reflecting.

3. *Make learning designs activity-based*. Materials should supplement activities and not

be substitutes for activities.

4. *Create a learning community*. Linking is the essence of intelligence. Create designs

and activities that allow everyone to be simultaneously learners and teachers.

5. *Alternate between physically active and physically passive learning activities*.

Alternating between active and passive activities sustains learners' energy. Manipulate

objects, build models, role-play, and demonstrate.

6. *Follow the 30/70 rule*. 70% of time should be devoted to learner practice and integration activities. What the learner says and does is most important. Have learners produce their own meaning, knowledge and skill.

7. *Create a flexible, open-ended design*. Make your design a work in progress.

The goals and structure of curriculum designed using RID principles address some of the weaknesses noted earlier regarding the success of typical training efforts in achieving transfer. Students must create their own learning through immersion, trial and error, feedback, reflection and re-immersion (Meier, 2000). Much of the focus should be on what teachers and learners do before and after the training intervention, and this has the greatest impact on learning transfer.

The Torrance Incubation Model (TIM) also addresses the pre, during, and post phases of learning interventions. Steps for designing a lesson using TIM are as follows (Murdock & Keller-Mathers, 2002):

1. Start with a clear description of your main topic and goal.

2. Select an aspect of creativity that you want to weave into the lesson.

3. Design the start of the lesson (set the purpose and motivation and utilize one or more of the strategies to heighten anticipation).

4. Design the heart of the lesson – it must deepen expectations by using one or more of the strategies to deepen expectations

5. Design the end of the lesson – utilizing one or more of the strategies designed to extend the learning.

The workshop outlined in Figure 4 contains a mix of elements from both the RID model and TIM.

Analogical Thinking Workshop	
Learning outcomes	1. Describe the steps in the analogical thinking process. 2. Identify source analogs that relate to a problem. 3. Apply a systematic approach to mapping source and target concepts. 4. Build concept maps for source and target analogs. 5. Create new learning about a target concept based on one or more source concepts.
Creativity goal	Use analogical thinking to help define problems and generate ideas.
Preparation Phase	
Learner benefit statements	Those who actively participate in this session will be able to: • Apply new tools for defining problems and generating ideas. • Improve their creative thinking capacity. • Build and use analogies and metaphors to learn and explain unfamiliar concepts. • Critically assess analogies used in politics, business, science and other aspects of everyday life.
Learner goal statements	• Describe what it means to use analogical thinking. • Know the steps in the analogical thinking process. • Identify concepts that you know that can be used to help describe and understand a new problem. • Help other learners make connections between what they already know and possible solutions to their problems
TIM strategies	• Creating a desire to know • Heightening expectation • Getting attention

	- Arousing curiosity - Tickling the imagination - Giving purpose and motivation
Activities	- Learners will be provided with a list and images of famous scientific and other breakthroughs that resulted from analogical thinking. - Learners will be invited to learn about more innovations that were born out of analogical thinking including ones in their own discipline. - Learners will be invited to learn how to use analogical thinking to understand and explain new concepts and how to incorporate analogical thinking into their teaching. - Pre-session warm-up exercise: Remote Associates Test (RAT) and/or simple analogy format A:B::C:D (A is to B as C is to D)
Presentation Phase	
TIM strategies	- Creating a desire to know - Heightening expectation - Arousing curiosity - Tickling the imagination - Giving purpose and motivation - Digging deeper - Looking twice - Listening for smells - Crossing out mistakes - Getting in deep water
Activities	**Introduction** **Warm-up activity** **Lecturette**

	1. Putting analogies into context
	2. Analogical thinking as the basis for learning
	Small group discussion
	• Given this idea/solution, what are some analogies that could have been used to come with the solution?
	Whole group discussion
	1. How is X like Y?
	2. Debrief
	Small group activity
	1. Draw a concept (related to the discipline) (flipchart or whiteboard) with as much detail as possible
	2. Debrief some few examples
	Lecturette
	1. The analogical thinking process
	2. Presentation of an example of concept mapping between source and target
	3. Highlight mapping of relationships vs. attributes
	4. Highlight one inference that could be drawn and ask for others
Practice Phase	
TIM strategies	• Creating a desire to know
	• Tickling the imagination
	• Giving purpose and motivation
	• Digging deeper
	• Looking twice
	• Listening for smells
	• Crossing out mistakes
	• Cutting corners
	• Getting in deep water

	• Getting out of locked doors
Activities	**Small group activity – concept mapping**
	1. Declare a source analog and specify the concept to focus on
	2. Participants draw the source analog/concept
	3. Participants list attributes
	4. Participants create a concept map for the source analog
	5. Coach and provide feedback
	6. Debrief a few examples
	Small group activity – analogical thinking process # 1
	1. Declare a source analog and specify the concept to focus on
	2. Participants draw the source analog/concept
	3. Participants list attributes
	4. Confirm participants understanding of the analog
	5. Participants create a concept map for the source analog
	6. Declare target analog
	7. Participants draw the target analog
	8. Participants list attributes
	9. Participants create a concept map for the target analog
	10. Participants map relationships between source and target analogs
	11. Coach and provide feedback
	12. Debrief a few examples
	13. Participants draw inferences from source to target
	14. Debrief all examples
	Whole group discussion
	• Reflection and discussion on the process (what was easy, difficult, confusing)
	Small group activity – analogical thinking process # 2
	1. Identify target concept (can be different one for each group)
	2. Have the group brainstorm potential source analogs

	3. Group selects source analog and (if necessary) specifies the concept to focus on
	4. Participants draw the source analog/concept
	5. Participants list source attributes
	6. Participants create a concept map for the source analog
	7. Participants draw the target analog
	8. Participants list target attributes
	9. Participants create a concept map for the target analog
	10. Participants map relationships between source and target analogs
	11. Coach and provide feedback
	12. Participants draw inferences from source to target
	13. Coach and provide feedback
	14. Debrief all examples
	15. Group reflection and discussion
	Whole group activity
	• RAT game
Performance Phase	
TIM strategies	• Tickling the imagination
	• Giving purpose and motivation
	• Digging deeper
	• Looking twice
	• Listening for smells
	• Cutting corners
	• Getting in deep water
	• Getting out of locked doors
	• Having a ball
	• Singing in one's own key
	• Shaking hands with tomorrow
Activities	**Small group activity – analogical thinking process # 3**

	1. Have each group select a target concept from their discipline (duplicates are ok)
	2. Have the group brainstorm potential source analogs
	3. Group selects source analog and (if necessary) specifies the concept to focus on
	4. Participants draw the source analog/concept
	5. Participants list source attributes
	6. Participants create a concept map for the source analog
	7. Participants draw the target analog
	8. Participants list target attributes
	9. Participants create a concept map for the target analog
	10. Participants map relationships between source and target analogs
	11. Coach and provide feedback
	12. Participants draw inferences from source to target
	13. Coach and provide feedback
	14. Debrief all examples
	15. Group reflection and discussion
	Small group exercise
	• Prototype of job aids for use after the session
	Individual exercises
	• Concept map for analogical thinking and workshop activities
	• Personal list of analogical thinking challenges to tackle
	• List of potential applications for analogical thinking back in the workplace
	Whole group discussion/debrief
	Distribution of job aids
	Review of key concepts
	Discussion of post-workshop activities
	Post-Workshop – Extending the Learning
TIM strategies	• Tickling the imagination

	• Giving purpose and motivation • Having a ball • Singing in one's own key • Plugging in the sun • Shaking hands with tomorrow
Activities	• Participants will be invited to challenge their associative thinking abilities by attempting a weekly online RAT crossword puzzle. • Participants will be invited to contribute to a concept map database that will be available to participants for use as a source of source analogs.

Figure 4. Framework for a workshop on analogical thinking.

SECTION FIVE: KEY LEARNINGS

Product

My main goals in executing this Master's project were to identify and develop creative thinking tools and methods that support and achieve transfer of learning. Such tools could be useful inclusions in the creativity course I teach at my college. Creative thinking tools and training could also be useful to my faculty colleagues as the college moves to add more creative and innovative learning opportunities across the curriculum for both students and faculty.

The literature reviews I undertook on transfer of learning, analogical thinking, structure mapping, and teaching with analogies are important components of my product for this project. I discovered several surprising research findings that will inform my teaching in the future and can possibly help other faculty and curriculum developers improve effectiveness of lessons, courses, programs, and learning.

The findings on the relative influences of pre, during, and post training activities were surprising to me. Research shows that only 25 percent of learning transfer is a result of in-session training. Twenty-five percent of what sticks is attributed to pre-session activities and 50 percent or more of learning transfer is the result of post-session follow-up activities. The findings will inform my choices and processes regarding pre-course, pre-class, in-class, and post-class materials and activities. Recently my program faculty team discussed our frustrations with our students' retention of learning as they progress through our program. The research on post-session activities suggests that our programs could be structured to include practice and feedback for key concepts in each semester throughout the program. We should consider a program structure and progression built around key concepts and skills instead of course names.

Ever since I started studying creativity, I have believed that creativity is predominantly based on associative abilities. Many of the authors I encountered during my research for this project commented on the significant contribution of analogical thinking to human learning and human progress. We build all new meaning from what we already know. This was an exciting confirmation for me and this helped to push me to continue to learn more about analogical thinking and how to teach the concept to others.

Although I have more to learn, the project helped me build foundational knowledge about the analogical thinking process and how to use analogical models to support learning and transfer. I think it is fascinating that structure mapping is a key component of analogical thinking as well as a key concept in the development of artificial intelligence. I wonder if, in the future, our grasp of structure mapping will help humans keep ahead of machines or contribute to the human-like capabilities of machines, which can both enhance and threaten our livelihood and experiences.

I was excited to discover tools and processes for concept mapping. I have used mind mapping tools and exercises in my classes and I see the benefit of constructing concept maps that identify relationships between source and target analogs. I look forward to incorporating concept maps into my creative thinking curriculum as well as in other courses I teach. I think that the prospect of linking relationships between multiple concept maps could enhance analogical thinking.

I also benefited greatly from the review of the TIM and RID models for curriculum development. When I think about it, I feel I have experienced the benefits of post-session practice by selecting these two models to contribute to my product. Both the models have very

useful features for curriculum development for my project as well as for other courses that I try to build and improve.

Process

As often happens in my vocational and scholarly work, the clarifier in me took over and led me deep into the literature on several concepts. My struggle to balance work, life, and study also endured throughout the project. I got off track from what I thought was a doable plan and schedule. I was fortunate to discover the connection between analogical thinking and learning transfer as it helped satisfy my dual project objectives of selecting creative thinking tools and enabling learning transfer. Otherwise, I would have needed to spend much more time assessing creative thinking tools for their transfer enabling capabilities.

I have a preference for working in relative isolation. I could have and should have sought more support from my cohort, my colleagues, and the ICSC faculty. Although I extoll the need for collaboration when I am with my students, I am normally hesitant to ask for help. I should have been a better support for my fellow students throughout the project. I always have found that being a student helps me to ground my teaching practices. This experience has helped me gain empathy for my students and how they deal with opportunities and requirements for collaboration.

I tend to be over-optimistic when planning projects in the sense of what I will be able to accomplish and the time it will take. Fortunately, my advisor for this project, Dr. Susan Keller-Mathers, helped me to narrow my focus for the project during the concept phase. One of my colleagues completed much of the preliminary work before our first meeting as a class. Dr. Keller-Mathers made this possible by sharing the course content and posting information weeks

before the class started. This was very beneficial and in retrospect, I wish I had made more progress in January when I had fewer demands on my time.

I do see the value in the advisement process. It incorporates a useful perspective on learning, namely that we learn through practice with feedback (Meier, 2000). Overall, the project challenged me to practice and develop my skills in all of the clarifying, ideating, developing and implementing FourSight preference areas (Puccio, Mance & Murdock, 2011).

Evaluation

I need to be more realistic, deliberate and precise regarding project goals. I was not able to make enough progress in time to seek feedback as planned from my colleagues. As stated in my process plan "As I start this project, I have no clear vision of what these mechanisms (tools and methods) will look like." Moreover, although the tools and methods materialized late in the project, there is more work to do.

I am very satisfied that the work I completed will be contribute to helping people learn to use a creative thinking tool in a way that achieves learning transfer. I will have the opportunity to apply what I have learned and developed at an upcoming retreat for another faculty division at my college. I also am satisfied that I will be able to incorporate what I have learned into my creativity course as well as other courses I teach. Analogies apply in all disciplines.

As per my evaluation plan, "I intend to create a starting point for the teaching of creative thinking tools in new ways to new audiences." I have made progress toward that goal. I believe I am on a path to discovering new ways to improve the effectiveness of teaching and help people achieve the highest level of learning. I am a better teacher because of this project.

SECTION 6: CONCLUSION

Although I designed this project to produce a new and useful product, I think that most of the value for me has been in my own new learning. I wanted to create a new method for teaching a creative thinking skill while tackling a challenge that I have been thinking about for decades (transfer of learning). I feel I know much more about both topics compared to when I started this project. Along the way, I feel I have utilized many of the creativity and change leadership concepts learned in the program.

Regarding the concept of analogical thinking, I now know:

- Because humans create new meaning based on what we already know, analogical thinking is the basis for all learning.

- We use analogies in all aspects of life, often without knowing or noticing.

- Analogies are the source of much scientific breakthrough, creativity and innovation.

- Analogical thinking represents learning transfer and creativity, the highest level of learning.

- Analogical thinking models can be useful in all educational disciplines.

- Analogies can be powerful tools for creating understanding and supporting arguments in politics, business, science, and other domains.

- There is a process for thinking analogically that can be taught and learned.

- Structure mapping is a key step in analogical thinking and is the basis for advances in artificial intelligence.

- Concept mapping between source and target analogs holds promise for teaching and learning analogical thinking.

- Teachers who are catalysts for change can develop pre, during, and post-training activities that help extend the learning.

I have been invited to speak about creative thinking at an upcoming retreat for a different faculty group at my college. What I see myself doing next is further developing my tools and methods for teaching analogical thinking and including it in my session at the retreat. I see myself experimenting with concept mapping techniques for mapping analogs to targets. I see myself incorporating my learning into the curriculum for my creativity course. I see myself working with faculty from all disciplines to investigate the use of analogical thinking models in their curriculum. I am excited about the possibility of collaborating with different academic disciplines on building new source analogs that can be used across disciplines.

Dr. Ruth Noller's equation for creativity (Puccio, Mance, Switalski & Reali, 2012), as shown in Figure 5, is useful for explaining the components of creative thought. I think it also represents the spirit and method of analogical thinking. Knowledge represents our source analogs. Evaluation helps us map concepts. We use our imagination to identify relationships and make inferences. Moreover, we do it all to learn and understand something new.

$$C = f_a(K, I, E)$$

Figure 5. Dr. Ruth Noller's equation for creativity as a function of knowledge, imagination, and evaluation moderated by attitude.

Finally, what I see myself doing in the future is a deep dive into famous and useful analogies for writing a blog or book on how to come up with good analogies and how to be a better analogical thinker.

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May 14, 2019

Date