11 DENNIE L. SMITH

BLENDING CREATIVITY AND PROBLEM SOLVING

Introduction

This paper is organized around the construction of a kaleidoscope, application of a problem-solving model, and the intersection of the two concepts to enhance creativity and discovery of new knowledge. An analogous process of transferring information or meaning from the physical construction of a kaleidoscope to a 5-step problem solving model is described to illustrate how blending, or associations with dissimilar objects or processes, can lead to the generation of new mental content and solutions to problems in accomplishing goals.

The theoretical underpinnings for using problem solving models to enhance creativity and stimulate the discovery of new knowledge are well established. According to Gordon (1973), invention or the discovery of something new can be facilitated with a formal problem solving approach. In addition, core literature in the fields of psychology, education, and applied sciences maintains that the nature of the creative process does not vary with the subject domain and can lead to the discovery of new relationships, products, and processes through the use of a variety of problem solving models. Related to this knowledge, cognitive psychologists have firmly established creativity as a basic aspect of learning in all content domains (Glover, Ronning, & Reynolds, 1989). In particular, the use of metaphors in various fields enhances the creative and discovery process and helps problem solvers understand unfamiliar problems by juxtaposing them with known situations (McCallister, 1994). An investigation between factors of creativity and factors of metaphors indicated that metaphors play an important role in design creativity in many fields (Bilchev & Parrnee, 1995; Casakin, H. (2007); Duit, 1991).

In general, a metaphor is a comparison between objects, actions, or concepts to which it is not literally applicable. This paper describes how a problem-solving model can be used in the construction (creation) of a kaleidoscope and how metaphors that are derived through the process can enhance the ability to solve problems and expand creativity.

Kaleidoscopes

Sir David Brewster is credited with inventing the kaleidoscope in 1816 and explicating a number of physical laws related to the behavior of light (Brewster, 1817; Groth, 2007). A kaleidoscope can be made out of a variety of materials,

objects, and mirror configurations to make colorful and complex designs that entertain the visual senses when held to the eye and turned by hand (Baker, 2001; Heard, 2012).

The elements of a kaleidoscope include five components: barrel, eyepiece, object cell, object cell housing, and the mirror system. Although the construction of a wooden kaleidoscope narrows the choice of materials, the first decision involves the selection of wood. The softer woods (e.g., western cedar, birch, poplar) or hardwoods (walnut, oak, cherry) will determine special techniques for making and finishing the kaleidoscope. A lathe is used to drill a 1 and ¼ inch hole in a block of wood to make the barrel to hold the mirror system. The mirror system consists of an equilateral (equal sides) or an isosceles (two equal sides) triangle and can be constructed with three mirrors or two mirrors and a piece of flat, black glass. The isosceles triangle kaleidoscope contains two 8 inches by 1 and 1/8 inch mirrors with an 8 ¾ inch flat black glass. The mirrors and black glass are placed face down and taped together to form a triangle that slides into the barrel. Light passing through the object cell and traveling down the mirror creates the image when the viewer looks through the eyepiece. The eyepiece is made by drilling a 1¾ inch hole in another 2 ½ inch diameter block of wood that will fit over the barrel. The eyepiece has a 3/8 inch hole in the end to look through the kaleidoscope. The object cell housing is then made by drilling a 1 ¾ inch diameter hole in another 2 ½ inch diameter block of wood. Additional care is taken to drill 1 ¼ inch hole in the end of the housing to hold the object cell. The object cell is made by using a small 1 ¼ inch plastic cup filled with beads and other small objects, filled with mineral oil, and sealed with super glue. The wood components of the kaleidoscope are sanded with 400- grit sandpaper and finished with five coats of lacquer. The final assembly involves the insertion of a keeper wire in a small groove on the barrel to hold the object cell housing for turning. Silicone sealant is used to hold the mirrors in the barrel and hold the eyepiece on the barrel. The kaleidoscope is now ready for that "ah ha" moment when one looks through the eyepiece and views the changing image in the object cell when the barrel is turned.

Throughout the process of construction, there are several opportunities for problems to occur including: using the wrong speed of the lathe in relationship to the wood and sharpness of the tools; mineral oil spilling over on the outside of the object cell causing the super glue not to stick; the wood cracking from drilling pressure, etc. Under any of these circumstances, the construction goal may need to shift completely to repurposing the components and creating a candlestick, wood vase, or paper clip holder.

Problem Solving Process

Creative problem solving is presented in scholarly literature in many forms

(Lumsdaine & Lumsdaine, 1994-95). The processes for solving problems are used informally and formally throughout all aspects of our lives and are generally used from the moment we wake to when we sleep. Simple as well as complex problems confront us daily with respect to our personal, work, and social lives. Many of these problems are quick fixes, such as finding something, or can be long term, as in addressing serious health issues. A vast amount of information is available on the inter-net related to problem solving as evidenced by 15,300,000 hits recorded on a recent web search of the topic.

The 5-Step Problem Solving Process (PSP) (Smith, 2013) described in this paper is relatively simple and can guide an individual or a group to find a solution to a problem through five organizing questions: 1. What is the problem?; 2. Who is impacted by the problem?; 3. How important is the problem?; 4. What are the possible solutions?; and 5. How is the solution used to solve the problem? Not only can the 5-step PSP guide the construction of a kaleidoscope but it also can serve as a framework for the use of an analogous process that combines and compares concrete elements or creative solutions. The remainder of this article provides explication and an example of the 5-step problem solving model used in conjunction with kaleidoscope metaphors to demonstrate the usefulness to individuals, as well as groups, in a multitude of areas of one's personal and professional life.

Applying the 5-Step Problem Solving Process

What is the problem?

A problem is an uncomfortable state of affairs and troubling to individuals or groups. Problems present challenges that require changes in order to eliminate the discomfort. Athough it may sound simplistic, one has to clearly identify the problem to initiate the 5-Step problem solving process. Often considerable time must be used to examine the nature of the problem, its scope, and specific causes in order to avoid an incomplete or faulty analysis that can lead to a flawed and frustrating solution.

For example purposes, we will consider Mary, a college engineering student who is having difficulty managing her finances and having sufficient funds to pay monthly bills that include her share of rent for an apartment and monthly tuition installments. Mary's parents have provided sufficient funds each month to pay her rent, tuition, food, and small miscellaneous expenses. In the past, Mary had relied upon her parents to provide for her monthly shortages, but she now has a sibling who is starting college and will no longer be able to depend upon them to bridge the gap.

Who is impacted by the problem?

Conceivably, a problem could only impact an individual; however, it usually affects others also. In the work place, all stakeholders should be involved in problems that directly impact them. A family or other groups may have a problem that requires attention by all of the members of the group in order to achieve satisfactory resolution. Given Mary's problem of inability to manage her finances, let us assume that the problem can be solved by the student. Thus, she must first acknowledge the problem, that it impacts others, and that it is within her control to solve.

How important is the problem?

Problems come in many forms and their intensity is related to an individual's perception and the context of the issue. Although some individuals seem to be able to handle problems better than others, it is necessary to specifically range problems according to their perceived importance. Those judged to be intense and of high importance to stakeholders often need to be addressed in an urgent manner. If Mary's finances as described above are not successfully managed, then her apartment friends, college status, and bill collectors could get involved. The problem may become so intense that it distracts from her academic studies and long-term goals of becoming an engineer.

What are possible solutions to the problem?

Possible solutions require gathering data and information from a variety of sources. If a company is experiencing an increased number of returned products, data related to the customers and the employees who handled these returns are essential. Research can reveal if others have experienced the same or similar problems and perhaps, how the problem was solved. It is possible, also, to benefit from learning about the unsuccessful solutions that others have tried. Brainstorming among directly involved constituents can also include the combination of solutions to arrive at an innovation or new approach to the problem.

For Mary, our college student with a monthly financial shortfall, an initial step in finding a solution would be an analysis of her previous months' fixed and flexible expenditures. The primary fixed costs would include her share of the rent and prorated tuition. Other costs related to food, concert tickets, and the purchase of new clothes would have financial flexibility. Possible solutions might include getting a part time job to maintain her college lifestyle, securing a loan, asking a relative to loan or give her money, applying for a credit card, or decreasing her spending to continue to work on her current goal of earning a college degree. Other

options could involve changing her goals as Mary has talent in writing and singing popular songs and opportunities for making music a full time career. Each of the generated solutions would then be analyzed with respect to the impact on the problem and Mary's commitment to becoming an engineer by using a ranking and plus-minus system to determine the best solution.

What is the plan for implementing the solution?

A detailed plan helps to identify the steps for the implementation of a solution. If others are involved, there should be some means of assigning responsibilities and monitoring accountability. The plan should be reviewed frequently to ensure that all aspects of the plan are being implemented. Communicating the success of implementing the solution can be extremely useful to the perceptions and morale of the stakeholders and can lead to future improvements and alternative solutions. In our example, Mary chose to change her goals and to use her passion, musical talent, and opportunities as a paid lead singer in a band to develop a new direction for her life. Mary made the decision in spite of contrary advice from her parents (stakeholders) and will need to communicate her progress and accomplishments of her goals to them as she changes career directions.

Blending Problem Solving with Kaleidoscope Construction

Construction of the kaleidoscope serves as a tangible object and process for thinking about and exploring various phases of the problem solving process. In the preceding college student example, it is necessary to begin by thinking about questions that can be used to connect the abstract concept of Mary's financial stability to the concrete process of constructing a wooden kaleidoscope in order to build the metaphors that will result in creative as well as practical solutions and outcomes. One such question might be "How can constructing the kaleidoscope be related to the financial situation of our fictitious student?" This aspect of the blending process requires the problem solver to begin to look for similarities and differences and to construct metaphors that relate two completely different problem areas while also forcing consideration of how successful outcomes can be achieved given components of each problem. In our example, the construction of the kaleidoscope's main components demonstrates the interconnectivity of the parts in order for it to work properly. In Mary's situation, her various financial needs are also interconnected and must be considered together in order for her to attain solvency. Thus, a focus on the function of the kaleidoscope helps one to start thinking about the financial situation in more than one way.

Looking through the kaleidoscope one sees various colors and design changes as the housing of the object cell is turned to form new patterns. The metaphor here

might be that Mary can make changes in her financial decisions to form new behavior. The kaleidoscope metaphor works well in suggesting that there are numerous ways of solving the problem, including pursuing new goals (a musical career) as noted in our example. The infinite number of images seen through the kaleidoscope suggests seeing things in different ways and generating new and possibly multiple solutions. Another metaphor uses the steps (or necessary sequence) in building the kaleidoscope as a comparison to establishing a plan for implementing the solution(s). Finally, the silicon that holds the kaleidoscope together can be compared to Mary's developing a new financial plan for her new goals and sticking to it, or perhaps exercising self-discipline or using an outside person or agency to help monitor her finances. Radical changes in the overall design of the kaleidoscope would require modifications in interrelationships of the components. The same would be true in making significant changes in one's career goals or creating a new product for marketing.

The author has used the kaleidoscope metaphor with groups for teaching about and demonstrating the problem solving process outlined above. Participants have opportunities to inspect the various components and experience views with several types and sizes of kaleidoscopes during the sessions. They also view a short video (Smith, 2013) of the construction of the kaleidoscope to help increase their knowledge about building and assembling the various components. These events are followed by introduction and explanation of the 5-step problem solving process along with examples to provide a structure for solving problems. The final activity of the session involves participants identifying several problems that may be common among the participants, prioritizing the problems, and selecting several for participants to apply the problem solving process and reach final conclusions about which solutions might work best. A kaleidoscope(s) is available during the session for stimulating metaphors and representation of various aspects of the problem or the solutions.

Although this paper presented the construction of the kaleidoscope as a metaphor for blending creativity with the problem solving process, other metaphors can certainly be used. For example, metaphors can be built around cars, windmills, ships, rainstorms, football games, lawnmowers, clocks, making a cake, banquets, the ecology of a pond, as well as many other possibilities. In addition to knowing about the physical aspects and components of the objects being used for developing metaphors, learning about the construction or other details about use of the objects will enhance the metaphorical associations that can be used in the problem solving process. The physical presence of the objects, models, and/or photos will also impact the overall utility of the metaphor in serving as direct or indirect influence on creativity and problem solving. Focusing on the process of constructing the kaleidoscope takes people's attention away from the problem and allows the possibility of the emergence of creative thought from the subconscious for forging new

associations that can result in new solutions to problems. The function of the kaleidoscope to produce many different views through the interconnectivity of the components is a reminder that there are often a myriad of possible solutions and creative approaches to solving problems when they are examined from multiple perspectives for creative ideas.

Correspondence

Dennie L. Smith, Professor
Department Head Emeritus, Teaching Learning and Culture
Educational Administration and Human Resources
Texas A & M University, College Station, Texas 77843, USA
Tel.: ++1 979 450 0830
Email: denniesmith@tamu.edu

Author's' brief bio
Dennie L. Smith is a professor in the Departments of Teaching, Learning and Culture and Educational Administration and Human Resources at Texas A&M University. He professional experiences also include being a Department Head, Director of a Family Business Center. He has published a number of articles in the area of education related to simulation, creativity, technology, leadership and decision-making. His current research includes exploring the methodology for using iPads and other tablets for teaching problem solving.

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