# Can a Creativity Exercise from the 1950s Still Be Relevant to Industrial Design Students Today?

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## 1. Introduction

This paper revisits a basic design creative problem-solving exercise that was initiated by Edward Zagorski in 1952 at the University of Wisconsin, Madison. In response to the way in which technology has affected industrial design students, the author reintroduced this exercise in reaction to students possibly ‘over’ relying on modern technology. The main concern being that basic form making knowledge, spatial awareness, and material experience is possibly being overlooked for more *seductive* technologies such as computers, three-dimensional modelers, and image-editing software.

### 1.1 The Original Design Problem

The 1950s design problem-solving exercise was established and developed by industrial design educator, Edward Zagorski. Initially, Zagorski delivered this exercise with very few instructions: The students were to begin with a block of wood that was a specified size and manipulate it by cutting and reconfiguring to create an entirely new form. What became pivotal during his development of this exercise was the element of constraints.

Freeing a designer from constraints can have an adverse impact upon them. Where one may perceive such freedom as an advantage it actually can dampen their creativity and reduce innovative problem solving. It is difficult to begin a large creative project without defining specific boundaries (Meyers, 1997).

Constraints such as material, size, color, production method, budget, and so forth, are essential in a design problem. “Without constraints, the students tended to lock in irons, handcuffed within the activity” (Zagorski, 2006). If a student is asked to create something without constraints, they can end up overwhelmed by the infinite possibilities and they oftentimes end up creating nothing. If the box is too large, it is difficult to get outside of it. Constraints in a basic design problem-solving activity simulate the experience of the design practitioner. The reality of professional practice is there will be limitations.

With this new outlook on the original problem, an important constraint was added. Inserted into the project parameters were the following instructions: The student must cut the block more than once, but cannot cut the block more than three times. This problem hence became known as the “Three-Cut Problem” (Zagorski, 2006).

### 1.2 The Three-Cut Problem

The aim of the Three-Cut Problem was to revisit an established exercise, introduce the craft of model making within considerable constraints, and encourage the students to become enthusiastic and eventually passionate about the design process. The objectives included integrating the exercise within a model making course specifically focused on sophomore industrial design students. The duration of this project was over 4 weeks, including 20 hours of contact time with the student group.

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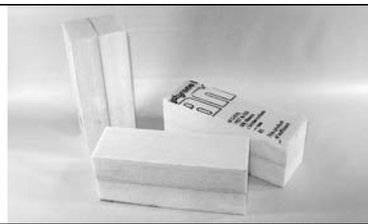
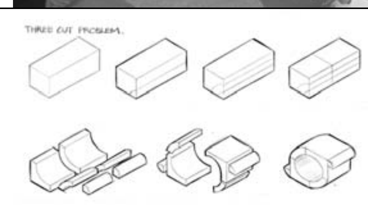
|---|---|---|---|
| 1. Foam blocks |  | 2. Three-dimensional sketching with foam |  |
| 3. Band saw production time |  | 4. Volume rearrangement |  |
| 5. Laminating to make a block |  | 6. Second part of the puzzle |  |
| 7. Enjoying the process |  | 8. Learning to use a spray gun |  |
| 9. Learning to use spot putty |  | 10. Flaws revealed by primer coat |  |
| 11. The final coat of lacquer |  | 12. Documenting The process |  |
| 13. Presenting the final concept |  | 14. The critique |  |

Figure 1. Illustrating various stages of the design process.

### 1.3 Context

Seventeen students (9 male and 8 female) were involved within this exercise. All were industrial design sophomores and the exercise was conducted within the first semester of their degree program. The venue was the school model shop, equipped with an array of wood working machines, hand tools and spray booth.

## 2. Stages of the Design Process

Each student was given a piece of foam 4” × 4” × 10” and was allowed a maximum of three cuts or passes on the band saw. The student was not permitted to throw away any of the pieces, but instead was asked to rearrange the volume into a pleasing form. Once the form was determined, the students were asked to repeat the solution using a block of wood. The block of wood needed to be laminated from smaller pieces. After the students created their own 4” × 4” × 10” block, they proceeded to make their three cuts. After gluing the pieces together, the final form was to be finished with several coats of sanding sealer and lacquer paint, and finally was to be presented as a finished model. In addition, the student was asked to turn in some form of documentation on how to go about replicating the design. Had time permitted, the students would have been asked to exchange their documentation with another student in the class and make a model based on someone else’s drawings or plans.

### 2.1 Foam First

Each student was given several pieces of foam 4” × 4” × 10” to begin their form finding experience (Figure 1-1). Unlike many design ideation sessions that begin with paper and a writing instrument, this project required exploration in three dimensions. Many students had difficulty with the concept of cutting into a piece of material without sketching a solution first (Figure 1-2).

This was the first time the students were shown an alternative to the 2D sketch pad. The foam block was referred to as a three-dimensional sketch pad in which the students were to work out their designs before moving on to the final material.

### 2.2 Warm up

At the beginning of the second class period, several students were observed staring at their pieces of foam, not knowing what to do. When gridlock appeared to swallow a high percentage of the class, all students were asked to stop and find a piece of paper. The students were then instructed to write down everything they could think of that they could do with a paper clip, and were given five minutes to do so (Figure 2).

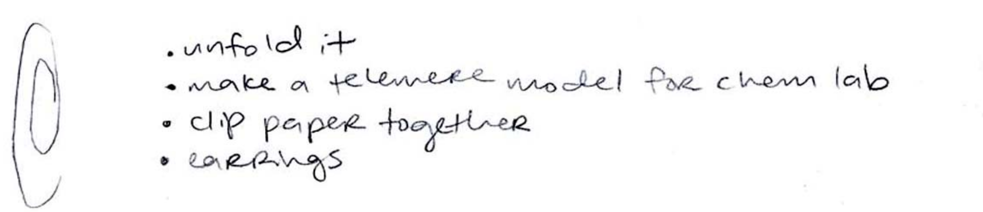
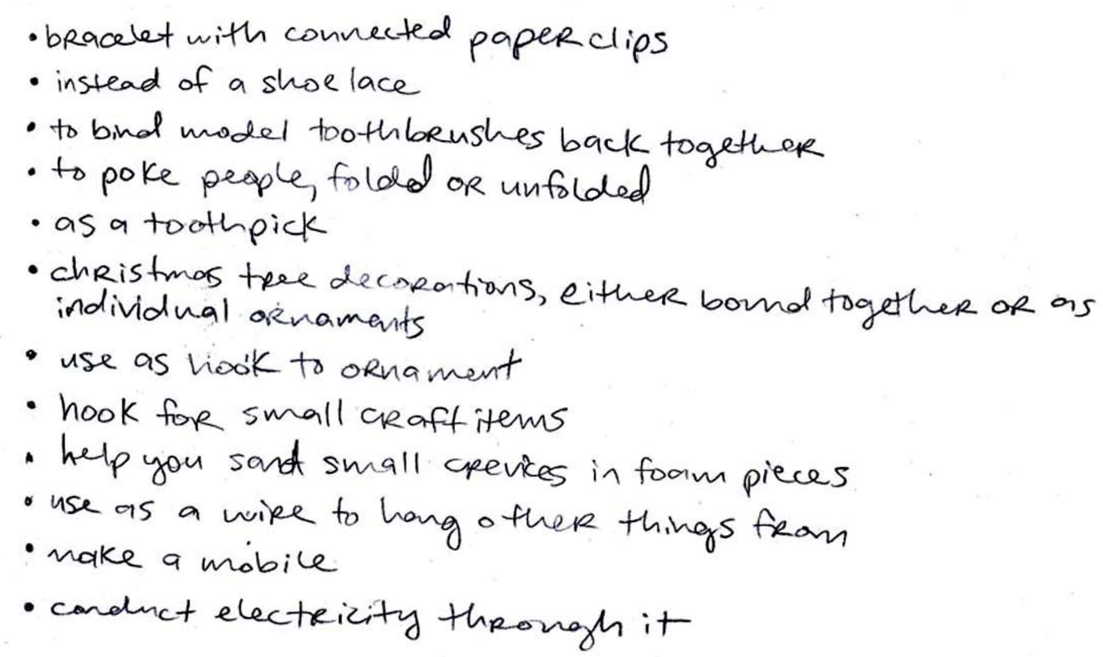



Figure 2. Five-minute question.

After about a minute, pens and pencils started moving. At the end of five minutes, the students were informed time was up. A question was asked by the author: how many had written clip paper together? Of the fifteen students present, twelve had placed somewhere on their list something about clipping paper together. Three students totally overlooked the most obvious answer. Next the students were instructed to turn their papers over and write down everything they could think of to do with a paper clip that they did not write down in the first five minutes (Figure 3).



- bracelet with connected paper clips
- instead of a shoe lace
- to bind model toothbrushes back together
- to poke people, folded or unfolded
- as a toothpick
- christmas tree decorations, either bound together or as individual ornaments
- use as hook to ornament
- hook for small craft items
- help you sand small crevices in foam pieces
- use as a wire to hang other things from
- make a mobile
- conduct electricity through it

Figure 3. Fifteen-minute question.

This exercise took fifteen minutes. The students discomfort levels where raised and this manifested itself in ‘loud groans’. However, eventually the pens and pencils began to move. When the fifteen minutes passed the author spent a few minutes discussing what happened. The students were lead to discover that their first answers were off the top of their heads, and if they pushed further themes often begin to emerge, and if they keep on pushing they are likely to discover profound material (Gelb, 1998). The paper clip discussion was concluded by asking the students to look at their foam pieces with the same depth of thought.

### 2.3 Curiosity

Lines formed at the workshop band saws as the students began to”sketch” with their foam. Even though the students were oriented on every machine in the workshop prior to being permitted to use any tool, continual discovery took place as the students learned to change the angle of the table, or the angle of the material passing through the blade (Figure 1-3). Once the foam was cut and glued back together and cut again, students pondered what was happening to the volume of form they were learning to manipulate (Figure 1-4).

### 2.4 Development of Self Confidence

The concept that form can have no function but possess beautiful appeal as a piece of sculpture was difficult for some students to grasp. When asking a group of sophomore designers to design a tooth brush, there is a familiarity with the subject that offers solace, because everyone has seen and used a toothbrush. “The Three-Cut problem forces a student to go where they have not been before; to a place where there is no previous answer, and forces them to rely on their own aesthetic judgment” (Zagorski, 2006). Eventually all the students arrived at an answer in foam and felt comfortable proceeding to wood.

### 2.5 Learning New Techniques

Asking the students to create their own block of wood by building up three separate pieces introduced the process of laminating. This created the opportunity to expand the student knowledge of materials and processes by discussing the characteristics of wood and outlining the pros and cons of using solid wood verses laminated wood (Figure 1-5).

As the students moved into the presentation phase of their concept they were faced with reproducing their form in wood. Only at this point did they realize the project puzzle was two-fold. The fist piece was finding a form they liked within the production constraints of only three cuts. The second piece of the puzzle was figuring out how to make the shape using wood (Figure 1-6).

More woodworking experience came in the form of jig construction and the tedious art of sanding. Patience and enjoyment of the process was stressed during this phase of the project (Figure 1-7).

**2.6 Risk Taking**

The students learned that the act of creation involved the destruction of something else (May, 1975). Every decision to move ahead left something else behind. The young designers were observed laboring over decisions, as if they were experiencing the loss of invention for the first time.

The limits of the band saw were experienced as one student attempted a radius a bit too tight and snapped the blade, burying it into his piece, necessitating extraction with the help of the workshop attendant.

**2.7 Synergy**

The Three-Cut Problem was designed to allow a group of students to create unique solutions beginning with a similar block of material. The author observed developing synergies as the class became closer through the experience of the assignment. Student leaders emerged as limited equipment and resources necessitated sharing resources and knowledge (Figure 1-8).

One enterprising student created a jig that allowed a perfect compound diagonal cut. When asked, this individual shared this jig with classmates who had planned the same cut.

Passing the first round of sanding sealer, the students became acquainted with spot putty. Another dose of patience was required as spot putty was applied and more sanding was required (Figure 1-9).

Several students voiced their disdain regarding the repetitive steps of sanding and sealing and sanding and sealing again. The author asked the students if they did not have time to do it right the first time, would they be able to find the time to do it over.

When the spot putty was in place and the final coat of sealer was applied and sanded, it was time to return to the spray booth for the primer coat. More frustration surfaced as the primer revealed flaws that were not visible through the sanding sealer. Yet another round of patience training was necessary and the students began to understand the importance of craftsmanship in every step of the process (Figure 1-10).

Moving from primer to the finish coat was partially determined by operation sequence and partially determined by time. Valuable lessons were learned in terms of budgeting time. The author observed passion and pride grow in the hearts of the students as they burned the midnight oil and the timeline clicked closer to the project critique. Eventually, there was no time for further sanding and spot putty application. The students were forced to make craftsmanship decisions based on how much time was available to complete the project. The students reached the realization that they had to apply the final coat of paint or risk missing the deadline (Figure 1-11).

Once the final coat of paint was applied and the sculptures were drying in the spray booth, the students began to fulfill the written portion of the project deliverables: they had to communicate in 2D how to duplicate their results (Figure 1-12).

The critique was scheduled for 1:00 P.M. Most of the class had been in the workshop until it closed at midnight the night before and were back in the workshop when it reopened at 8:00 A.M. the following morning. Even though the students were tired, they cleaned themselves up and dressed for success, showing up looking professional, eager to present their unique findings. Professor Emeritus Ed Zagorski accepted the invitation to emcee the critique. Each student was given the opportunity to talk about their unique solution to the Three-Cut Problem (Figure 1-13).

**3. Discussion**

The Three-Cut Problem is a good problem for sophomore-level design students for several reasons. First and foremost, the problem allows a group of students to start from a common place and end up with totally different answers. Second, the problem forces a diverse range of experience beginning with the freedom of exploration and experience in making judgments, and culminating with tedious time crunch processes and order of operations constraints. Third, the project enables growth in material knowledge yielding hands-on experience with wood, sanding sealer, spot putty, and paint. Finally, the project encourages the design student to push the limits of shop tool capabilities, including experience using paint gun and spray booth.

“The components of a good design problem appear to be open ended, deliberately ambiguous problem statements with no world shaking consequences that allow a student to think around the problem and connect the dots, creating unique, one-of-a-kind solutions” (Zagorski, 2006). Empowering your students to find their own creativity helps students achieve incredible learning results (Bain, 2004). Enjoyment is a positive ingredient within the process.

Creativity cannot be taught using conventional methods. Creativity implies the creation of something new. You cannot teach a student to look for something new by giving them a problem that has an old answer.

The educational system for teaching math or English often relies on presenting facts, and asking the students to give them all back. “One right answer” is on Roger von Oech’s top ten blocks to creativity (von Oech, 1992). Successful teachers of creativity leave loose or open ends and keep descriptions vague, allowing the students to fill in the blanks. “If you want to know if a student can create, put them in a situation where they can find an answer (Zagorski, 2006). Give them a problem without having a solution.”

**3.1 Overcoming Challenges**

Many students are accustomed to attempting to please their instructor by finding the answer they think the instructor is looking for. The Three-Cut Problem is a successful creative problem-solving project because the instructor does not have the answer. The problem sets up a situation enabling the student to discover an answer that even surprises the instructor; an answer even the instructor had not thought of. The Three-Cut Problem starts every student in the same place but yields totally individual original answers, all of which have merit.

The students were visibly uncomfortable in the early stages of form exploration, continually looking to the author for validation or confirmation of right or wrong answers or directions. Clearly, confidence levels were low, as the students hesitated to verbally voice their own opinions on the forms they were discovering. The most popular question asked of the author was, “What do you think of this shape?” The most popular answer given by the author was, “What do you think about your shape?”

One student created two forms with three cuts and displayed them side by side. She asked the author “Is it okay if I leave them separate?” “What do you think?”

The author responded, “What do you think?”

Because English and math answers have been fed to students from grade school through high school, we see college design students asking if it is okay to deviate from the expected solution.
Problems that have no clarifying traits have been referred to as wicked problems (Horst & Melvin, 1973). Design problems fit into this category. Design problems rely upon judgments for resolution, not solution (Garner et al., 1991). Design problems can be resolved—over and over again and are inherently different from most of the problems students have dealt with in other areas of their education. The design educator's challenge becomes teaching the students to stand up for their opinions, stand up for their designs, and trust their own intuitive answers.

Another student pushed the exercise further than three cuts. When he arrived at three cuts, he found he wanted to go further. He ended up finding a four-cut form that really pleased him. He turned to the author and said, "What do I do?" The author asked him, "What do you want to do?" The student decided to produce two solutions: one three cut, per the project parameters, and one four cut, doubling his time and resource commitment to the project. Responding to the motivation of his own curiosity, the student left the boundaries of the project. Had he been more confident in his own opinion and design sense he may have submitted only the four cut solution. He took on double the work to show a solution clearly outside the project parameters while retaining a safety net by also producing a solution within the project parameters. This scenario opened the door for the author to discuss the subject of more than one right answer, and that sometimes a designer has to break a rule to find the best answer.

Questions arose regarding color choice of the final models. Forty automotive lacquer colors yielded too many choices for several students. Unhappiness generally does not come from too little choice, but rather from too many. One student wanted to photograph his primed sculpture and take it into photo editing software so he could see his work of art in different colors before he actually bought the paint. This was not an option when this project was first run in 1952.

### 3.2 Student feedback

The students were asked to fill out an evaluation form at the end of the project and the response was generally very positive. Ten of the seventeen reported that they worked up to their potential during the project, rating themselves five on a five-point scale. Six gave themselves a four on a five-point scale, and one self graded a three on a five point scale. The most important thing learned, as perceived by the students, was a thorough understanding of the finishing process and the finer points of craftsmanship. Also mentioned was patience and time management. One student thought the most important thing learned was the experience of trail and error.

## 4. Conclusion

The feedback provided by the students, in addition to the high-quality models produced suggests that the project was successful in facilitating students in creating form and learning model making methods (Figure 1-14). The author acknowledges that although modern technology has extended the traditional designer's tool kit, it is important that the students are also exposed to basic model making techniques and approaches. If the student automatically designs in the virtual (e.g., on a computer screen) before developing a sensitivity through exploration to form, material, space and texture, their design outcomes could be lacking.

The exercise was successful in that it met the original objectives, however, on reflection, the author would consider changing the proportions of the block of wood to dimensions in keeping with the Fibonacci proportion. This would introduce proportion to the form study. Alternate materials might be considered as well. The project could be run utilizing REN foam, resin, and spray-on Bondo.

In today's highly technological educational environments, students, and educators can become extremely reliant on technology that can lead to a detachment from the real world. For the student designer, this particular exercise enables and encourages exploration and develops awareness of processes and relationships with materials. The students responded that they appreciated the opportunity to develop their patience and knowledge of process while experiencing the craft of model making. This exercise is not only relevant today, but offers valuable insight and educational benefits that may become lost in years to come.

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