April 2017

Making Inventions Using SCAMPER and Animal Adaptation Ideas with Elementary Students

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ABSTRACT

The study employed repeated measures to explore the use of SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, and Reincarnate) with or without animal adaptation ideas learned through form and function analogy activities to generate creative ideas. Twenty-four 4th graders, aged 9-10, at a suburban Midwestern elementary school were subjected to two conditions and measured under each treatment condition. In the experimental condition, students used SCAMPER charts with animal adaptation ideas to generate ideas to improve a product using limited materials, in the control condition, they used simple SCAMPER charts to improve a product with limited materials. A scoring rubric was designed to assess the utilization of the SCAMPER charts and students’ inventiveness. Paired t-tests were done. Students’ inventiveness scores showed a significant difference with a p-value of .003. Cohen’s d was .64, a medium effect size, favoring the experimental condition. Student scores for the two types of SCAMPER charts favored the simpler control chart. The study employed repeated measures to explore the use of SCAMPER (Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, and Reincarnate). Participants’ use of SCAMPER chart and animal adaptation ideas were noted. Table 3, student attitudes concerning SCAMPER technique, Table 4, provides a summary of students’ reasons for collecting and using SCAMPER with animal adaptation ideas.

LITERATURE REVIEW

Systematic application of SCAMPER (Ehrele, 1972) to a problem promotes both creative thought process and engineering experience among students. Studies on students’ use of inventive problem-solving methods, LOGICRIOLOK netcot in the context of engineering design, and hands-on activities related to both Ehrele’s (1972) SCAMPER technique and physics concepts, have all indicated development of thinking skills and heuristics and comprehension of physics, programming, and math concepts (e.g., Barak & Mesika, 2007; Rogers & Fournier, 2004). Combination of creative techniques has been found to contribute to children’s understanding of science content (e.g., Rule, Baldwin, & Schell, 2009; Rule & Rust, 2001). Because scientific problem-based activities engage elementary students in STEM content, earlier exposure for elementary students to STEM initiatives is necessary (Swift & Watkins, 2004) to motivate them to STEM careers eventually.

STANDARDS ADDRESSED BY THE LESSON ACTIVITIES

Lessons focused on engineering design that involved innovation, improvement, and problem solving. The following Standards were addressed:

- Next Generation Science Standard (NGSS) 3-5-ETS1-1 for Engineering Design (Achieve Inc., 2013, p. 46) for 4th grade
- National Core Arts Standards for 4th graders; Visual Arts: Creating 2.1.4a; Visual Arts: Creating 1.1.4a; Visual Arts: Creating 1.2.4a; Visual Arts: Creating 2.2.4a; Visual Arts: Creating 3.1.4a
- Standards for Technological Literacy (2000); STLS9 & STLS11 for grades 3-5

DATA ANALYSIS AND RESULTS

Data analysis: using spreadsheet; spreadsheet functions provided calculation tools for means, standard deviations, paired t-tests, and Cohen’s d effect sizes.

Results: Students’ inventiveness scores showed statistically significant difference with a p-value of .003, resulting Cohen’s d was .64, a medium effect size, favoring the experimental condition.

- Student scores for completing two types of SCAMPER charts favored simpler condition. Student products completed under experimental condition showed more complexity and originality.
- A comparison of SCAMPER-idea technique lead to production of a variety of inventions. Figure 4 shows inventions produced under control conditions and experimental conditions by three different students. Table 2 shows the list of student-made inventions from the study.

RESULTS

Table 4 provides a summary of students’ reasons for using/not using SCAMPER chart. 
- Found creative technique difficult: students’ level of enjoyment impacted.
- Showed resistance to writing when using SCAMPER-idea technique.
- Express discomfort having to “write so much” and not enjoying it all as it required effort.
- Enjoyed using SCAMPER if found helpful: “It helped me think what I should add or eliminate.” The enjoyment was simply because it was “fun.”

Table 5 provides a summary of students’ explanations for how much they felt the animal form and function ideas helped with the invention.

DISCUSSION AND CONCLUSION

- Participants attained growth with a medium effect size in inventive abilities which was consistent with prior invention studies that showed improved inventiveness when students used creative techniques (e.g., Barak & Mesika, 2007; Rule, Baldwin, & Schell, 2009; Wongkraosit, Sinti, & Pyakis, 2015).
- Findings support Rule and colleagues’ (2009) findings in a study conducted on 2nd graders taught using SCAMPER-idea analogy technique. There was a higher mean score during the experimental (24.8) as opposed to control conditions (22.8) in the present study just like the previous study.
- Findings revealed elementary students to be open to challenges, the new techniques rather than familiar traditional approaches better supported idea generation.
- Challenge is a desirable component for fostering creative thinking, inventive skills, and engineering skills. Experience and exposure were important for students to confront that challenge.
- Students should be allowed adequate time to explore the SCAMPER-idea technique so that time constraints do not result in cognitive overload.

LIMITATIONS

- Children inadequately equipped with engineering skills, require skill development from young age.
- Technique involves provocation and remote analogies, demands more skills to create new ideas.
- Classroom preparation requires extra time.

ACKNOWLEDGEMENTS

This material is based upon work supported by NASA under Grant No. NNX15AJ16H. A grant from the Iowa Biotechnology Association also supported this work.

REFERENCES


Rule, A. C. (2015). Figure 3. Form and Function analogy activities (Rule, 2015).


Rule, A. C., Baldwin, A., & Schell, M. (2009). Animal adaptation lessons and build and design using products and limited materials they were given.
