Analogy and Humor as Tools for Understanding and Retention

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Abstract

Best practices for teaching require the instructor to endeavor to help the student learn, not just for the instructor to deliver content. Student learning involves gaining understanding of concepts and developing the ability to apply those concepts to problems, but also retaining these abilities. Many excellent mechanisms for achieving these outcomes have been developed, including techniques such as active learning and problem-based learning. This paper proposes the use of analogies and humor as complementary techniques for increasing the student's understanding of concepts and promoting their retention of those concepts. We give several illustrative examples, as well as an assessment of the effectiveness of these techniques in two courses where they were applied.

Introduction

Many techniques have been developed for improving student learning, including active learning and problem-based learning. The use of analogy and humor provide complementary techniques for enhancing student understanding and retention of new concepts. Garner[1] shows the usefulness of humor, analogy, and metaphor through a review of the literature on these subjects. They were shown to increase student comprehension and retention of concepts, and to help students connect the unfamiliar with the familiar. Cautions were given to be culturally aware when using humor, keep it relevant to the content, and ensure it is well planned. Analogy should be kept simple, and must align with what the students are familiar with.

Analogy has also been shown to be helpful in the design process. Analogy was shown to enhance the design process, particularly in the early phase of concept generation[2]. This conclusion was also reached by Casakin[3], who showed that visual analogies were especially helpful for novices. Analogy was presented as scaffolding for building new concepts by Daugherty[4], as well as having a role in conceptual change, a factor in creativity. Finally, analogy was shown to be used by experts to deal with uncertainty in the problem solving process[5]. Exposure of students to analogy will help familiarize them with this useful tool, as well as directly help them learn new concepts.

Analogy is presented as a mechanism for improving teaching efficiency by Yelamarthi[6], who also showed that in-discipline analogy is perceived to be more effective by students. Analogy and metaphor were also used to enhance learning in a medical school[7], where students were also required to develop metaphors themselves. A caution is also expressed that the analogy must match the new concept well or the students may become confused. This caution is also expressed by Glynn[8] and Sunal[9], who also propose systematic methods for developing analogies. Another mention of this caution is made by Brown[10], who gives the advice to ensure a good explanation of the relationship between the source and target concepts, and also discusses the limitations of a given analogy.

Illustrative Examples

In this section, several examples are given of analogies and humor used in two classes. The first class is Fundamentals of Programming, which used C as the language, and was comprised mainly of sophomores. The second course is Computer Architecture, comprised mainly of seniors. These examples will illustrate how analogy and humor were used to enhance the presentation of specific content in these two courses, and will hopefully serve as aids in helping other teachers develop analogies suitable for other courses. Several of these analogies were also part of the assessment of the effectiveness of the technique.

In the Fundamentals of Programming course, a box of tools was used as an analogy of the variety of parts to a programming language. Each tool has special characteristics and qualities that make it suitable for specific tasks, but not for others. To properly use a tool, there must be knowledge of how the tool works and skill in using the tool developed through practice and use. The same applies to the various features of the C programming language. A programmer must know how each feature works, when it is appropriate to use it, how to apply it, and what its limitations are. Acquiring this skill takes practice. This tool analogy could also be applied to almost any area of engineering.

One analogy used in the programming course also incorporated humor. To demonstrate the use of functions, and specifically the idea of locality of data within a function, an example was put on the board using a function called 'vegas'. Then the phrase 'What happens in Vegas, stays in Vegas' was stated to drive home the point that the variables inside a function are local to that function, and are not accessible outside that function. This reference provided a 'memory handle' for the students. Any time the idea of locality of data came up in lecture, using a phrase like 'remember the Vegas rule' would immediately bring to their minds the meaning of locality of data.

At the start of the section dealing with loops, an analogy was made between loops and building a wall from Lego™ bricks. A student was given a pile of Lego bricks and a ruler, and asked to take the bricks one at a time over to another location and stack them on each other until the wall reached a height of two inches. After the task was completed, the

procedure used by the student was analyzed and then compared to using a loop in C. The wall building procedure had a repeated action (stacking a brick), just as a loop has a body consisting of one or more statements that are repeated. There was also a terminating condition and check of that condition each time, just as a loop needs a terminating condition, which is tested in each iteration of the loop.

A third analogy specific to the programming class involved a restaurant menu. The customer selects the appropriate menu item, then waits for someone else to take care of all the details of creating that dish and delivering it to them. Similarly, when a C program calls a function, the main program doesn't 'know' the details of what happens inside the function, it just waits for the function to take care of accomplishing its task and then receives the final result.

A final example from the programming course was using a street address to illustrate the idea of what a pointer is in C. Just as a street address gives the location of something, a pointer in C contains not the data itself, but the address, or location, of the data.

An additional analogy comes from an electrical engineering course concerned with computer architecture. This course focuses on the design of a 32-bit pipelined processor. The concept of processor interrupts, which require several actions in hardware, was introduced late in the course. The analogy for this process was a person reading a book, who then receives a phone call. The person must handle the interrupting task in the same way that a processor must handle an exception such as arithmetic overflow or invalid operations. Students were told a narrative of the professor reading a textbook, hearing the phone ring, answering it, and subsequently returning to his reading. Then the following steps were written on the board:

1) Stop Reading
2) Remember Current Page (Bookmark)
3) Identify the Cause of the Interruption
4) Take Phone Call
5) Return to Correct Page and Resume Reading

Then the instructor gave a narrative about what needs to happen in the processor, and how it related to the steps in the reading/phone analogy. The instructor related the need to halt the sequence of instructions in the pipeline, save a code for the cause of the interrupt, save the value of the program counter, and then jump to the interrupt handling routine address by loading a new value into the program counter. The following steps were then written horizontally aligned on the board:

1) Halt the Pipeline (0's to Pipeline Register Load Inputs)
2) Save Program Counter (Store in EPC Register)
3) Identify Interrupt (Save Code in Cause Register)
4) Jump to Interrupt Service Routine (Load PC with 8008)
   <interrupt routine executes>

5) Resume Instructions (Load EPC Register into PC)

Thus the analogy between the two operations was presented in a parallel fashion. Students heard this analogy once and saw the board material once. Three weeks later, they were given a quiz on the material, the results of which are discussed below.

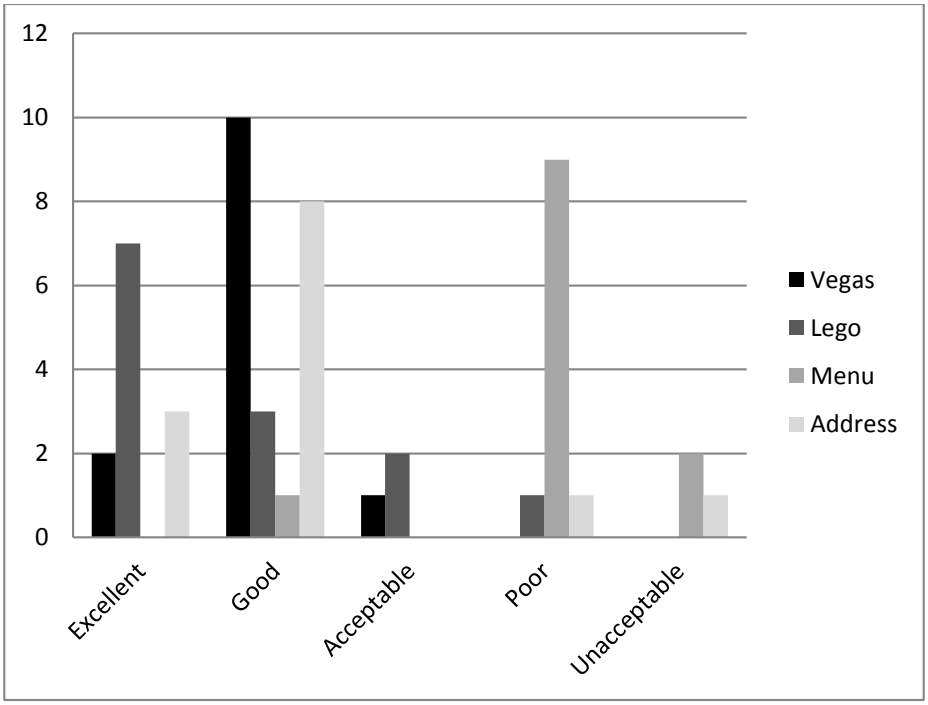
Analysis

The assessment of the effectiveness of the use of humor and analogy to enhance student understanding and retention of concepts was obtained using surveys of the students at the conclusion of the courses. There were two mechanisms used. The first assessment mechanism assigns to each student response a value from the set {Excellent, Good, Acceptable, Poor, Unacceptable} to measure how well students remembered the course concepts that were connected to the given analogy. These assessments were for specific analogy examples. The second type of assessment utilized a Likert scale to measure student's perception of the effectiveness of humor and analogy to increase understanding and enhance the classroom experience. This assessment was only performed in the programming class.

For each of the four analogies used in the programming class, students were asked to describe the C concept that corresponded to the analogous real-world item. The rating was done using the values identified above, where an Excellent response included all the relevant features of the C language feature that corresponded to the example. The results are summarized in Table 1. The responses show a strong positive benefit for the use of analogy, with three of the four analogies having most responses (85%) in the Excellent or Good categories. The exception is the restaurant menu analogy, which had mostly Poor responses. Most of the students identified a different feature of C than what was presented in class for this example.

Students assessed on their understanding of the hardware necessary for the servicing of an interrupt in a processor were given a fill-in-the-blank table asking them to recall the steps for both handling a phone call and the corresponding computer hardware steps. The results were judged using a rubric assigning "Excellent, Good, Acceptable, Poor, and Unacceptable" based on their identification of the hardware and procedure necessary in a processor. Students had not seen the material for three weeks, and had only seen the material one time. Additionally, students were not given any reading assignment on the topic and were specifically told that the interrupt material would not be on any test.

Table 1 Results of student performance in the programming class analogies.



The results of the application of the rubric are shown in Table 2. Students did not do as well as the instructor had hoped, but no students had unacceptable answers. Five were in the excellent range, seven good, eight acceptable, and nine poor. It is clear that students did retain a significant amount of material, and it is important to stress that students saw the material in no other context, nor were they able to review any printed material. Given this, the results are pleasing in that content was retained given a very brief introduction to the material.

The survey administered to the programming class also had a section with questions directed toward the student's perception of the benefits of using analogy and humor in the class. This assessment utilized a four-point Likert scale. The students were asked if analogies and humor helped them better understand the C concepts, if analogies and humor were a good use of class time, and whether the use of humor helped keep their attention and interest. The results of this part of the survey are summarized in Table 3, where it can be seen that 92% of the responses were agree or strongly agree. The responses indicate that these students perceived the analogies and humor used in this class to be beneficial to their learning.

Table 2 Results of student performance in recalling steps for interrupt handling in a computer processor.

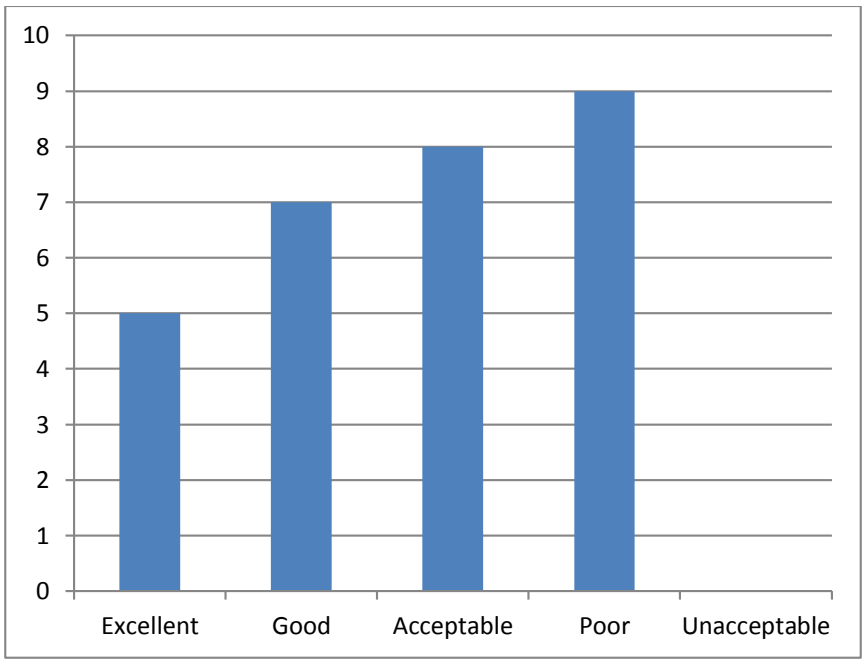
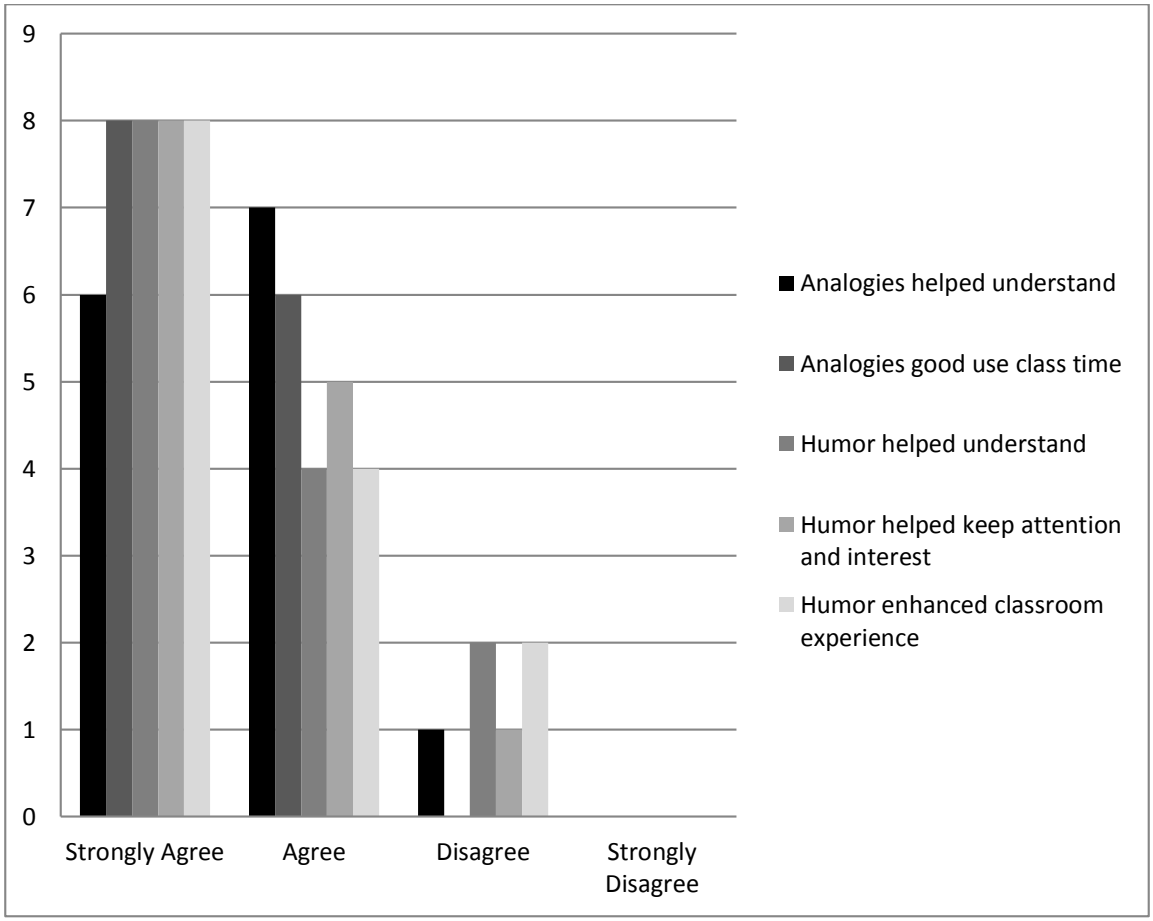


Table 3 Results of student perception of the benefits of analogies and humor.



Conclusions

Previous research has identified benefits associated with using analogy and humor in classroom instruction. The results of this study support this. The assessment performed in two classes where analogy and humor were used show that student understanding and retention of concepts was enhanced. The students' perceptions of these benefits were also very evident in the results of this assessment. The sample sizes for this assessment data were only twenty nine and fourteen, so some caution is warranted in drawing conclusions from the data.

Future work in this area could include enlarging the sample size in future classes. Other interesting questions remain to be asked and explored, such as whether the benefits apply equally to different types of classes, different levels of student, etc.

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