What's a Thabblethratchet? – A Communication Exercise in an Introductory Design Class

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Abstract

Educators and employers recognize communication skills as necessary to successful engineering. Communication is included in the list of ABET 2000 criteria[1], but students do not always appreciate the need for graphical as well as written and oral communication skills, nor do they understand how to integrate text and graphics in engineering design reports. We have introduced several exercises into our sophomore level introduction to engineering design course to emphasize the importance of graphical communication skills. One of these exercises involves the use of familiar mechanical construction toys such as LEGOs and K'Nex. This paper discusses the implementation and outcomes from these exercises.

Introduction

Writing has been introduced into many engineering courses as a means to improve students' communication skills in response to the newly developed ABET accreditation criteria[1] (eg. Sharp *et al.*[2]). In the area of mechanical design, effective communication requires not only a facility with words, but also the ability to integrate graphics with text to describe products and processes. Verbal descriptions alone are not sufficient. We are all familiar with the old adage "a picture is worth a thousand words", and this is nowhere more true than in the area of mechanical design. In order to develop the students appreciation for the use of graphics in design communication, the author has developed several exercises to be used in an introductory mechanical design course.

Communications Exercise #1 – Gizmos and Thabblethratchets

In this exercise, the students are given an object constructed using 10-20 parts from a familiar construction toy set such as LEGOs, K'Nex or GeoShapes. A typical object is shown in Figure 1. All of the objects were constructed by the teaching assistants with the criteria that the objects would not be symmetrical, nor would they resemble common objects such as a house. A plastic sandwich bag containing a set of duplicate parts (and perhaps a few extras) was also provided. The students are instructed to "describe the object" such that a classmate can build an exact duplicate from the spare parts. No further instructions are provided. If the instructor is questioned concerning the use of graphics, the response is given for the students to complete the assignment as they interpret the directions. Thus, if, in their opinion, a "description" includes graphics, then they may use graphics in their assignment. The students typically complete the write-up in about 20 minutes. Students then pass their descriptions along with the bag of spare parts to a classmate, who attempts to construct an exact duplicate of the object. The builder then compares his or her duplicate with the original object and fills out a critique sheet for the writer. The exercise is concluded with a discussion of the importance of accurate technical communication, and techniques that can be used to improve design descriptions.

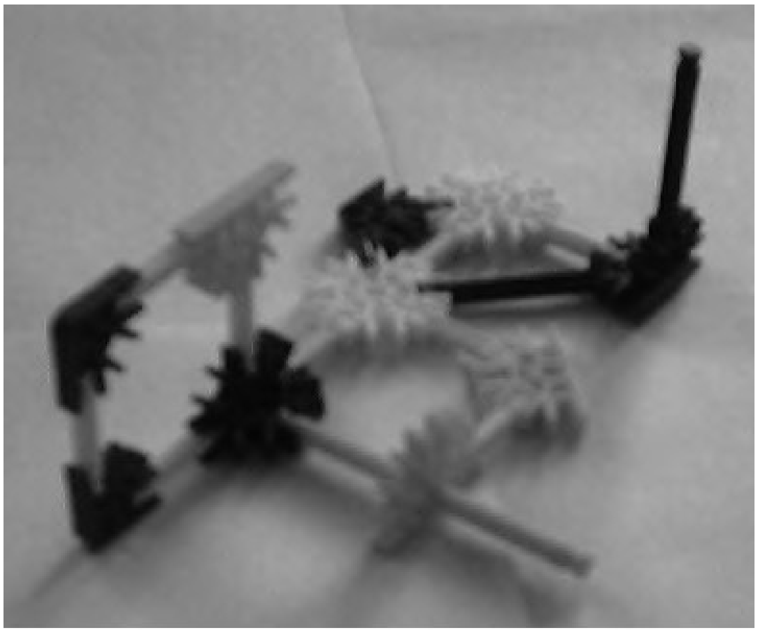

Figure 1. Object to be constructed – a “thabblethratchet”.

The results of the exercise were compiled from the critique sheets. Thirty-five students completed the exercise. The majority of students (80%) used both text (prose) and graphics to describe their objects, however, four students used text alone (11%), and three students used annotated graphics alone (9%). Interestingly, it was noted that two of the student who used only graphics were students whose first language was not English. Almost all of the remaining students used pictorial sketches, most of which included some level of annotation. Pictorial or isometric sketches were favored over orthographic drawings. Typical sketches are shown in Figure 2.

Only eleven students (31%) were able to duplicate the original objects from the descriptions written by their classmates. None of the text-only descriptions were successfully duplicated. In general, the successful descriptions contained more graphics, better annotation and more multi-view sketches than the unsuccessful descriptions. Students found the use of technical terminology to aid in the construction and identification of parts. Geometric term such as parallel and perpendicular, isosceles and equilateral triangles were used by some students, whereas the lack of such terms were noted as problems by the unsuccessful builders. Domain specific terms such as “2x2 bricks” for LEGO parts were also helpful. In some cases, the omission of specific information such as color or length of components was noted as a factor. Attention to detail was critical to the success of the exercise.

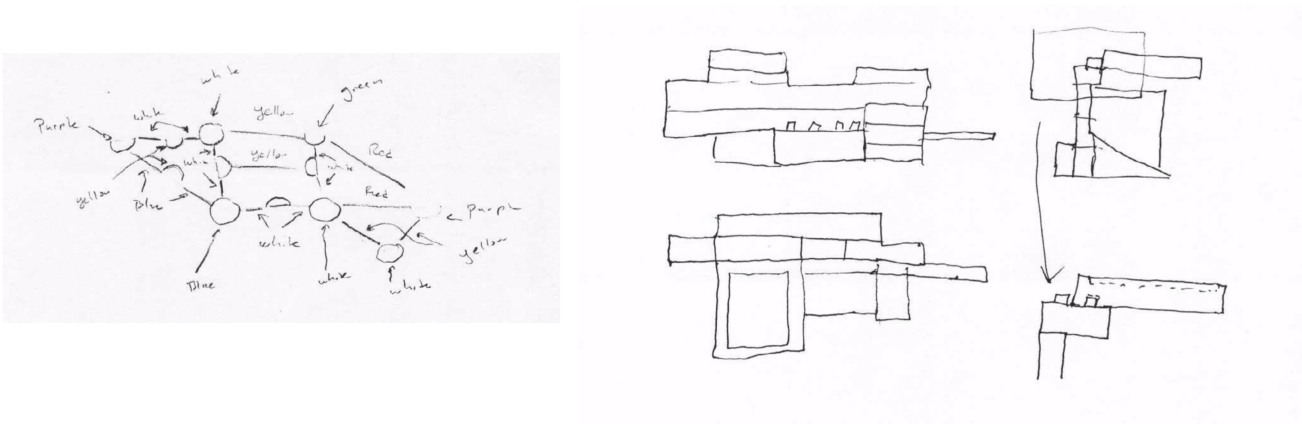

Figure 2. Student sketches.

Communications Exercise #2 - 2D Shapes

In this exercise the student is given a drawing of a group of simple geometric shapes and asked to write a *verbal* description of the drawing. A second student then draws the shapes based on the verbal description. A typical shape set is shown in Figure 3.

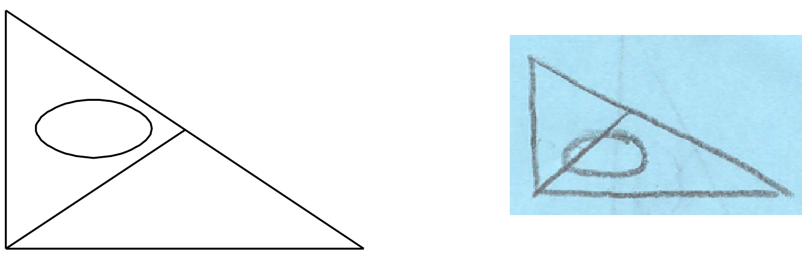

Figure 3. Shapes used for verbal description exercise. Original (left) and student sketch (right).

Conclusions

Through these exercises, students develop an appreciation for the use of graphics in engineering design documentation. The use of accurate technical terminology, pictorial and orthographic sketches, annotation, coordinate systems and referencing text to graphics are discussed in the classroom following the exercises. Further studies are needed to determine whether these simple activities aid the students in improving their technical writing skills. Expanding the exercise to have the students compare good and poor descriptions, and to edit and improve poorly written descriptions may be included in future classes. Limited class time precludes any extensive writing exercise, however, it is hoped that by introducing concepts and examples of good and poor writing, the students will be able to improve their own design documentation in this introductory course.

References

[1] Engineering Accreditation Committee, *Criteria for Accrediting Engineering Programs Effective for Evaluations During the 2001-2002 Evaluation Cycle*, ABET, Baltimore MD, 2000.

[2] Sharp, J.E., Olds, B.M., Miller, R.L., and Dyrud, M.A. (1999), *Four Effective Writing Strategies for Engineering Classes*, Journal of Engineering Education, January 1999, p. 53-57.

Biographical Information

Holly K. Ault received her BS, MS and Ph.D. degrees from Worcester Polytechnic Institute in 1974, 1983 and 1988 respectively. She has worked as a Manufacturing Engineer for the Norton Company and Product Development Engineer for the Olin Corporation. She is currently Associate Professor of Mechanical Engineering at Worcester Polytechnic Institute and has been a co-director of the Assistive Technology Resource Center at WPI since 1999. In the fall of 2001, she was invited as the Lise Meitner Visiting Professor, Department of Design Sciences, Lund Technical University, Lund, Sweden. She served as the Director of Liaison for the Engineering Design Graphics Division of ASEE from 1995-8 and EDGD Program Chair for the ASEE Annual Conference in 2002. Her teaching and research interests include computer aided mechanical design, geometric modeling, kinematics, design methodology, machine design and rehabilitation engineering. She is a member of ASME, ASEE, SWE, ISGG and RESNA.