CSM 151: APPLIED SPATIAL VISUALIZATION FOR ENGINEERS
Providing Students With Opportunities to Develop Spatial Skills for Success in Engineering

BACKGROUND

BULLETIN COURSE DESCRIPTION
Research has shown that students with developed spatial visualization skills are more successful in engineering, chemistry, and calculus courses. These skills can be developed over time and with specific training and practice. These skills are not typically taught in high school but are highly valuable in upper-division coursework at Mines. This course aims to heighten a student’s ability to mentally rotate and physically manipulate models.

PAST SEMESTERS
• 1 credit hour elective through CASA
• Recommended for students who score below 70% on PSVT:R (Purdue Spatial Visualization Test) analogies style mental rotation pretest
• Taught during three consecutive spring semesters
• 2015/2016 Mix of students
  • 27% freshmen
  • 23% sophomores
  • 10% juniors
  • 40% seniors
  and only
  • 58% scored 70% or lower on PSVT:R
• Course structure
  • 10 minute lecture on new material
  • 10 minute quiz on previous material
  • 40 minutes to work on workbook
    ■ Varies 2-12 minutes -> bored students
  • Many students worked ahead on their own and left class early

TARGET POPULATION
Goal: First year students with poor spatial visualization skills, as determined by PSVT:R pretest.
Plan: To get these students into CSM 151 we will
• Encourage new freshmen to take PSVT:R in early July.
• Encourage students who score below 70% to enroll.
• Open 5 sections of CSM 151 in mid-July.

NEW COURSE STRUCTURE
• Weekly in-class activities support targeted skill (see schedule below)
• Workbook moved to homework (checked weekly as formative assessment)
• Two exams for summative assessment
• Team research project to explore the importance of spatial skills in a selected course or industry

Week | Topic | Activity
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1 | Introduction | Syllabus, expectations, pre-writing, research project
2 | Research project work | Work with group to plan research project focus
3 | Combining Solid Objects | Activities: Calc 3 Applications, Tangrams and Tetriss
4 | Isometric Drawings and Coded Plans | Activity: Building with Snap Cubes
5 | Orthographic Drawings | Activity: Working with an Ortho-Box
6 | Inclined and Curved Surfaces | Activity: Ortho-Boxes for Complex Objects
7 | Flat Patterns | Activity: Working with Paper Patterns
8 | Cutting Planes and Cross Sections | Activity: Play-doh and Floss Cross Sections
9 | Exam 1 – 2D and 3D Sketching | In-class exam
10 | Surfaces and Solids of Revolution | Activity: Drawing Revolved Objects
11 | Rotation of Objects about a Single Axis | Activity: Connecting Rotations with Ortho Sketches
12 | Rotation of Objects about Multiple Axes | Activity: Solving a Rubik’s Cube
13 | Object Reflections and Symmetry | Activity: Fold and Cut Theorem
14 | Exam 2 – Mental Rotations | In-class exam
15 | Final presentations | Half the student teams present
16 | Final presentations | Half the student teams present

INTENDED OUTCOMES

• Revised communication and marketing should allow for better identification and participation of the target audience.
• Student performance on PSVT:R should continue to increase from pre to post test.
• End of semester student evaluation results should increase over previous semesters.
• Students should gain a better understanding of the importance of spatial skills to their future courses and careers.
• Students should enjoy and fully participate in the class, and feel that they are learning and truly benefiting from the class.

“Encouraging students to work more in pairs or groups could really help the dynamic of the class.”
-Spring 2016 student (from end of semester evaluation)

“... if you do not focus and try to learn the new ways of thinking, it will not get you very far at all.”
-Spring 2016 student (from end of semester evaluation)

“Individuals can dramatically improve their 3-D spatial visualization skills within a short time with training and that female engineering students with poorly developed spatial skills who receive spatial-visualization training are more likely to stay in engineering than their peers who do not receive training.”
-Sheryl Sorby, author of “Developing Spatial Thinking”

“Deliberate practice [means] expert performance is acquired gradually and that effective improvement of performance requires the opportunity to find suitable training tasks that the performer can master sequentially — typically the design of training tasks and monitoring of the attained performance is done by a teacher or a coach. Deliberate practice presents performers with tasks that are initially outside their current realm of reliable performance, yet can be mastered ... by concentrating on critical aspects and by gradually refining performance through repetitions after feedback.”

“Neurons that fire together, wire together.”
-- Donald Hebb

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June 2016 Cohort