Enhancing Spatial Visualization Skills Online

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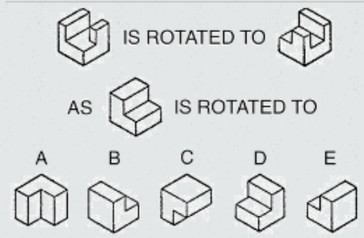
In engineering, spatial visualization skills correlate with retention and academic success in the first academic year [1,2]. Spatial visualization can be developed through practice, offering an opportunity to better prepare incoming freshmen for their studies.

PRE-TESTING

Process

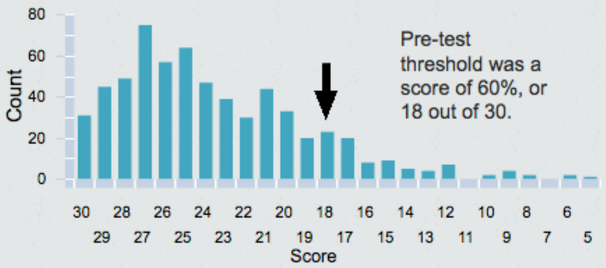
First-time students entering the College of Engineering were given the Purdue Spatial Visualization Test for Rotations online using Blackboard Vista. This is a multiple choice exam with thirty 1- and 2-axis rotation tasks. Testing was voluntary, and done prior to the start of the fall quarter.

Sample Task



30 tasks in 25 minutes

PSVT:R Pre-Test Score Histogram



Result Highlights

- Below Threshold: 16%
- Male Students Below Threshold: 12%
- Female Students Below Threshold: 24%

Numbers reflect the percentage of students tested who scored 18 or lower on the PSVT:R test

Actions

- Spatial visualization skill level of the fall 2012 incoming engineering class was assessed on a voluntary basis using the Purdue Spatial Visualization Test: Visualization of Rotations (PSVT:R)
- A 6-module, 10-week web-delivered course was offered (opt-in) to those students who scored below a threshold score. Course supported by workbook and web-based simulation software [3,4].
- Skill level was reassessed with the PSVT:R after the course.

Course Goals

- Improve our students ability to perform spatial visualization tasks
- Improve our student's ability to learn and succeed in their first year science and mathematics courses
- Through improved learning, to get our students into the second year of their engineering program in good academic position

Course Outcomes

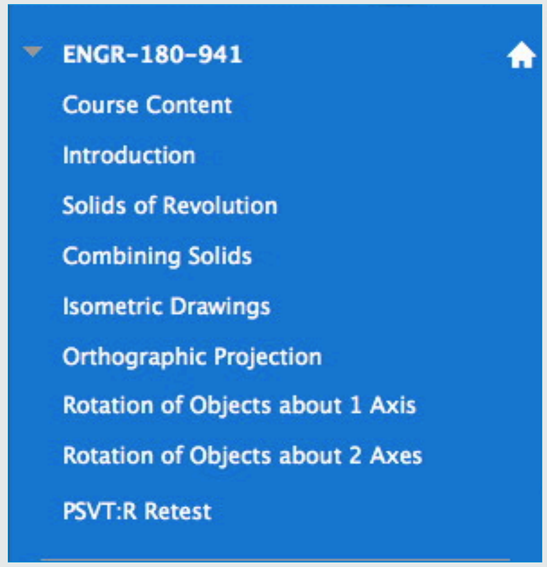
- Improved ability to interpret spatial visualization problems as indicated by an increased number of correct responses on the Purdue Spatial Visualization Test: Visualization of Rotations

Course Module Structure in Learn

- Multimedia Lecture
- Reading Assignment
- Simulation Exercise - browser-based
- Homework
- Test - Homework Entry
- Lecture Slides (PDF)

Course Development Tools Used

- Learn 9, Blackboard
- Keynote, Apple
- Numbers, Apple
- Camtasia 2, TechSmith
- MovieCaptioner, SynchriMedia
- GraphicConverter, Lemke Software



Results - Conclusions

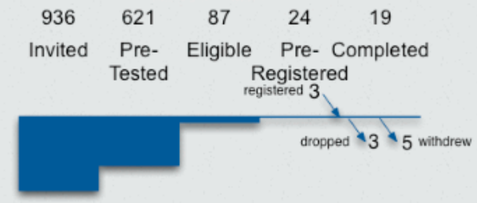
- 80% of students who took the course and post-test were able to achieve a grade above threshold
- Next phase: academic history tracking (IRB pending), statistics
- Sample size small
  - Repeat over summer 2013, opt-out registration, ~100 students, 6-week course
- Course improvements needed
  - More practice with feedback, better feedback
- Student course feedback limited, but positive

POST-TESTING

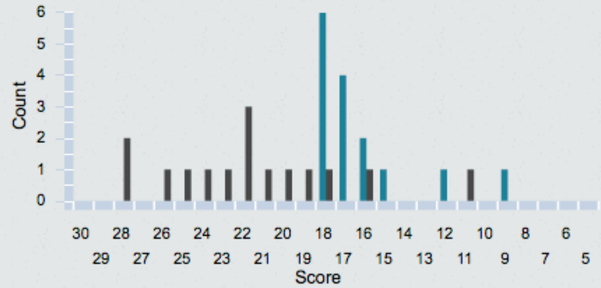
Process

Students were reassessed using the Purdue Spatial Visualization Test for Rotations following the 6-module development course. Credit was issued based on a minimum score of 70% on homework assignments and completion of the PSVT:R retest, regardless of score.

Registration History



Pre- (Blue), Post-Course (Black) Histogram



Result Highlights

- Average Score Increase: 5.6
- Male Students Gaining Threshold Score: 80% N = 10
- Female Students Gaining Threshold Score: 80% N = 5

Summaries based on students who completed course and took both pre- and post-tests

References

1. S.A. Sorby and B.J. Baartmans, "The Development and Assessment of a Course for Enhancing the 3-D Spatial Visualization Skills of First Year Engineering Students", *Journal of Engineering Education*, vol. 89, pp. 301-307, July 2000.
2. S. Hsi et al, "The Role of Spatial Reasoning in Engineering and the Design of Spatial Instruction", *Journal of Engineering Education*, Vol. 86, pp. 151-158, 1997.
3. S. Sorby, *Developing Spatial Thinking*, Clifton Park, NY: DELMAR/Cengage Learning, 2012. (workbook)
4. A.F. Wysocki, *Developing Spatial Thinking*, Clifton Park, NY: DELMAR/Cengage Learning, 2012 (simulation software)

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