Problem Solving When Textbook Problems Are Replaced with Student-Written YouTube Problems

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Thank you

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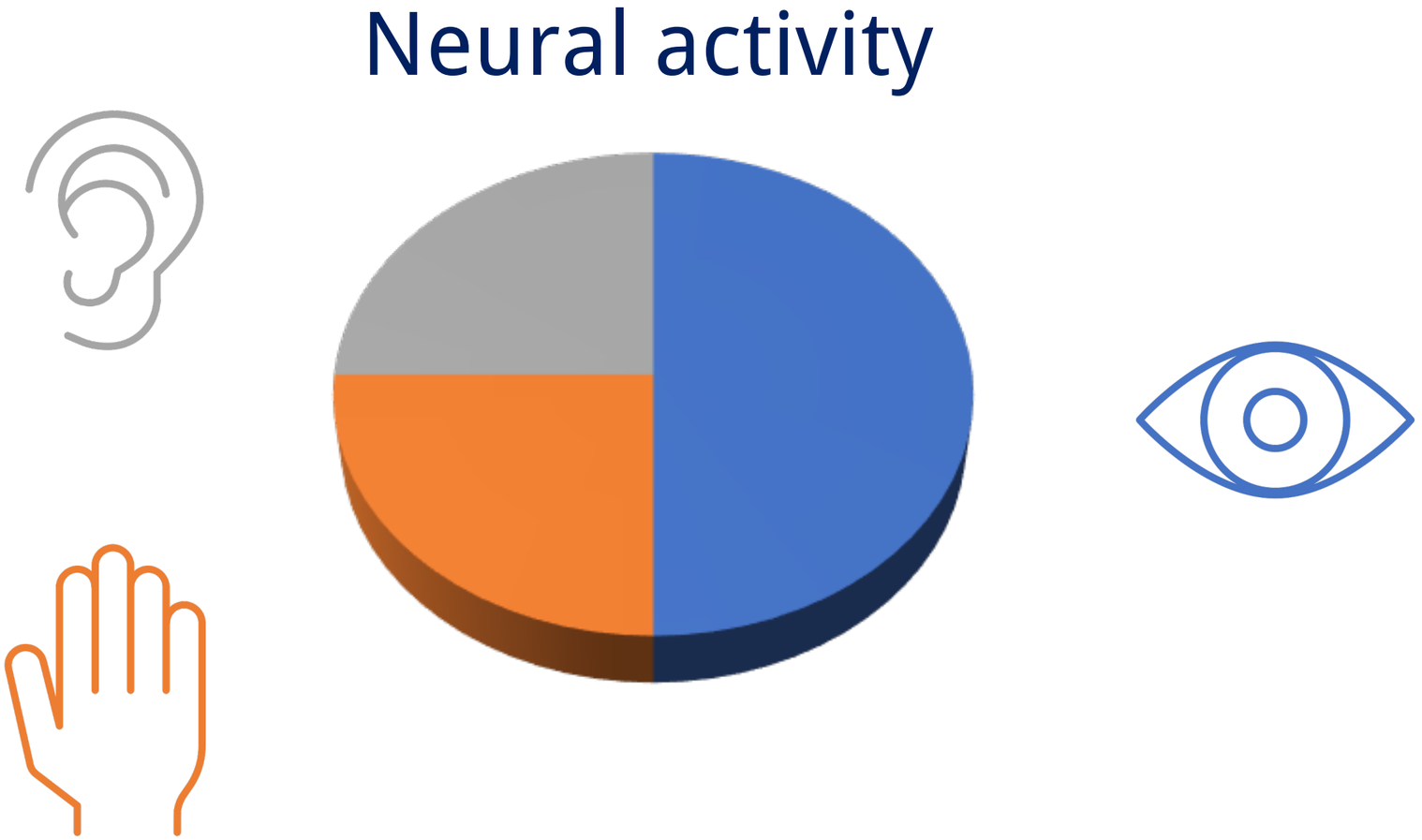
Visuals most important for learning



Hawkins & Blakeslee, *On intelligence*. 2005: St. Martin's Griffin.

Videos are everywhere

Just search for what you want to learn…

Khan Academy

YouTube

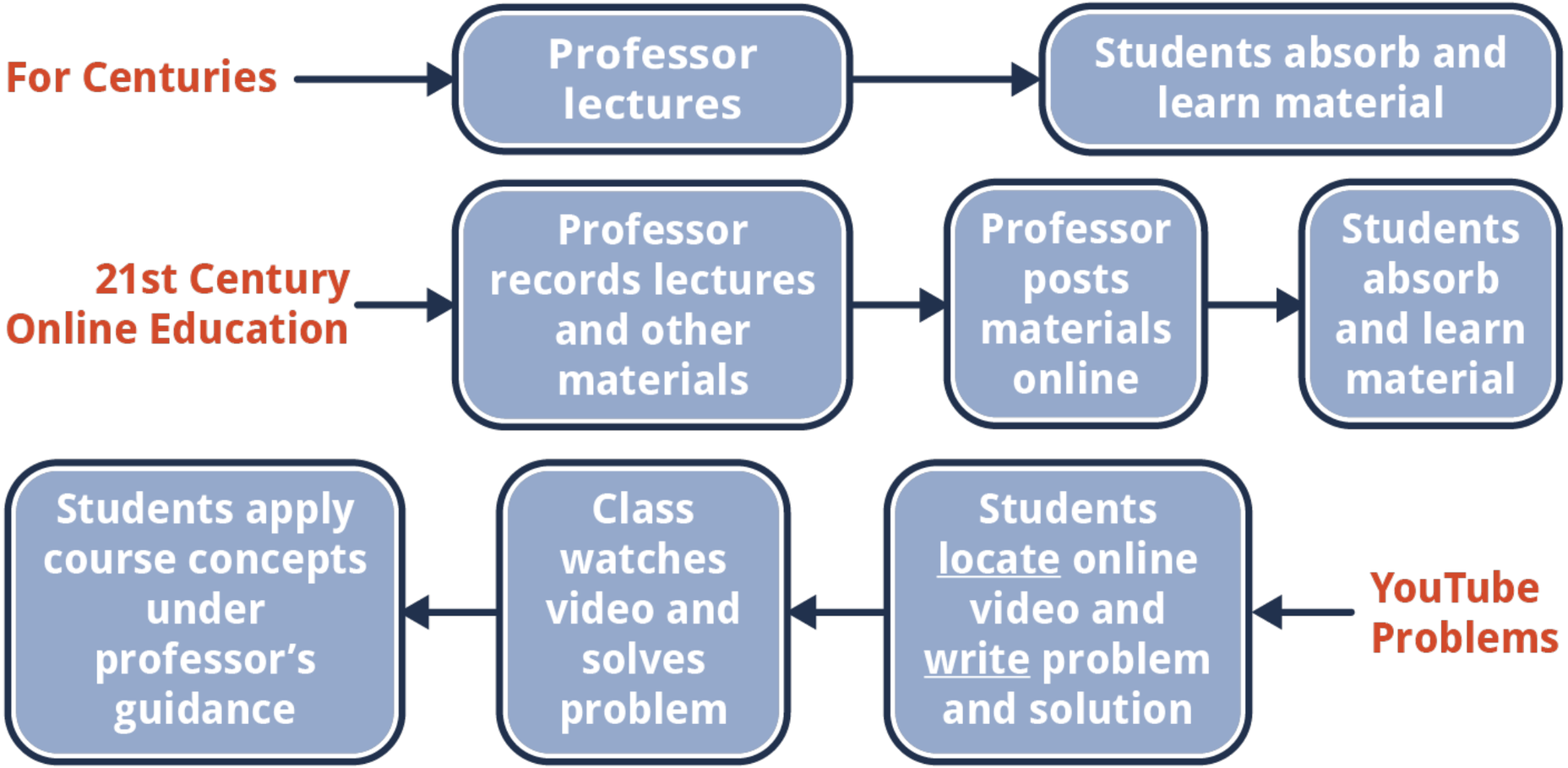
LEARNING

AIChE Academy
Connect | Learn | Solve

LearnChemE
Educational Resources for Chemical Engineering
University of Colorado Boulder

Does viewing lead to deep learning?

YouTube pedagogy is student-centric



500+ problems collected over 5+ years

Student-created YouTube problems

Video title: Ethanol Production Process

https://www.youtube.com/embed/lXnUCPPTDOc

A liquid stream containing 22 mol% water, 45 mol% ethanol, and balance solids is fed into a distillation column. The distillation column produces a gas and liquid stream. The liquid stream contains 37.5 mol% ethanol, and the balance water and solids. The flow rate of the gas stream is 75% the flow rate of the liquid stream. The gas stream flows at 147 mol/s and contains only ethanol and water. The gas stream is condensed and the new liquid is then fed to an evaporator working at 5670 mmHg and 152C. The evaporator produces a liquid and gas stream in VLE.

(a) Draw and label a process flow diagram.

(b) Find the mole fractions and component molar flowrate (mol/s) in the streams exiting the distillation column.

(c) Find the mole fractions and component molar flowrate (mol/s) in the streams exiting the evaporator.

(d) If the pressure is reduced by 10% what happens to the mole fraction of ethanol in the vapor stream? Increase, decrease, or stay the same

Liberatore, Marr, Herring, and Way. Chemical Engineering Education, 2013. 47(2): p. 122-132.

Course and cohort size

Material and Energy Balances

- 1st chemical engineering course

19 Homework problems (out of many)

- 9 YouTube and 10 Textbook

Cohort size:

- Control (~30) and Treatment (~90)

Research questions

Can student-written YouTube problems replace Textbook problems?

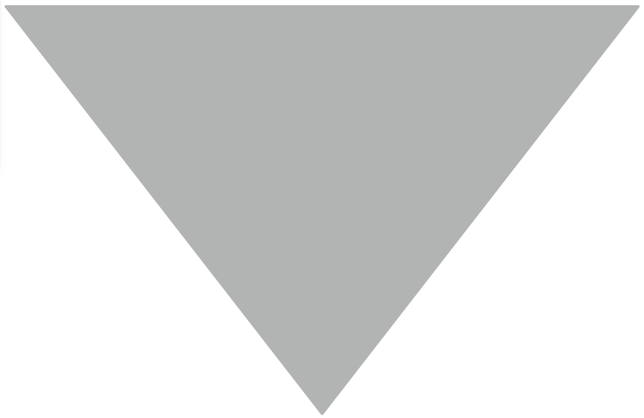
How does problem solving compare between YouTube and Textbook problems?

Does problem solving correlate with difficulty perception?

Tools measure different components

Problem solving
PROCESS

Problem difficulty
NASA TLX



Learning attitudes
CLASS

NASA Task Load Index measures rigor

Categories

Mental Demand

Physical Demand

Temporal Demand

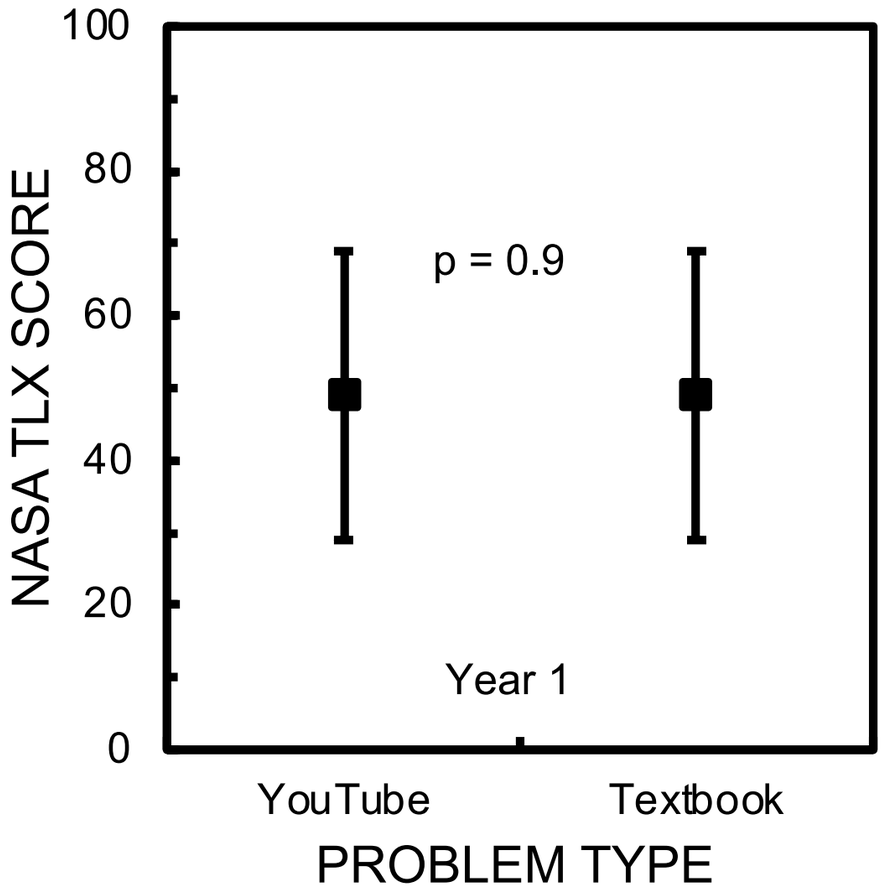
Performance

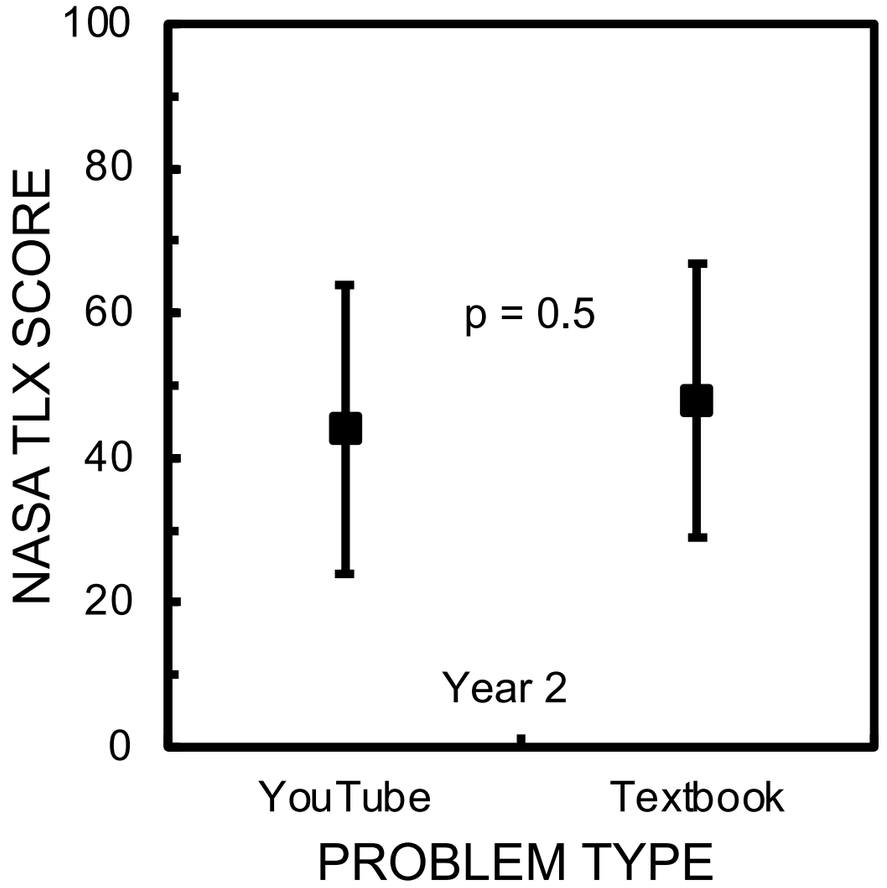
Effort

Frustration

User selects levels from very low (1) to very high (6)

Similar rigor between problem types





Key categories are Mental demand and Effort

Problem solving rubric = PROCESS

Modified PROCESS has 6 stages:

Problem definition

Representing the problem

Organizing information

Calculations

Solution Completion

Solution Accuracy

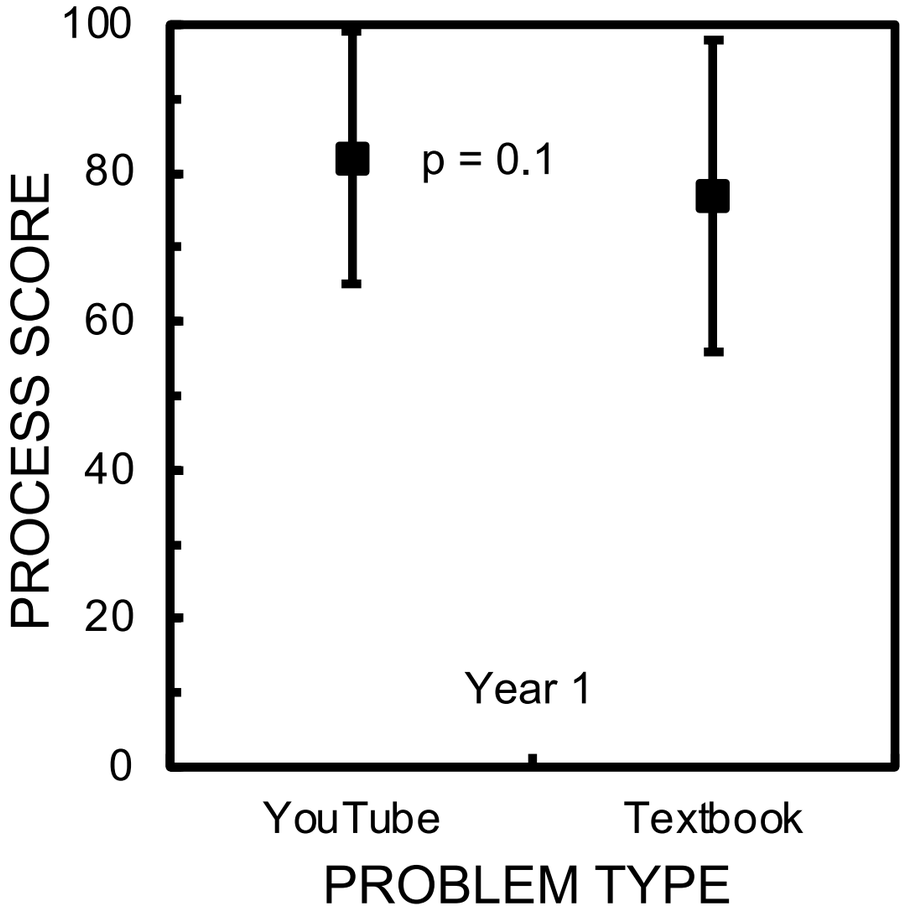
Score: 0,1,2,3

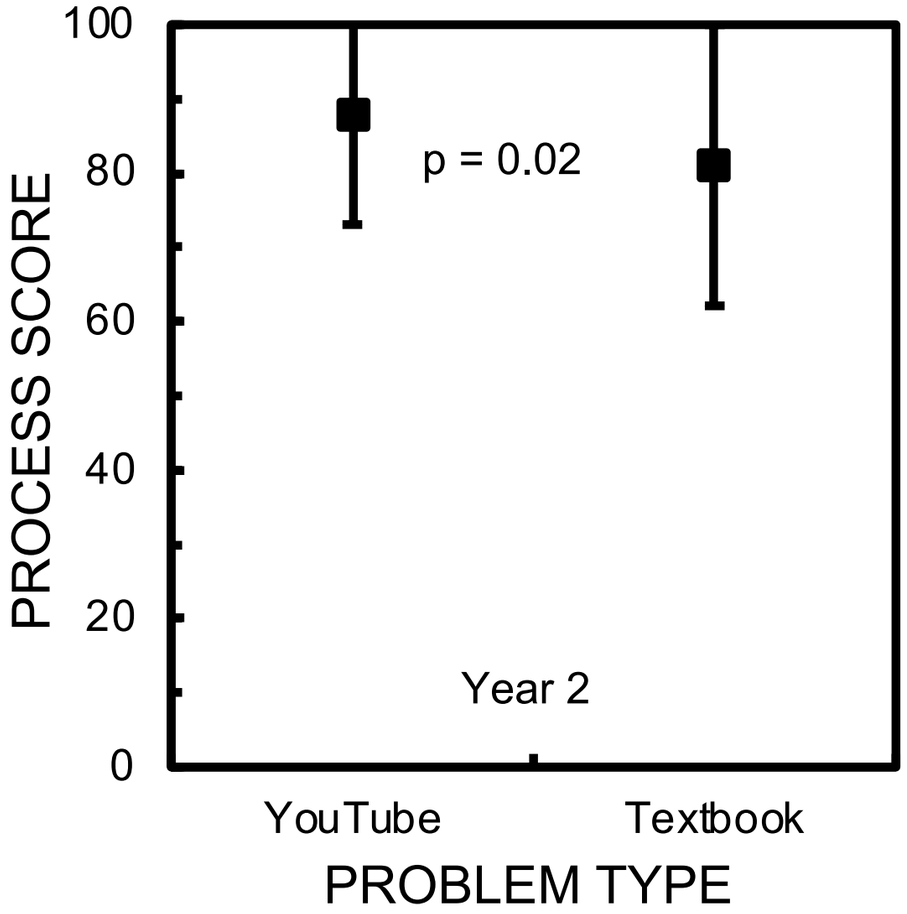
Raters: 3

Scores: >1000

Original PROCESS: Grigg, S.J. and L. Benson. ASEE Annual Meeting. 2015. Seattle, WA

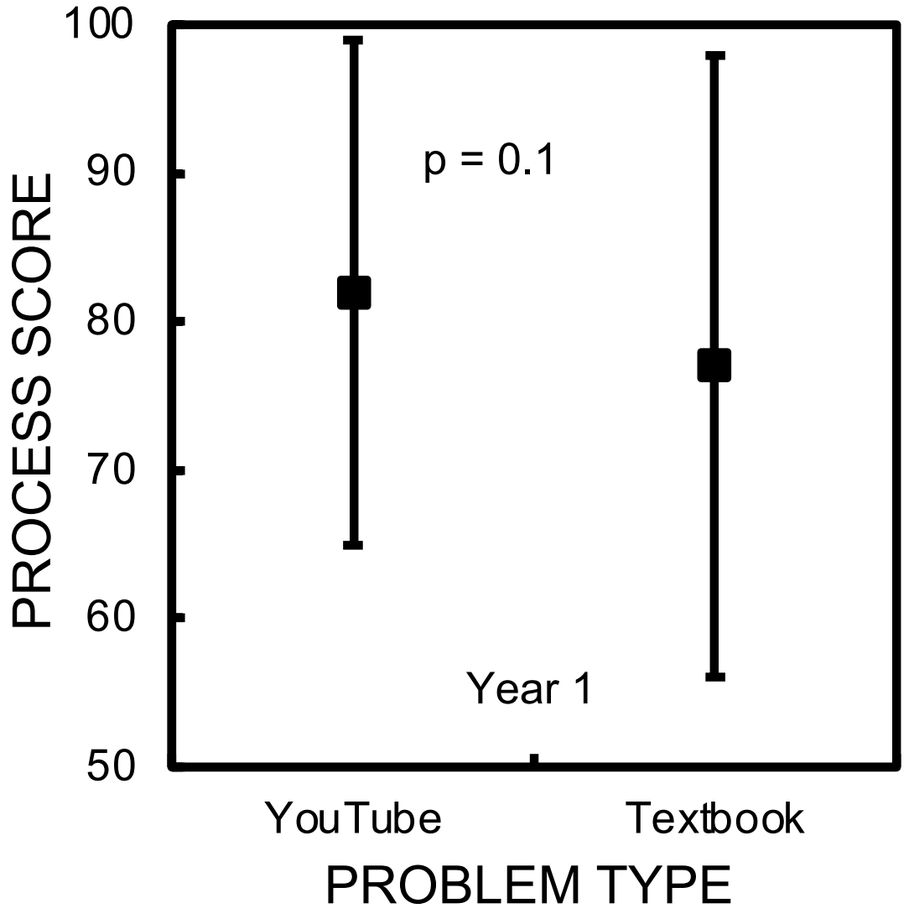
Better problem solving with YouTube

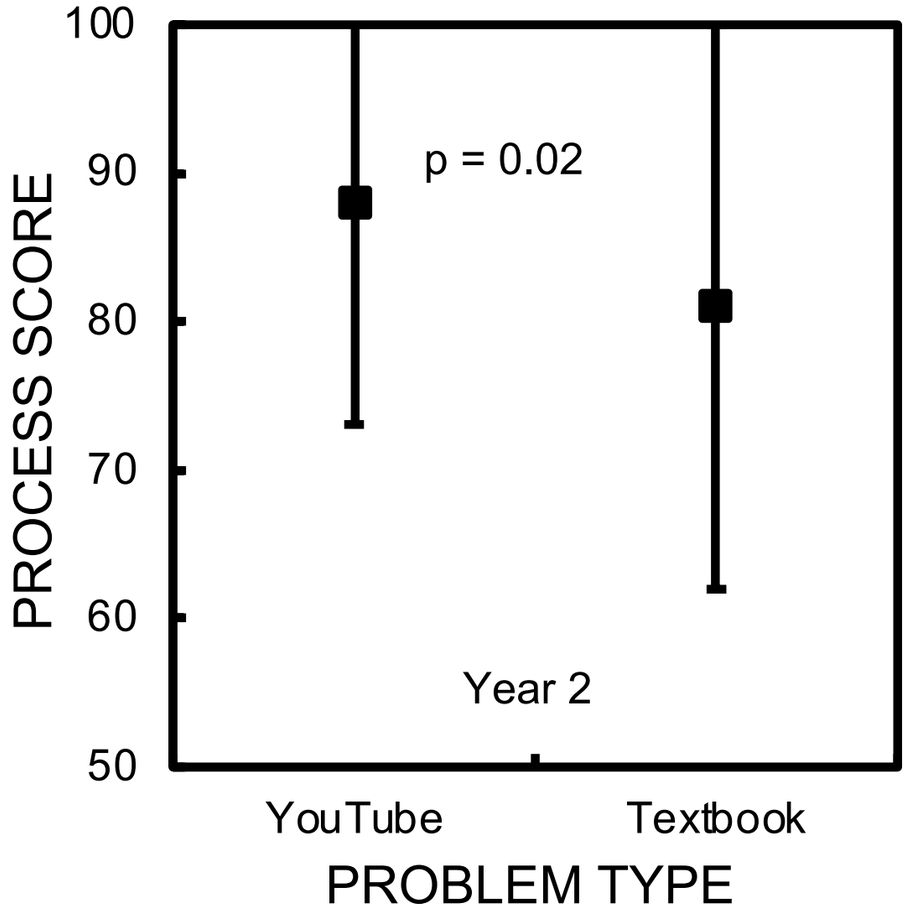




Verified with two cohorts

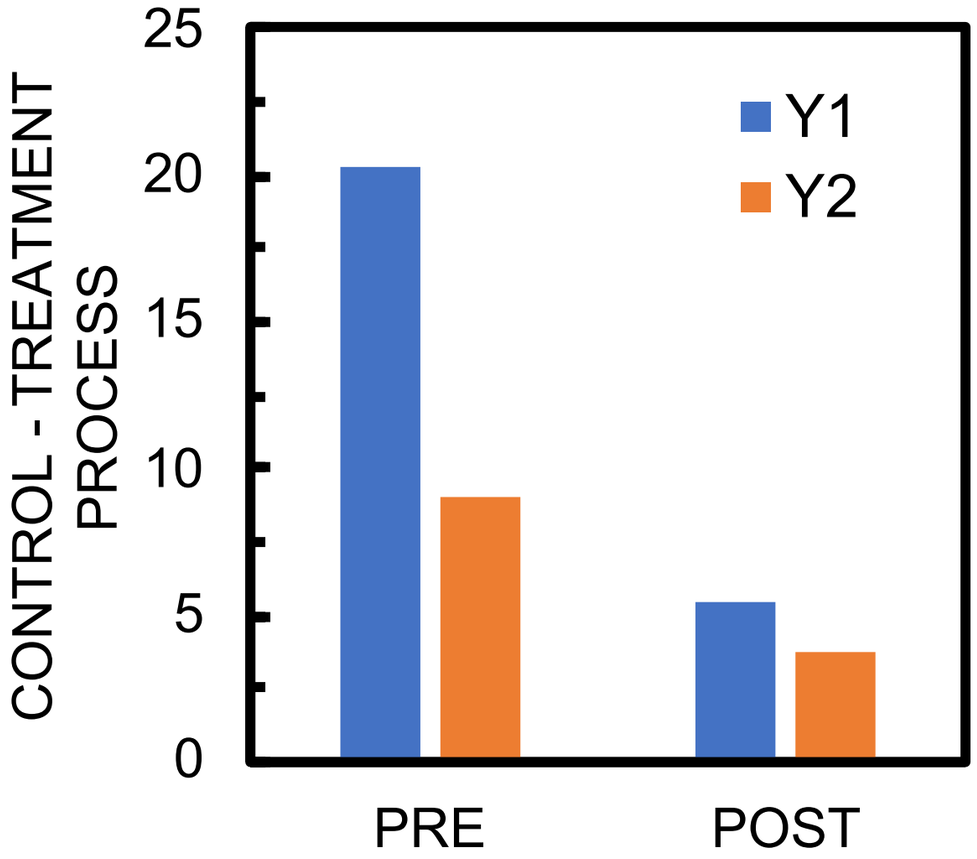
Better problem solving with YouTube





Verified with two cohorts

Improvements with Treatment



Hedges' g

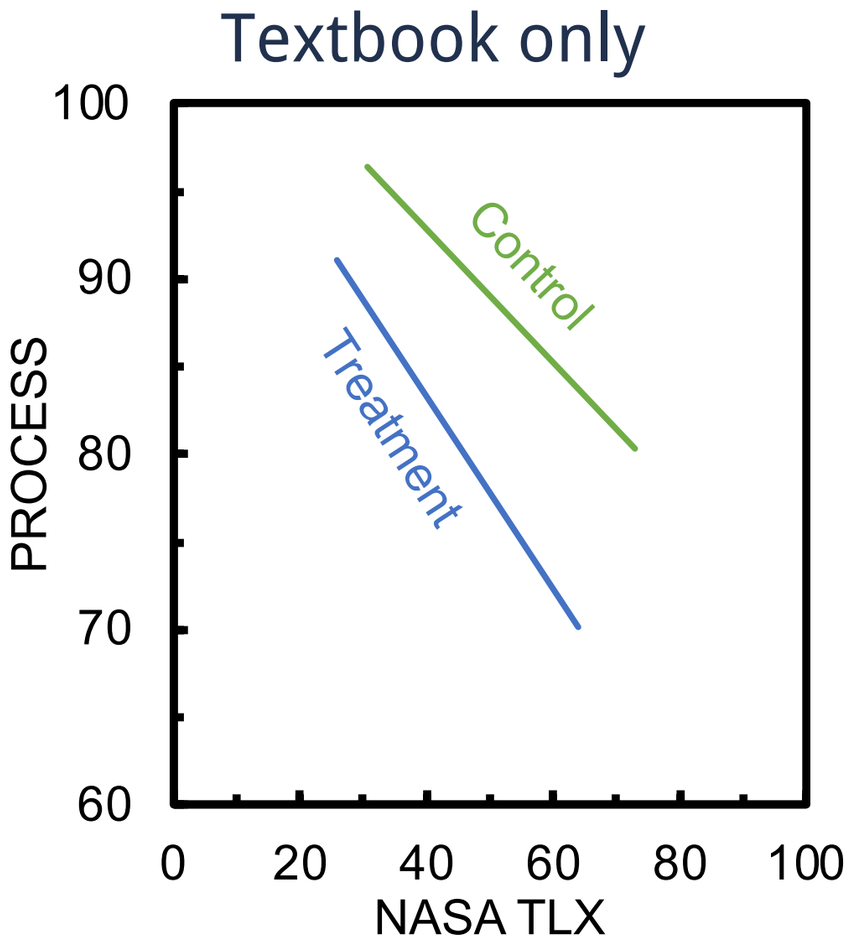
Y1 ~0.57

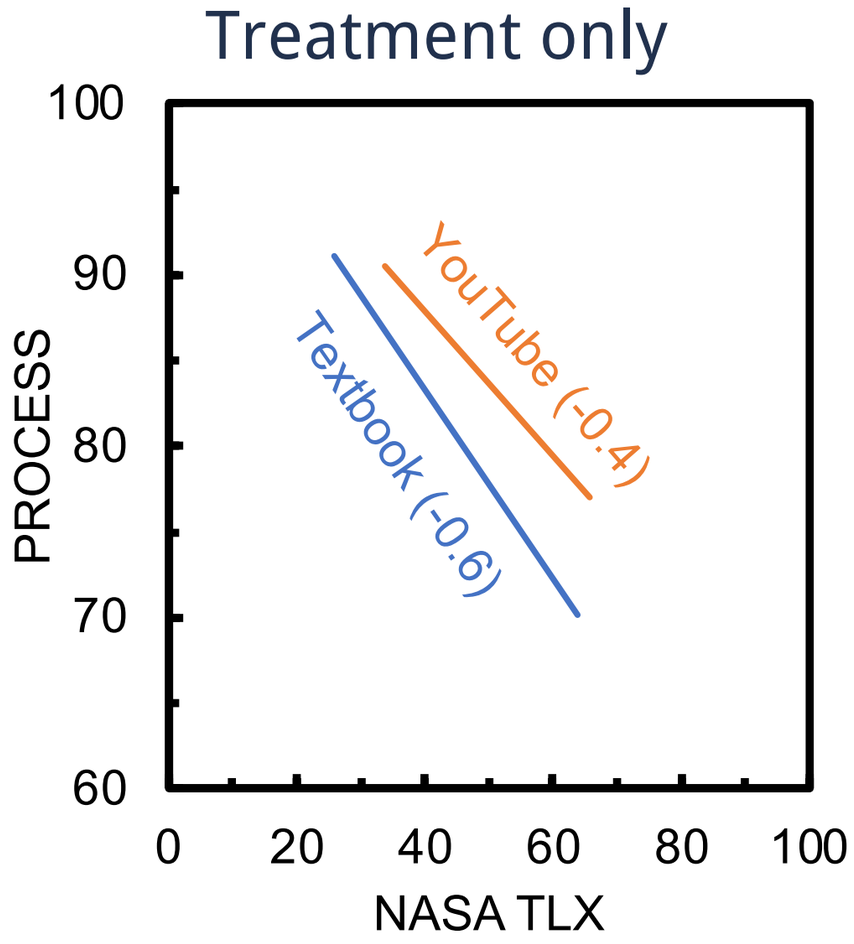
Y2 ~0.2

Asogwa, et al, 2021 IJEE

Small to medium effect gains in Treatment group

PROCESS correlates with NASA TLX





Less sensitivity with YouTube problems

Conclusions

YouTube problems replaced textbook problems well

Better problem-solving skills measured for YouTube problems

Improvement in problem solving greater in treatment than control

Negative correlation between measured problem solving and perceived difficulty