



Mastery Learning in High School Academic Physical Science

By Amanda C. Stone



Background

Observations

- Spring academic physical science is physics. Skills build off of learned foundational skills
- Some students were ready to move on, but others had not mastered foundational skills
- Needed to individualize practice based on the level the students were at to help them reach learning goals

My Research Population

- Size: 60 pupils (freshmen, one sophomore, one senior)
- Brecksville-Broadview Heights High School
 - 1,460 total enrollment
 - 11% economically disadvantaged

Interventions

Chapters 5 and 6: Forces Self-Paced Mastery Unit			
1.CANS:			
Level 4: Skills: Interpretation of Force Pairs	LO 1: 1) Video notes on Edmentum 2) 9.3 OLN Teacher initials for 6.3 OLN: _____	LO 2: 1) Review pages. Check with answer key. If mastered, teacher initials: _____	LO 3: 1) Force Pairs Quiz (from Ms. Stone) Pass mastery at 80% (see resources) 2) Physical Science Department Website: Use resources in "Forces Pairs" section. Retake quiz
Level 3: Skills: Interpretation of Force, Mass and Acceleration	LO 1: 1) Class notes 2) 5.1 OLN (pg. 146) 6.2 OLN Teacher initials for 6.2 OLN: _____	LO 2: 1) Pgs. 57-58, 64-65. Check with answer key. If mastered, teacher initials: _____	LO 3: 1) Free-body diagram and net force review! Kahoot on website (solo/small group). Score: _____/24
Level 2: Skills: Interpretation of Force Diagrams and Motion	LO 1: 1) Class notes 2) 5.1 & 5.2 OLN (pgs. 124-125) 127-128, 136-140 Teacher initials for 5.3 & 5.1 OLN: _____	LO 2: 1) Class notes 2) 5.1 & 5.2 OLN (pgs. 124-125) 127-128, 136-140 Teacher initials: _____	LO 3: 1) Free-body diagram and net force review! Kahoot on website (solo/small group). Score: _____/24
Level 1: The Basics	LO 1: 1) Class Notes 2) 5.1 & 5.2 (online) 5.3 OLN (pg. 110-113) 136-137-138-139 Teacher initials for 5.2 OLN: _____	LO 2: 1) Online review! 2) "Types of Forces" Kahoot! (Solo or small group) Score: _____/32	LO 3: 1) Free-body diagrams Draw free-body diagrams to show how they happened (solo/small group). If mastered, teacher initials: _____

Two rotating treatment and non-treatment units

Treatment Units

- Pupils worked through learning targets at own pace following order of activities outlined on mastery grids
- Mastery of each objective was defined as >80% on the checkpoint quiz. Remediation resources prepared for students scoring below mastery.

Literature

- Tiering in 9th grade general science: learners with least background knowledge had most academic growth (Richards & Omdal, 2007)
- Self-pacing in Calculus I university course: increased overall learning, engagement, and motivation (Konstantinou-Katzi, Tsolaki, Meletiou-Mavrotheris & Koutsellini, 2013)
- 108 studies of mastery learning: Kulik, Kulik and Bangert-Drowns found medium to large gains in student achievement (as cited in Ostrowski, 2015)

Research Questions

Focus Question

What is the effect of the interventions on student achievement?

Sub-Questions

1. What is the effect of the interventions on student engagement?
2. What is the effect of the interventions on student self-efficacy?

Student Achievement in Non-Treatment and Treatment Units

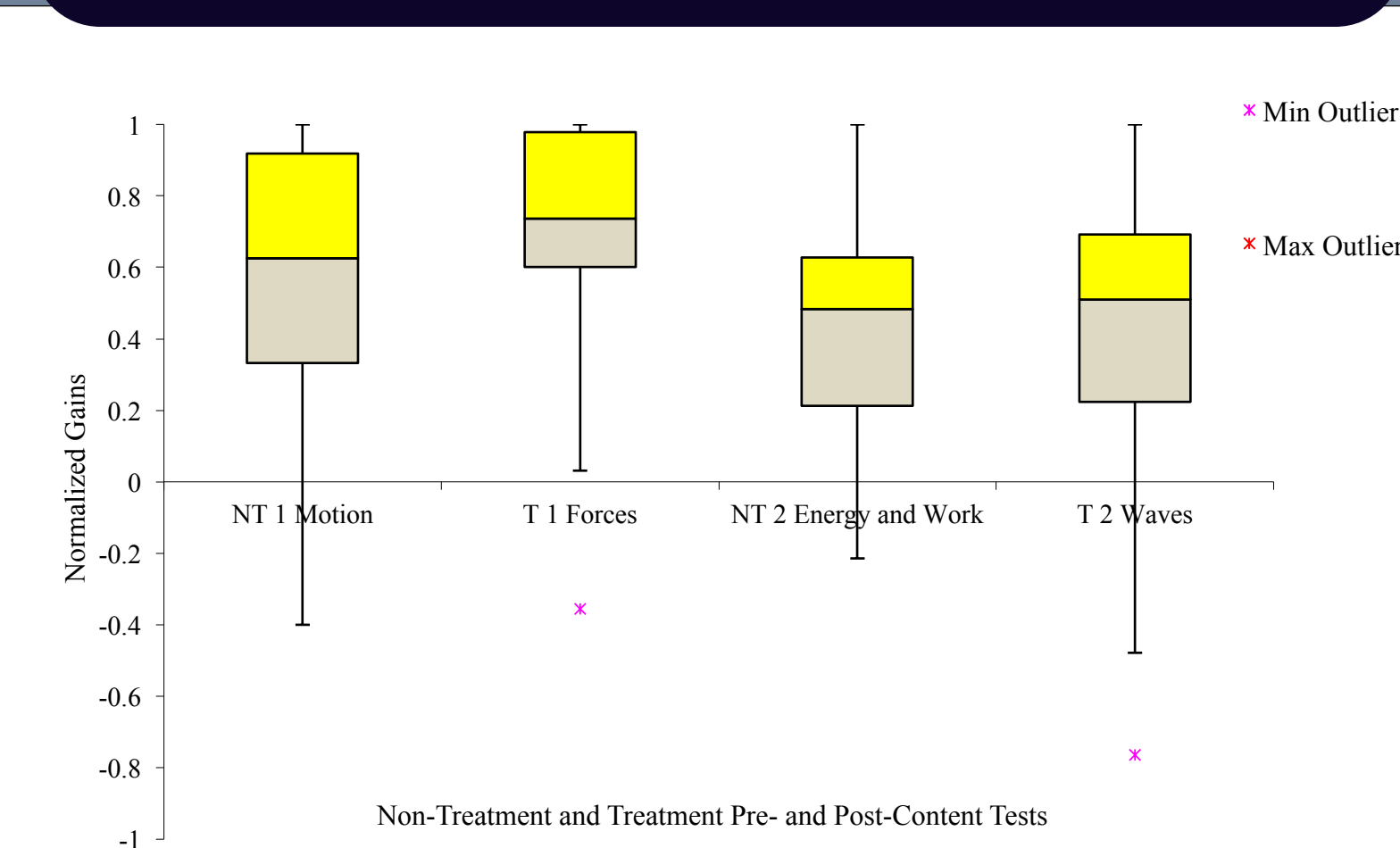


Figure 1. Content pre- and post-test normalized gain scores for non-treatment and treatment units, (N=60).

References

- Konstantinou-Katzi, P., Tsolaki, E., Meletiou-Mavrotheris, M., & Koutsellini, M. (2013). Differentiation of teaching and learning mathematics: an action research study in tertiary education. *International Journal of Mathematical Education in Science & Technology*, 44(3), 332-349. doi:10.1080/0020739X.2012.714491
- Ostrowski, C. (2015). Introduction / Research overview. In *The Grid Method: Mastery Learning System*. Progressive Mastery Learning.
- Richards, M. E., & Omdal, S. N. (2007). Effects of tiered instruction on academic performance in a secondary science course. *Journal of Advanced Academics*, 18(3), 424-453.

Engagement Survey Before and After Interventions

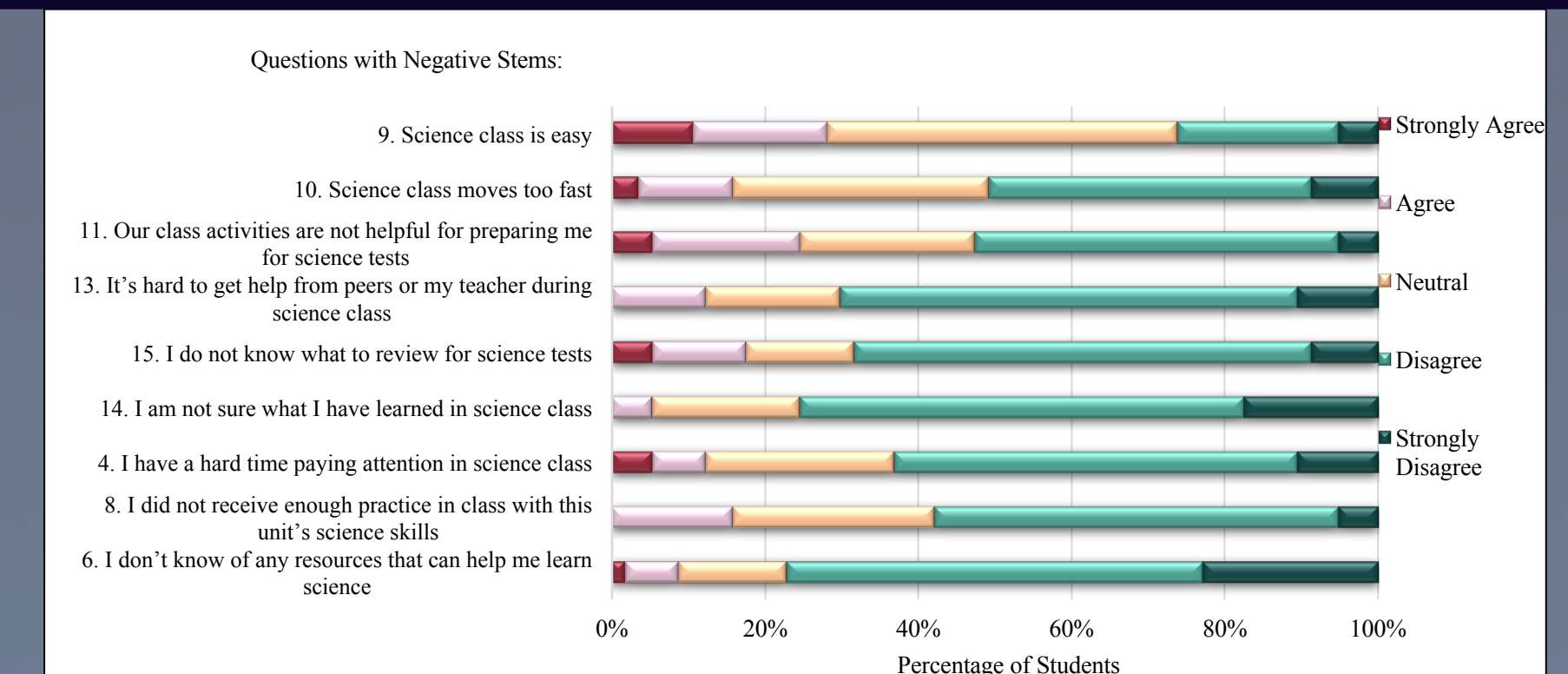


Figure 2. Results of the negatively-stemmed questions on the non-treatment Student Engagement and Value of Intervention Survey, (N=57).

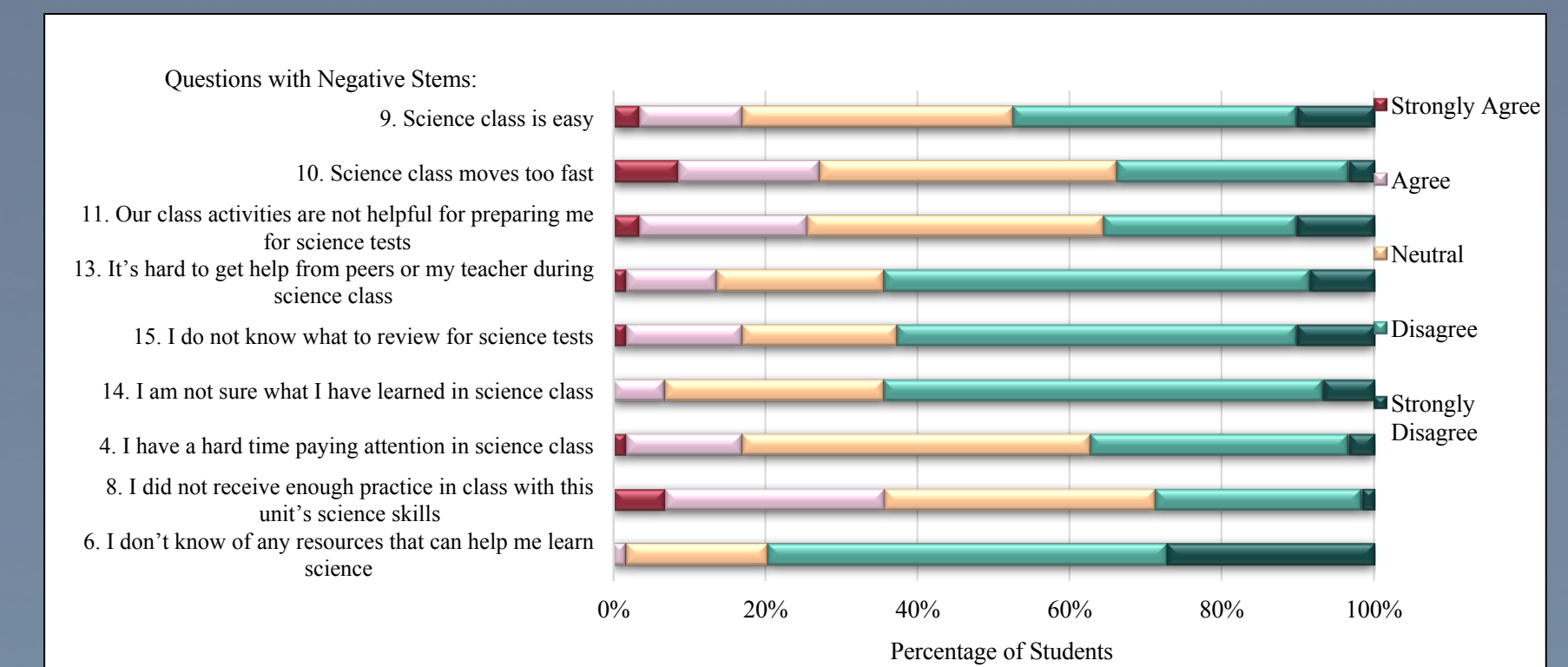


Figure 3. Results of the negatively-stemmed questions on the treatment Student Engagement and Value of Intervention Survey, (N=59).

Conclusions

- Medium to large learning gains were reported using the mastery learning interventions
- Survey data indicated that student engagement decreased over time, while self-efficacy increased
- Of the random student interviews, 75% liked the organization and structure of the mastery grid

Implications for Further Research

- Testing the method at the beginning of the school year
- Adjusting the incorporation of hands-on activities in the mastery learning format
- Using the strategy for a few select concepts as opposed to a full unit

Research conducted in Broadview Heights, Ohio from January 2017 to May 2017