A study of student learning comparing hands-on with traditional mathematics instruction with 10th grade high school students

By: Chelsea Brown* Advised by: Dr. Robert Boram
Department of Mathematics and Physics

MOREHEAD STATE UNIVERSITY

Introduction:

- Teaching strategies defined as, "A generalized plan for lesson(s) which includes structure, desired behavior, in terms of the goal of instruction, and an outline of tactics necessary to implement the strategy." (School of Ed, 2011)

- Traditional approach to teaching is defined as, "The teacher being the controller of the learning environment. Power and responsibility are held by the teacher and they play the role of instructor (in the form of lectures) and decision maker (in regards to curriculum content and specific outcomes). The lesson's content and delivery are considered to be most important and students master knowledge through drill and practice." (Griffiths et. al., 2002)

- Hands-on approach is defined as, "Students cooperate to construct a consensus to an open-ended activity. Students are in control of their own learning and ultimately, the outcome of their learning." (Griffiths et. al., 2002)

Demographics:

- The research took place at a county school in central Kentucky that serves a largely rural population

- Total of 105 students, 49 in the traditional instruction group and 56 in the hands-on instruction group

- 10th grade high students in Algebra 2

- Students were Caucasian, African American, Hispanic and Asian

- Groups were predetermined by students class schedule; early morning, 2nd, 3rd and 4th period.

- No exceptionalities (disabilities, ELL, IEP, etc.)

- Lesson over trigonometry (sine, cosine, tangent)

- Teacher of lesson was a college students studying to become a secondary math educator

Literature Review:

- J. McLiesh Conducted a research that shows student's concentration/ attention spans are limited to 15-20 minutes, therefore lectures should be broken up with active participations

- Yorke made the conclusion from his research that traditional teaching, if done well, can be proficient in that students can be taught concurrently, but it's assuming that all students are starting from similar mathematical 'platforms of knowledge'.

- Boaler stated that there has been a lack of careful research on the impact of different approaches to mathematics teaching and learning.

Methods:

- Four classes were chosen as participants in this study; two classes were taught using traditional instruction and two were taught using hands-on approach

- Days of instructions extended over 7 days

- All subjects of the study, in both groups, were given the same pretest and the same posttest (pictures below)

- Traditional instruction included lectures, notes, and problems assigned from the book

- Hands-on instruction included making a foldable, playing trashketball, and completing problems posted around the room
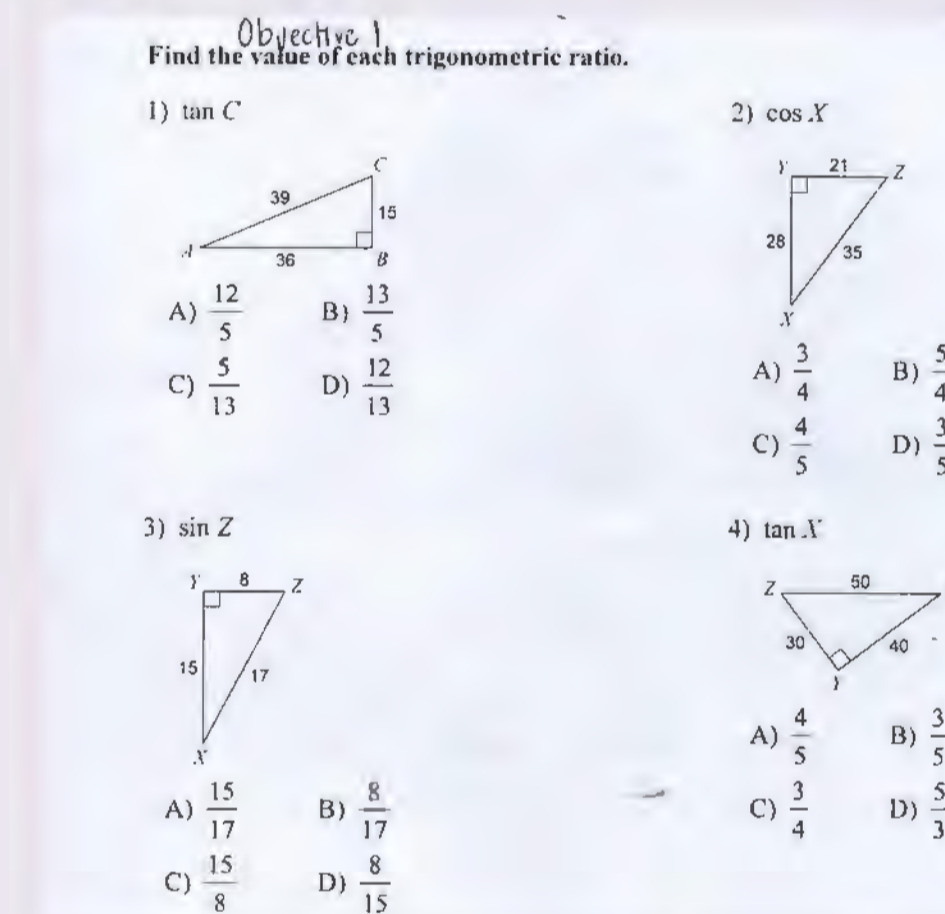
Instrument:

Objective 1: Students will be able to define trigonometric functions; sine, cosine, tangent
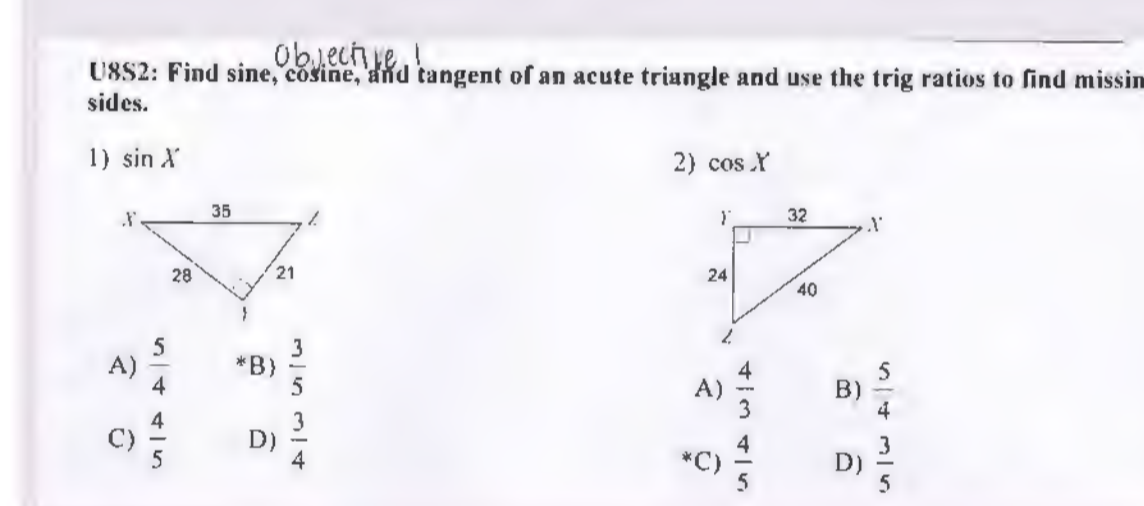
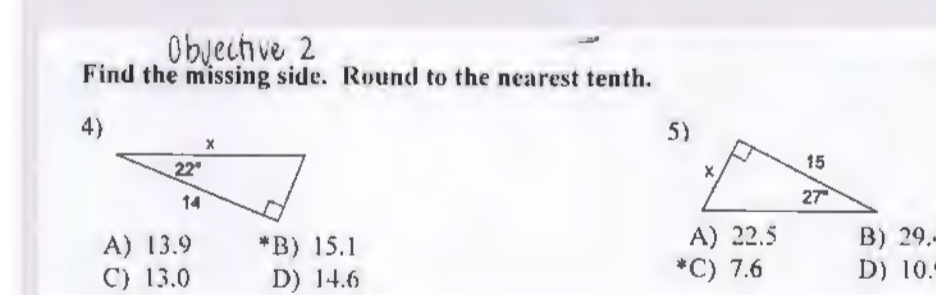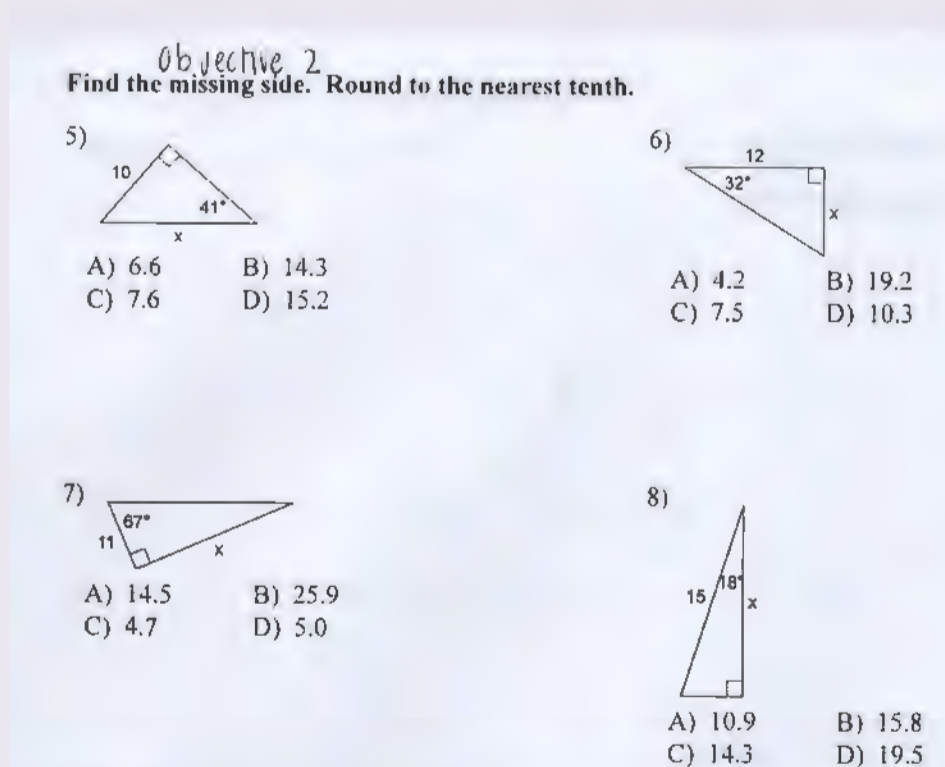Pretest: Posttest:

Objective 2: Students will be able to find the missing side using trigonometric ratios.
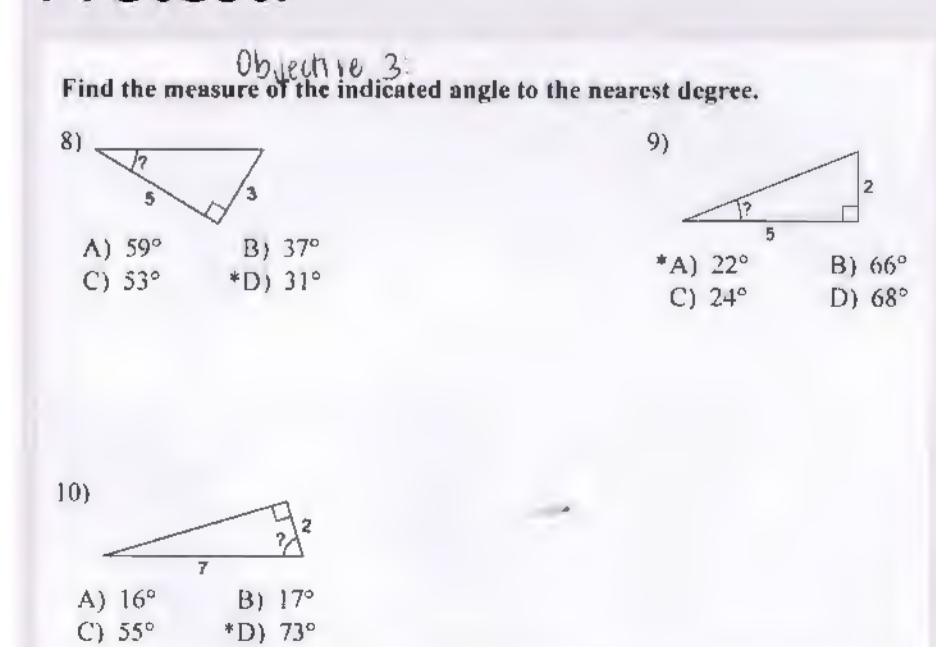
Pretest: Posttest:
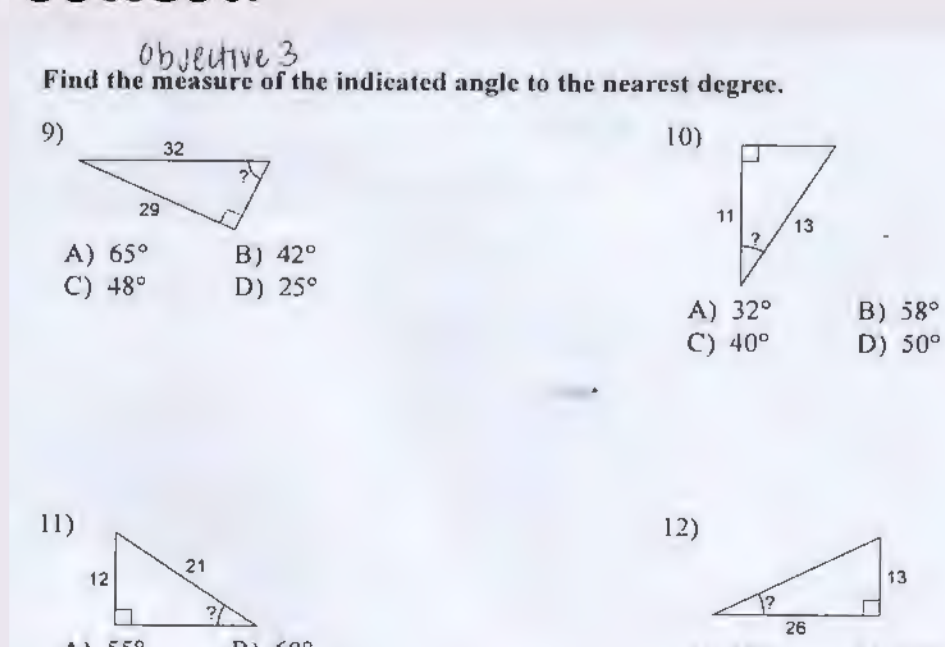

Objective 3: Students will be able to find the measure of the missing angle using trigonometric ratios.
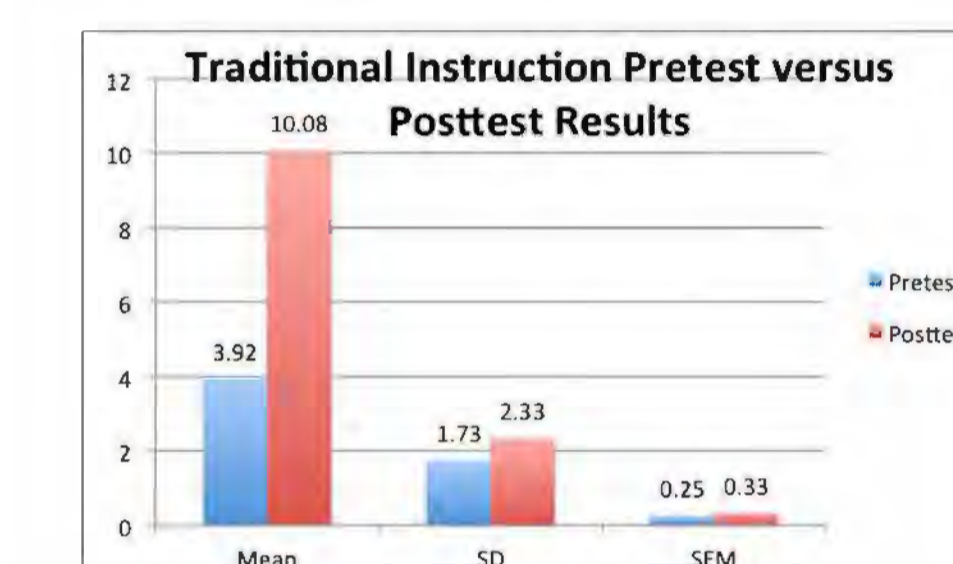
Pretest: Posttest:

Results:

Traditional Instruction Pretest versus Posttest Results	
Two-tailed P-value	<0.0001
95% Confidence Interval	-6.99 to -5.34
t-value	14.8462
Degrees of Freedom	96
Standard Error of Difference	-0.415
# of students	49

*Statistically significant

Hands-on Instruction Pretest versus Posttest Results	
Two-tailed P-value	<0.0001
95% Confidence Interval	-7.09 to -5.62
t-value	17.1309
Degrees of Freedom	110
Standard Error of Difference	0.371
# of students	56

*Statistically significant
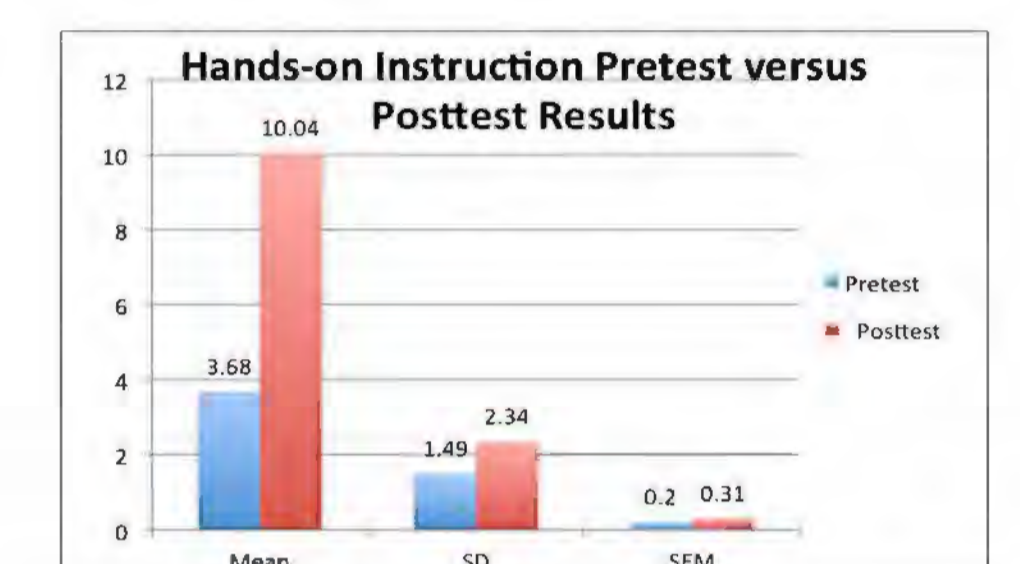
Traditional versus Hands-on Pretest	
Two-tailed P-value	0.4472
95% Confidence Interval	-0.38 to 0.86
t-value	0.7630
Degrees of Freedom	103
Standard Error of Difference	0.314
# of students	105

*Not statistically significant

Traditional versus Hands-on Posttest	
Two-tailed P-value	0.9203
95% Confidence Interval	-0.86 to 0.95
t-value	0.1003
Degrees of Freedom	103
Standard Error of Difference	0.458
# of students	105

*Not statistically significant
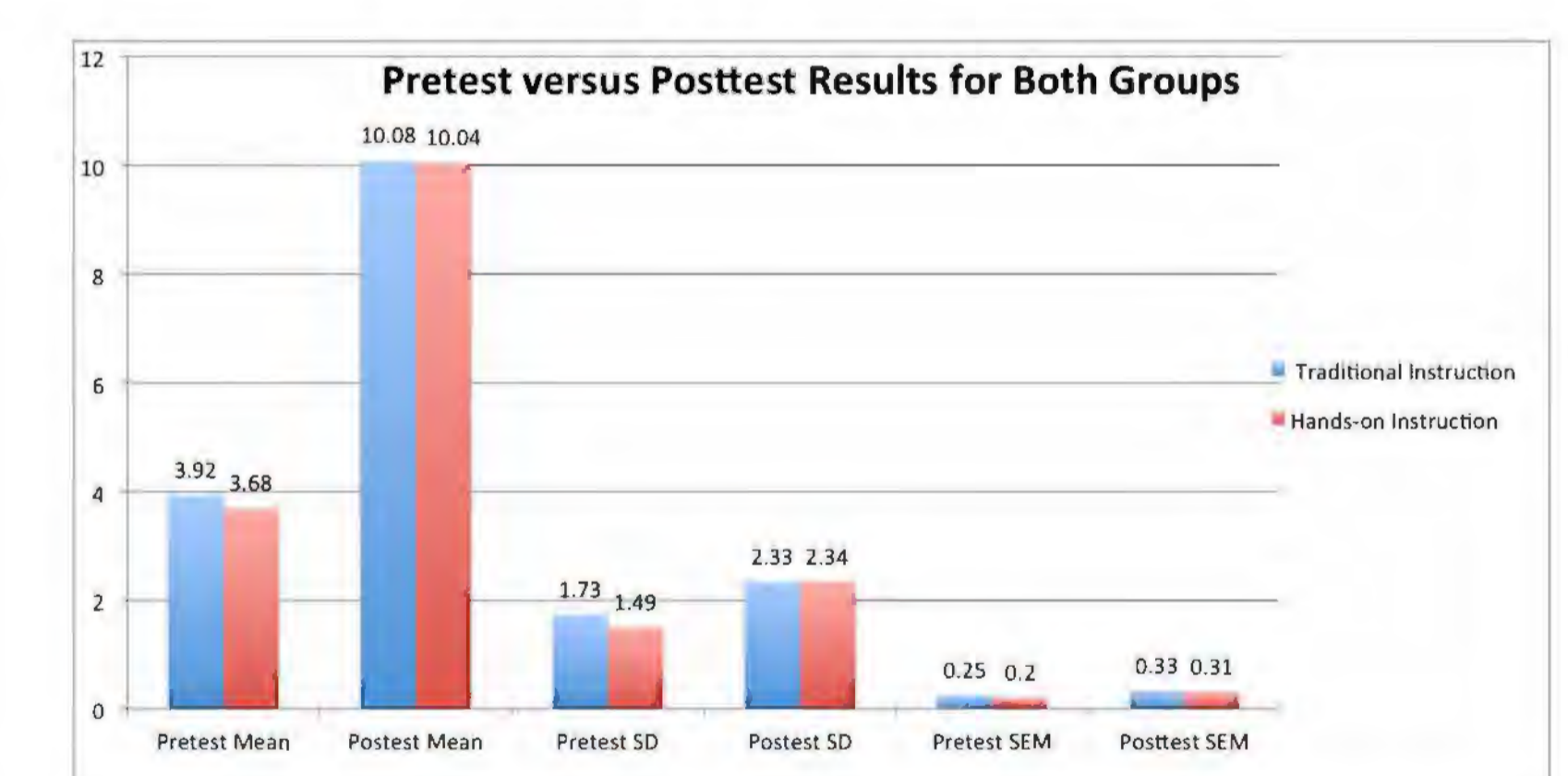
Conclusion:

- Based on pretest data, the hands-on and traditional group were comparable

- Both groups demonstrated significant learning (P<0.0001) based on content objectives

- Since both groups demonstrated significant learning (P<0.0001), both teaching strategies were effective with these students

- When comparing the hands-on and traditional strategies, there was no statistically significant difference in their effectiveness based on student posttest results.