Approved proposal and background

Research Question

Can students' practical scores be improved by drawing activities and encouragement to draw in lab?

Course Description

Course number: ZOL 365

Instructor: Barbara Lundrigan

Course Components: Two 75 minute lectures T-Th; One 3 hour lab

Course Goals: Lab goals: Most labs are designed to introduce students to one or more extant mammalian orders.

Section Number: 001- Treatment and 002- Control

Student Demographics: ~120 sophomores, juniors, seniors

Problem

Low level of observation of lab material during lab.

Often students spend less than 5 minutes observing characters of a Family before moving to the next Family (multiple specimens per family). Instead students take photographs of specimens with smart phones. Once a student has photographed everything in lab they leave lab early. Students later ask me to identify the specimens in their photos. Photos are often out of focus, have poor lighting and have no reference for size. Identification is often impossible. When students attend the review session before the practical, where all materials covered on the practical are present, students are distressed to find they are ill prepared to differentiate between specimens.

My goal is to increase student observational skills.

Hypothesis

Students in sections with drawing activities and encouragement to draw as a means of observation mean scores will be 10 points higher than students in control sections. Natural drawers in control sections will not be discouraged.

I propose to have drawing activities and encourage students to draw as a tool to better observe specimens.

Background science

I think drawing with labeling will be an effective tool for observation because research on learning generally agrees that combined visual and verbal representations are most effective for conveying information(Dalbotten, Haacker-Santos, & Zurn-Birkhimer, 2014; Quillin & Thomas, 2015). By evaluating student drawings I will be able to see how students are perceiving specimens. I will be able to correct misconceptions and guide observations to important characters which will auspiciously improve their performance and understanding of course material. The highest degree of active learning, using drawing, is when drawings are learner generated (Quillin & Thomas, 2015). My plan is to: 1) *model* drawing with labeling as a tool for observation of specimens by drawing on the board and by having students draw in lab 2) *coach* students using a detailed handout of structures to draw and compare in lab 1 and 2 and by providing verbal feedback when they show me their drawings in lab and 3) *fade* by allowing students to draw the characters as they choose in the character tables in the lab notebook. Hopefully students become comfortable drawing structures and naturally draw as a means of focusing observation.

Dealing with fear of drawing

Many people are insecure about their ability to draw. Fear can be dispelled by creating a safe environment, transparency about expectations and practice. I will create a safe environment by using preconceived words of encouragement and positive critiques (talking about what was good about their drawings, then suggesting places where it could be improved). I will have model examples of the good drawings. Students will have experience practicing drawing in lab with verbal feedback.

Work Cited

Dalbotten, D., Haacker-Santos, R., & Zurn-Birkhimer, S. (2014). New voices: The role of undergraduate geoscience research in supporting alternative perspectives on the Anthropocene. In Future Earth—Advancing Civic Understanding of the Anthropocene: New York, John Wiley & Sons (pp. 77-88).

Quillin, K., & Thomas, S. (2015). Drawing-to-learn: a framework for using drawings to promote model-based reasoning in biology. CBE—Life Sciences Education, 14(1), es2.

Methods

Logistics and Teaching Strategy

- Tuesday morning section of Biology of Mammals Spring 2015 taught by C.N. Cavalieri will be the treatment group, and the afternoon section of Biology of Mammals will be the control group.
- Treatment group
    - Will have drawing activities in lab and be encouraged to draw
    - Activities
        - Lab 1
            - Talk about why we are drawing and the benefits of drawing
            - Show what level of drawing is expected on board (I will draw for class)
                - Schematic with labels
                - Show and explain rubric, examples of not acceptable and acceptable drawing and labeling
            - Quell fears about drawing
            - Handout list of structures to draw and compare from lab 1
            - Have them show me their drawing before they leave lab
        - Lab 2
            - Handout list of structures to draw and compare from lab 2
            - Have them show me their drawing before they leave lab
        - Lab 3
            - Show them examples of drawing in character tables
            - Have them draw characters in character tables
            - Encourage students to draw key structures from PowerPoint
            - Have them show me their character table drawings before they leave lab
        - Labs 4-10 and 12-13
            - Encourage students to draw key structures from PowerPoint
            - Have them show me their character table drawings before they leave lab

- Control group
    - Will not have drawing activities in lab, natural drawers will not be discouraged from drawing
        - Lab 1 and 2 lab
            - Answer questions in lab course pack about structures, and compare structures
        - Labs 4-10 and 12-13

- Have them show me their filled out character tables before they leave lab

Assessment

- Quiz at the beginning of labs 2-10 and12-13 (5 points)
    - Identification, structures, habitat and range
- Two Practicals (100 points)
    - Identification, structures, habitat and range

Data collection

- Quiz scores
- Practical scores

Data analysis

- Compare mean scores using a t-test
    - Spring 2015 treatment VS Spring 2015 control
    - Spring 2014 VS Spring 2015 treatment
    - Spring 2014 VS Spring 2015 control

Assessment instrument

Drawing exercise lab one

- Draw plantigrade stance
    - Label metacarpals, carpals, phalanges

- Draw digitigrade stance
    - Label metacarpals, carpals, phalanges

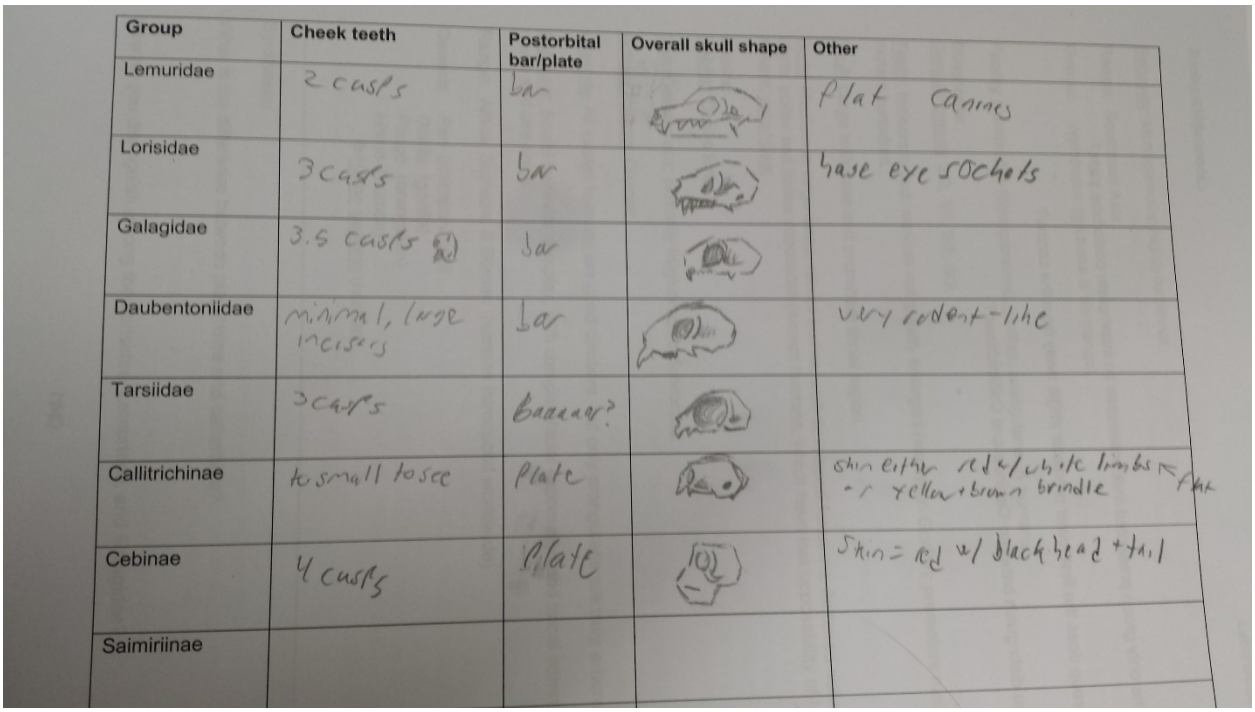
- Draw unguligrade stance
    - Label metacarpals, carpals, phalanges

- Draw bat wing
    - Label metacarpals, carpals, phalanges

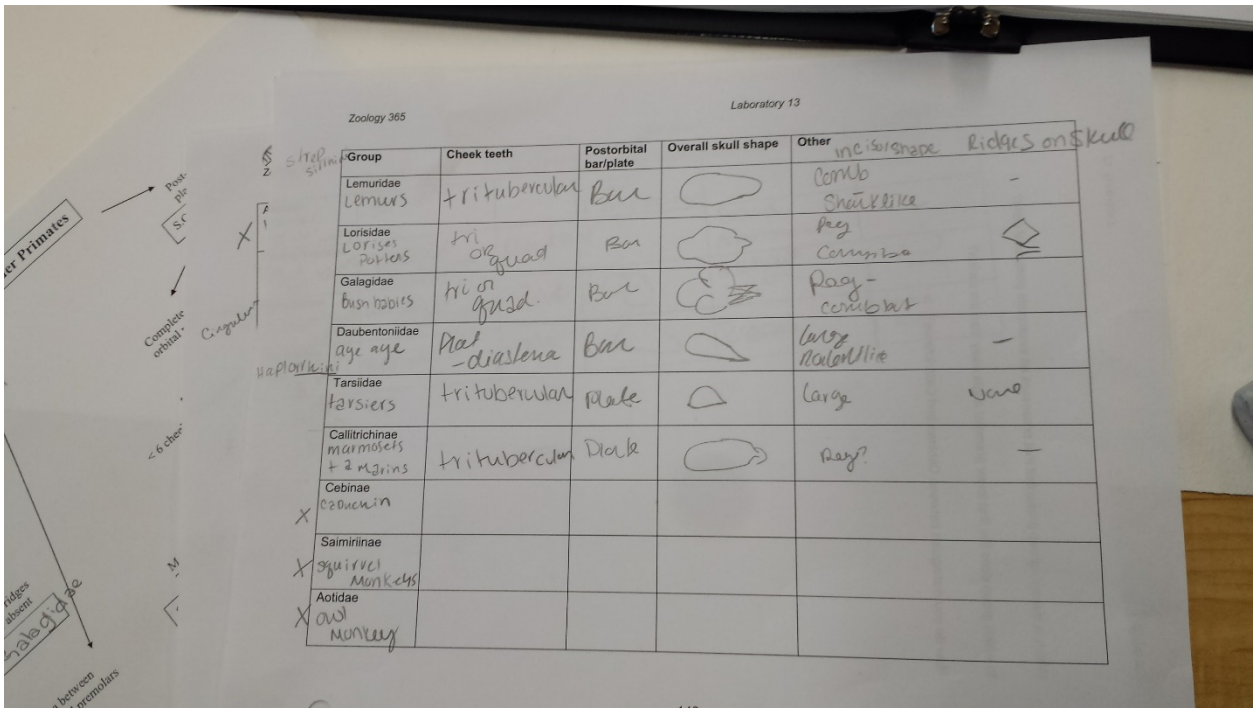
Drawing exercise lab two

- Pick a skull to study
- What is it?
- Draw the mandible
    - Label
        - Dentary
        - Angular
        - Coronoid
        - Masseteric fossa
        - Incisors
        - Canines
        - Premolars
        - Molars
        - type of tooth cusp pattern

Character table drawings



Group	Cheek teeth	Postorbital bar/plate	Overall skull shape	Other
Lemuridae	2 cusps	bar		flat canines
Lorisidae	3 cusps	bar		large eye sockets
Galagidae	3.5 cusps	bar		
Daubentoniidae	minimal, large incisors	bar		very rodent-like
Tarsiidae	3 cusps	Baaaar?		
Callitrichinae	too small to see	Plate		skin either red w/ white limbs or yellow + brown brindle ← flat
Cebinae	4 cusps	Plate		Skin = red w/ black head + tail
Saimiriinae				

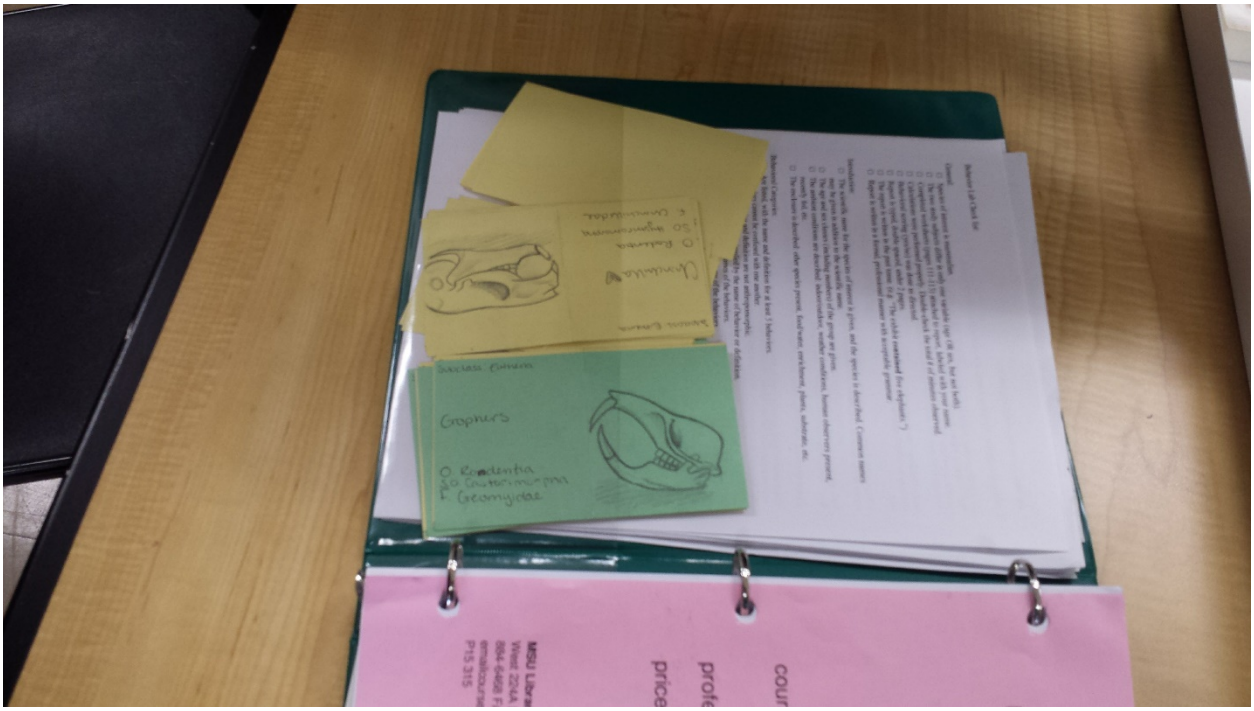


Zoology 365

Laboratory 13

Group	Cheek teeth	Postorbital bar/plate	Overall skull shape	Other	incisor shape	Ridges on skull
Lemuridae Lemurs	tritubercular	Bar		Comb Shark like		–
Lorisidae Lorises Pottos	tri or quad	Bar		Pacy Cerrmba		
Galagidae Bush babies	tri or quad.	Bar		Pacy – cerebral		
Daubentoniidae aye aye	Flat – diastema	Bar		Large Rodent like		–
Tarsiidae tarsiers	tritubercular	Plate		Large		Vane
Callitrichinae marmosets + 2 marins	tritubercular	Plate		Pacy?		–
Cebinae capuchin						
Saimiriinae squirrel Monkeys						
Aotidae owl Monkey						

Learner generated drawing



Results

I used a Welch's t-test to determine if there was a significant difference between the means of my drawing and nondrying sections of mammalogy and 2015. There was not a significant difference in mean scores between my drawing section and my non-drawing section for mammalogy in 2015 ($t_{df.\ 53.06}$ = 53.06, p = 0.3961). A further analysis using ANOVA to test differences between sections for 2014 and 2015 did not find a significant difference between sections for these two years ($F_{d.f.\ 3}$ = 0.566, p = 0.639).

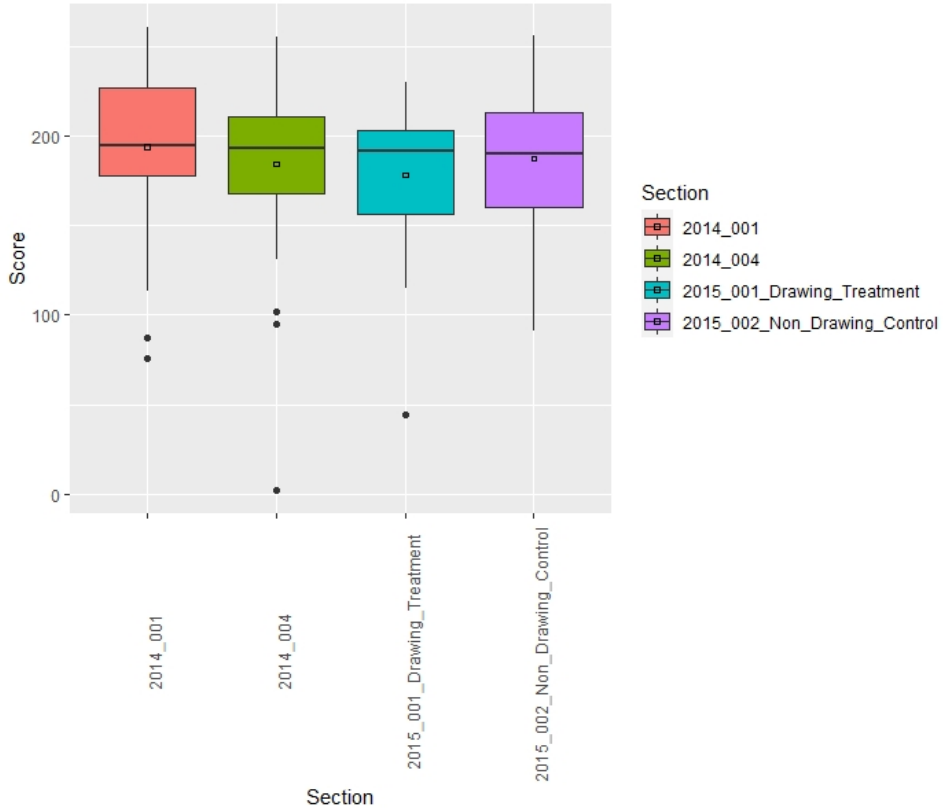


Figure 1: Boxplot of laboratory scores by section. Maximum points available in laboratory 270. The open square indicates the mean and the small black points indicate outline values. The heavy horizontal black bar represents the median. The lower and upper hinges correspond to the first and third quartiles (the 25th and 75th percentiles). The upper whisker extends from the hinge to the largest value no further than 1.5 * inter-quartile range (distance between the first and third quartiles). The lower whisker extends from the hinge to the smallest value at most 1.5 * inter-quartile range of the hinge.

Conclusions

My goal in this study was to see if drawing activities increase student's observation skills and resulted in higher laboratory scores. There was not a significant difference between mammalogy sections that did drawing exercises and were encouraged to draw and mammalogy sections that did not do drawing exercises and were not encouraged to draw. I reject my hypothesis that sections with drawing activities would have scores higher than students in control sections. The section with drawing activities had the lowest mean of all sections; although not significantly different. Other factors beyond encouragement to draw and drying activities more strongly influenced student scores. There are six laboratory scores at are outliers this is from students that stop participating in class but did not withdraw from the course. Encouraging students to draw in laboratory and guiding them through drawing structures did not result in increased student scores in laboratory. However, the protocol for this study was helpful as the instructor could correct misconceptions and guide observations of important characters based on how students drew specimens. As a result of this study I used guided drawing and encouragement to draw in the subsequent semesters I taught mammalogy lab.

In this study students were not penalized for not drawing in laboratory and many chose not to despite positive encouragement. Students that engaged in learner generated drawing beyond what was encouraged in this study were happier and had a better understanding of structures and how they related to function, based on their comments to instructors. Unfortunately, student's feelings towards their learning experience could not be quantified during this study. Student happiness, and feelings of satisfaction with their learning growth should be included in future studies using survey methods. This study represents a small population and I would recommend that larger and more robust studies of the influence of guided drawing and learning in mammalogy laboratories be conducted.