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Recommended Citation

Massey, Kelly, "Clay Modeling of the Musculoskeletal System: Does Active Learning Increase Retention and Comprehension" (2014). *Interdisciplinary STEM Teaching & Learning Conference (2012-2019)*. 35. <https://digitalcommons.georgiasouthern.edu/stem/2014/2014/35>

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Clay Modeling of the Musculoskeletal System: Does Active Learning Increase Retention and Comprehension

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Introduction

In the course *KINS 3013 - Structural Kinesiology*, the focus is a detailed study into the musculoskeletal system and joint actions for students in the School of Health and Human Performance. This course is important not only for Exercise Science majors but also for Athletic Training majors as both work directly and extensively with muscle movements and joint actions. This course however is a lot of memorization: skeletal muscle origin, insertions, innervations and muscle/joint actions. Having instructed a section of this course for the past three (3) years, I have witnessed many students suffer with this detailed material. Even though they are exposed to this material during their Anatomy & Physiology courses, this is the first time they have to delve deeply into musculoskeletal details. The instructional delivery method for the course three years ago was utilizing a traditional lecture format. Examples and case studies were fully incorporated however the majority of students still struggled not only with the memorization component but also with the applied component. The next year a system of group study called GAP groups was incorporated. At the beginning of the semester students were randomly assigned to a group of five members who would complete the course together as a group. They would work together in class, study together and be assessed together as a group. Their individual knowledge would be examined with the final exam, which would be completed on their own. From this mode of instruction, improvement was seen in the retention and understanding of the content during the group assessments yet not in the individual assessment. The end of course survey had students stating it was difficult to work in a group mainly because they didn't know what to discuss; they did not understand how they could participate in active group learning. These responses led to the consideration of how a small group could actively participate with each other during group study, to be able to successfully retain the information, and more importantly, understand the information.

Two studies looked at group construction of skeletal muscle models using clay during class time in assisting with the active learning of muscle origin, insertion and actions (Cruz-Espaillet et al., 2010 & Waters et al., 2011). Both of these studies reported good results within the student populations. By adding this instructional method into the *KINS 3103* course, it would be beneficial in the examination of the issues observed in how active group interaction and discussion of the material during active learning can assist in each student's individual attainment and understanding of the course material.

Methods



At the start of the *KINS 3103 - Structural Kinesiology* course in the fall semester 2013, students will be split into six (6) Group Assessment Procedure (GAP) groups consisting of five (5) students each and each group will be given one complete box of equipment.

- Each box will include:
- one 33" skeleton
 - multi-colors of modeling clay
 - a modeling tool set
- And a functional, fully flexible model of the:
- shoulder
 - elbow
 - wrist
 - hip
 - knee
 - ankle

All equipment will be kept in an equipment closet when not in use during class. Throughout the course, traditional lecture will continue to be utilized with the addition of weekly "Clay Days" in which each GAP group will concentrate on creating the muscles discussed and interacting within the group on the joint actions of those muscles on the model. GAP testing will continue to be used for group assessment as will the final individual assessment. After the course has been completed, both GAP testing scores and individual testing scores will be compared to the two (2) previous *KINS 3103* classes that did NOT utilize clay models during the course yet had identical course lecture material and group and individual assessments.

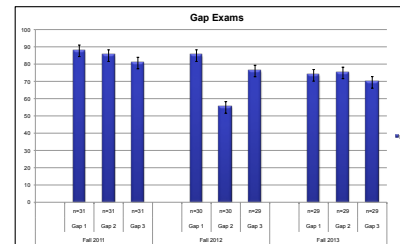


Results

Final Exam Scores		Mean	SE
Fall 2011	n=31	69.4	± 1.66
Fall 2012	n=30	70.7	± 1.54
Fall 2013	n=28	71.3	± 1.98

Gap Exams		Mean	SE
Fall 2011			
Gap 1	n=31	87.7	± 1.42
Gap 2	n=31	84.9	± 1.78#
Gap 3	n=31	80.6	± 1.5
Fall 2012			
Gap 1	n=30	84.9	± 1.34
Gap 2	n=30	54.9	± 1.38#
Gap 3	n=29	76	± 2.09
Fall 2013			
Gap 1	n=29	73.5	± 1.47*
Gap 2	n=29	74.9	± 2.04#
Gap 3	n=29	69.4	± 2.02*

* = significantly different from Fall 2011 and Fall 2012 p < 0.05
= significantly different p < 0.05
* = significantly different from Fall 2011 and Fall 2012 p < 0.05



Conclusions

Although the results seen from GAP Exams as well as the Final Exams for the classes observed, incorporating the clay modeling did not produce the anticipated results on formal assessments, when used in conjunction with the GAP groups. However, student opinion surveys showed that 30.77% of the Fall 2013 class enjoyed the use of the clay modeling VERY MUCH, and 46.15% SOMEWHAT enjoyed the activity. 46.15% found the activity to be SOMEWHAT helpful in studying for the course whereas 7.69% found it EXTREMELY helpful in studying for the course.

Individual responses to the utilization of clay modeling within the Structural Kinesiology course included:

"I enjoyed the Mr. Thrifty skeleton. It made learning and visualizing the muscles easier. I would recommend using the thrifty for future classes"

"For a hands on learner, Mr. Thrifty would help a lot"

References:

- Cruz-Espaillet, G., Stabile, C., & Reyes, C. (2010). Anatomy in Clay® Testing. *Journal of Career Education Principles and Practices* - Keiser University. [http://www.keiseruniversity.edu/iccpe/Vol. 1, No. 1 \(April 2010\)](http://www.keiseruniversity.edu/iccpe/Vol.1, No. 1 (April 2010))
- Waters, J.R., Van Meter, P., Perrotti, W., Drogo, S., & Cyr, R.J. (2011). Human clay models versus cat dissection: how the similarity between the classroom and the exam affects student performance. *Adv Physiol Educ*, 35: 227 - 236.



For further information

Please contact kelly.massey@qcsu.edu for more information on this and related projects.

