Sarcomere in the Classroom: Learning with Undergraduate Group Projects

In most major universities today, there are many classes that assign few, if any, group projects or engage in peer to peer interaction of any kind. The reasons for this may vary and sometimes they are as simple as a large class size prohibiting effective use. However, when class size and other factors permit, group projects can be valuable teaching tools both in and out of the classroom. Currently there is a trend toward classroom teamwork, which has been stimulated by students and prospective employers of college graduates (Colbeck et al., 2000). The benefits of a group project are numerous and the project itself can have great effects on the confidence of the participating members. In most situations where a group project is assigned there are a variety of reasons for participation. Some students will want to gain experience on the subject, while others will simply focus on just getting the best grade possible (Colbeck et al., 2000). In an introduction to skeletal muscle physiology class (Dodson, 2001), maxing out at a mere 16 students of mainly upper classmen, the perfect environment for a team project was presented, and as such, a voluntary venture was assigned.

Initial Undertaking

In reality, the subject of skeletal muscle physiology can be rather dry to some and fascinating to others. One of the most important components of skeletal muscle is the sarcomere and one must know which proteins are present where, how they interact with each other and other proteins, and what the combined effects of those interactions are. The prompt for this project consisted of two major components: creating a large scale graphical representation of a sarcomere with all identified proteins correctly drawn according to their molecular shape, as well as submitting a paper containing the location, structure, function, and regulation of each protein with a copy of all sources of information. All of the information to be used in the project was required to be collected from credible, peer-reviewed scientific-based papers or journal articles. Aside from these few requirements, students were given free rein with the optional project, and if the product was up to par, participants would be rewarded with extra credit.

However, differing goals led to varying levels of motivation among team members. Without specific guidance from our instructor about how to share leadership and process management roles amongst ourselves, those with high motivation became leaders and those with low motivation had the temptation to become slackers (Colbeck et al., 2000). As such, it soon became obvious as to who were team players, and who would be the less productive members. Of course, the vast variety of tasks that needed to be done, such as collecting reading materials, drawing the sarcomere or z-disc, and combining everyone's written work into one collaborative paper, ensured that every member was given the opportunity to contribute. Under the guidance of our student volunteered team captain, we were able to efficiently determine our expected roles and the project began to gradually take form.

Approach to Researching

The benefits of working in a group eliminated the need to individually research and write about all fifty-two sarcomeric proteins. Instead, we were able to reduce the workload of each person by efficiently dividing the collected list of proteins into approximately three to four proteins per person, with the project leaders willingly taking on as many as six proteins. Researching each protein took a considerable amount of time and effort and having to sift through thousands of relevant and irrelevant articles was an arduous task. To complicate matters more, it was often necessary to combine the information from multiple sources for each protein since some did not cover the structure, function, regulation, and location on the sarcomere in a clear manner. As the stack of collected information began to reach the ceiling, some students were shocked to find out that this process of sifting and uniting had to be repeated up to five times. However, the most frustrating, and time consuming, component of the project was finding an accurate graphical depiction of each protein, as the majority of the proteins were in obscure locations in the z-disc of the sarcomere or were too simple to have an actual shape.

Researching each protein took a fair amount of time and proved to be a task worth putting extra effort into. Since a few team members were unable to make the out of class meetings to work on the sarcomere model, they instead focused on the research or writing portion of the assignment. Those who spent a considerable amount of time researching papers, reading journal articles and applying what we discovered to our collective paper of

protein definitions even implicated doing more complex research projects in the future. This implies that the project itself influenced students' perspectives on how to apply what was learned to what future internships, graduate programs, or careers may entail.

Approach to Team Component

When an instructor assigns group work there are those students that are quite happy to work in a group. Sometimes it's because they work better in a social group and see that the ability to bounce ideas off of other members working towards the same goal is beneficial. Then there are those individuals that dread group work because they have been exposed to conflicts of opinions, perspectives or backgrounds and motivations, as well as the fact that typically as the size of the team increases, the potential for slacking also increases (Colbeck et al., 2000). Group projects, especially those that incorporate an out of class component, can be difficult to initiate due to the fact that individual members have different class schedules and previously made social events that prevent a collaborative meeting time. Our group was not immune to this fact, and as a result, most members of the group could not meet to work on the sarcomere model outside of class until well into the second week, thus having to focus on researching their assigned proteins first. Of course, if people did not utilize this time to research and write out their definitions, other problems could potentially be created rather than resolved.

Consequently, our group definitely had mixed feelings about working together in a troupe of thirteen and apprehensions about the difficulties that could be faced while working with the majority of a class began to surface. However, these insecurities dissipated as we learned how to best approach individual learning with doing. Once members realized their role within the group and how to effectively work together for a common goal, the haphazardly put together collection of classmates became a productive team.

Rainbow of Proteins

To display our behemoth of a project, we purchased a large tri-fold poster board to create our model of the skeletal muscle sarcomere. The center of the board exhibited a large interpretation of the macro structure of the sarcomere and cytoskeleton, while the side panels sported 3D drawings of specifically selected proteins drawn by each student in our group. In addition, an extensive drawing of the z-disc of the sarcomere was added to display the proteins not visible on the macro structure. Most students contributed to the poster board by drawing their assigned proteins on the central sarcomere or junctional complexes located on the z-disc drawing. Of course for some, the word "drawing" had more power to cause emotional turmoil than the words "group project" or "pop quiz", as some members saw art as their downfall rather than strong point. In fact, thoughts of potentially screwing up a fantastic looking sarcomere drawing with their hideously drawn, permanently affixed proteins were downright overwhelming. On the other hand, there were a select few talented artists who had no anxiety over drawing. These students stepped up within their roles and were more than willing to assist the other group members who were unable to draw.

After the initial sarcomere skeleton was completed, permanent markers were used to color each section of the display, with each protein assigned to a different color. However complicated it may sound, this use of a color code made it possible to unify the macro structure with the additional 3-D and z-disc drawings organized around the panels of the tri-fold. Since fifty-two proteins were the focus of this project, our resulting masterpiece was the ultimate rainbow of proteins.

Conclusion

The comprehension of the three-dimensional visualization was the solution to making our expanded view of the sarcomere. The sheer number of junctional, myofibrillar, regulatory and structural proteins required us to utilize various methods of visualization, thus, enabling us to create a mostly accurate and complete model of the sarcomere. This physical model enhanced the learning experience by providing a visual compilation of the proteins we had researched that was far more detailed than the average "textbook" version and gave us tangible proof of our accomplishment. The project also had an additional benefit. Aside from learning more about each respective protein, the drawing itself was often referenced by some as a means to study the sarcomere prior to a test. Participation in this group project improved communication, conflict management, and problem solving skills even when we received minimal guidance about how to work together (Colbeck et al., 2000) and were striving toward completion before a deadline.

At the beginning of the project, most people were motivated only by the promise of extra credit, but no matter their field of interest, whether it was veterinary medicine, zoology, animal management, or human medicine and therapy, the majority agreed in the end that expanding our knowledge on the skeletal muscle sarcomere would ultimately benefit all of us by providing a universal application of what we had learned in class to our future careers. This end revelation was possible as a result of the group project and is one of many important benefits of working as a group (Colbeck et al., 2000).

In reality, people became sick, papers were accidentally deleted, and no one wanted to take the poster board home, but with a few days designated as a cushion, the apocalypse was averted by the time the due date rolled around. As the impending date approached, people were stressed and hunting for the color coding key, but overall, when the project was completed and dumped on our professor's desk, everyone shared a sense of relief and an even greater sense of accomplishment.

Working together in a large group may have had its benefits and setbacks, but ultimately it became an excellent way for individuals to gain knowledge on their own without wasting class time. Each student fueled individual interest in the subject and simultaneously made the material more interesting. Students discovered that there were many ways to solve the same problem, while having to organize their work, learn time management, and collaborate effectively in order to complete the tasks on time. Group, or class, projects provide an excellent way for instructors to introduce hands-on learning to their students and encourage out of class collaboration, which helps students understand the subject at their own pace and in their own unique way.

References

Colbeck, C.L., S.E. Campbell, S.A. Bjorklund. 2000. Grouping in the Dark: What College Students Learn from Group Projects. The Journal of Higher Education 71(1):60-83

Dodson, M.V. 2001. Being a balanced teacher. NACTA 54(4):41-45

Submitted by:
H.K. Floren, L.E. Hansen, C.L. Harris, W.C. Lewis, J.L. Mutch and M.V. Dodson
Department of Animal Sciences
Washington State University
Pullman, WA 99163 USA
Email: dodson@wsu.edu

M. Bowie, J.K.B. Gentry and M.A. Jackson
School of Biological Sciences
Washington State University
Pullman, WA 99163 USA

Teaching Undergraduate Researchers: Eliminating the Drinking from the Fire Hose Effect

Including undergraduates in research is an increasing trend in many programs of agriculture and natural resources across the United States. As teachers we struggle with how to introduce the most important concepts without overwhelming students in the process. Aavudai Anandhi, an assistant professor of agronomy at Kansas State University, developed a technique to understand complex topics when reading secondary research. She developed this technique in order to help her when researching for her dissertation, but she has continued using the technique herself and teaching students in her lab the technique too. She has noticed that students grasp the major concepts quicker and are able to interpret what they are reading better. This has resulted in her ability to keep students working in her lab for longer, because they feel empowered by understanding the purpose in what they are doing.

In fall of 2012, Anandhi shared this technique with Lauri M. Baker, an assistant professor in agricultural communications at Kansas State University. She adapted the technique and implemented it with her undergraduate students working on her research and those completing independent studies in research. Baker noticed the same results. Students grasped concepts quicker, they referred back to the technique throughout the research process, and were able to demonstrate greater understanding of the material. This success in a social science setting indicated to Anandhi and Baker that the technique works well for researchers at multiple levels of expertise and in a variety of disciplines. This inspired the pair to share this as a teaching tip with NACTA members in this format.

The technique itself is simple, but clearly effective. The process begins with students gathering all of the scholarly articles they can find on an assigned topic. The teacher will need to introduce the student to the concept of scholarly articles and show them how to find them within the university system. Next, the teacher asks the students to spend no more than five minutes reading each article. This is a "skim" reading for the most important points. As the student skims these articles, they put information about the articles into a research chart. The titles of the columns in this chart will vary by discipline, but columns may include: article title, subject, method used, specific subject and/or region investigated, theoretical base, intext citation, jargon used, etc. It may be beneficial to you and the student to break the chart up into multiple sessions. A possible suggestion for how to break this up is by weeks. For example in week one the student could just read the abstracts of the articles and fill in the following:

Article Title	Purpose/Objectives/Hypothoses	Method	In-text Citation

Then, the next week the student could proceed to filling in more of the chart. This time the student would move beyond the abstract to find the following information (still spending no more than five minutes spent reading each article):

Region	Population	Method Details/ Sampling	Analysis	Theories Used or Jargon/Key Terms

After the student has completed the chart, they look back at the results and are able to realize what has been studied on a particular topic in the past and what methods have been used to address the subject. This process clearly outlines where there are gaps in research and where there are common themes of methods utilized and jargon specific to this subject area. Next, students are encouraged to research any terms they don't understand, including methods of analysis that are a mystery. From this chart, the student is now asked to go back and read the articles in their entirety. This time around the students are not overwhelmed because they now know the terms and concepts. After reading all articles thoroughly, the student is ask to make any updates to the chart. Now, the student can begin writing a review of literature with confidence, while referring to the chart. At this point in the process, students are able to identify research objectives or questions based on gaps in the literature. The students are also able to begin working on a faculty member's research, knowing the purpose and direction of the research through this technique.

Submitted by:
Lauri Baker and Aavudai Anandhi
Department of Communications and Agricultural Education
Kansas State University
Email: lmbaker@k-state.edu

Student-centered Teaching through Experiential Learning and its Assessment

Experiential learning is defined as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (Kolb, 1984). Research shows that students are better able to effectively apply principles when instruction is combined with experiential learning. To better prepare the students of agriculture for future, faculty must teach skills that tackle complex situations, and experiential learning is one of the best ways to teach such skills. Moreover, students also demand more experience based projects as observed through course feedbacks.

Often experiential learning is incorrectly equated with *only* hands-on or the "do it" part of the process ignoring the other equally important components of the learning cycle. The current experiential learning project was designed in such a way as to ensure that students actually participate in all the four stages of the Kolb's Experiential Learning model as described below. Additionally, several assessment tools were designed to evaluate the effectiveness of each step of the experiential learning model, which further added to uniqueness and strength of this project.

According to this model, in order to gain genuine knowledge from a learning experience, the students must go through the following **4 steps**:

1. **"Do It":** actively involve in doing something **(Concrete Experience);**
2. **"What":** reflect on what happened; what were the results **(Reflective Observation)**.
3. **"So What":** analyze what do these results imply; how do they influence the outcome **(Abstract Conceptualization)**; and
4. **"Now What":** problem solve and decide what they will do differently next time based on ideas gained from the experience **(Active Experimentation)**.

The Experiential Learning Project: A comprehensive Cover Crop and Vegetable Management Project was introduced in a junior level crop production course incorporating all the four steps of the experiential learning model and its assessment through various tools. The students worked in pairs and managed 13 different cover crops and 6 vegetable crops throughout the semester. They were actively involved in planting, weeding, caring for, and harvesting their crops **(Step 1: "Do It")**. During the project, students recorded crop growth and soil quality parameters **(Step 2: "What")**, reflected on their observations of their own crop plots as well as those of others, and synthesized concepts **(Step 3: "So What")**. Students also documented issues they faced, how they addressed those issues, what decisions they made in their efforts to grow the best possible crop, and what they would do differently if they grew the same crop again **(Step 4: "Now What")**.

The Assessment: Assessment of any new teaching method is critical to ensure that students' learning objectives are met. A number of exercises were developed to evaluate impact of this project on student learning of conceptual and applied knowledge as well as critical thinking and problem solving. The quizzes included i) Students' pre- and post-self-assessment of conceptual knowledge, ii) Instructor assessment of conceptual knowledge, iii) instructor assessment of applied knowledge , and iv) instructor assessment of application. In addition, students recorded what they believed were the most important lessons they learned from this project, including commentary on how the project reinforced the concepts learned in the classroom. Results indicated that the experiential learning project

improved both the conceptual knowledge of the students and their ability to synthesize and apply the concepts learned.

Reference:

Kolb, David A. 1984. Experiential Learning: Experience as the Source of Learning and Development. Prentice-Hall, Inc., Englewood Cliffs, N.J

Submitted by:
Kulbhushan Grover and Shelly Stovall
New Mexico State University
Las Cruces, NM
Email: kgrover@nmsu.edu[1]
Email: sstovall@ad.nmsu.edu

Undergraduate Teaching Philosophy

- The primary reason I chose an academic career is because **I enjoy teaching** and **genuinely care** for students' well-being, and I am very much interested in helping students to be successful in their studies.
- My overriding teaching philosophy is that '**students come first**' because colleges and universities exist because of and for students.
- Teaching is an **important part of my job** and I take it very seriously and strive for excellence in all aspects of teaching.
- I get very **excited about teaching**; once I am done preparing notes, I cannot wait to deliver the lectures. I have a great enthusiasm for teaching, which gets students excited in learning.
- Establishing good rapport with students is very important. Toward this goal, I follow an **open-door policy**, and **go the extra mile** to help students in every possible way.
- I am a strong **advocate of active class participation** and firm believer that teaching and learning is a **two-way communication** that provides opportunities for class discussions.
- The most important goal I set for myself and for my students is that **all students excel in their studies** because the primary reason they came to the university is to get a good education.
- To improve students' performance, I focus on the following points: thorough preparation, good organization of lectures and course, sound explanation of the material, clear oral and written presentations, keep abreast of new developments in the subject matter, encourage class discussion, and motivate and stimulate students' interest in the subject.
- As a teacher, I want to **contribute to the students' learning** process and impart the skills and knowledge needed for students to be successful. When they do well in their studies and get good grades, it will be easier for them to find jobs.
- I encourage students to understand the subject matter, succeed in the class, **think critically**, gain experience, and accomplish their academic goals.
- I ensure that **learning is fun, interesting**, and helps accumulate knowledge. At the end of the semester, students should feel they not only learned a lot but also enjoyed the course.
- I assist students to achieve well-defined educational and career goals and to grow as matured and well-rounded students so that they can **stand on their own legs**.
- I train students to become good team workers, collaborators, and **highly motivated**.
- I monitor students' academic performance, **am aware of their needs**, provide accurate and specific information, offer timely feedback, and am courteous to students.
- I **focus on each one's strength** to maximize their potential, intellectual, and personal growth, and academic performance.
- I assist students with further studies and **job searches**.
- Since **teaching is one of the integral parts of the land grant mission**, I strive to achieve excellence in my teaching responsibilities.
- It is important for me that students learn from my courses and make use of their knowledge in their future employment.
- It gives me great pleasure when my students succeed in their goals. I would like to see my students make significant progress by showing positive growth and development.
- I want my students to **enjoy, value, and treasure their experience in undergraduate studies at the university**.
- I reward top performing students by taking them to lunch.
- I recommend deserving students for honors, awards, and scholarships. **I take great pride in my students' awards**, honors, and achievements.

Submitted by:
Stephen Devadoss
Agricultural Economics
University of Idaho
Email: devadoss@uidaho.edu