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Integration of a Flipped Classroom Module with a Peer-Learning Laboratory Exercise to Encourage Deeper Learning of Protein Structure

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Extended Abstract

In introductory biochemistry courses, some of the traditional approaches commonly used to teach the basic principles of protein structure can lead to the development of misconceptions. Because it is difficult to convey concepts on three-dimensional structure through textbook readings and traditional lectures, a flipped classroom module that included podcasts, movies and interactive graphics software and in-class peer-learning assignments was originally introduced. Although this module seemed effective for teaching some concepts and clarifying some misconceptions, many students still appeared to have a fragmented and superficial understanding of key principles of protein structure.

To rectify this limitation, a peer-learning laboratory exercise was developed based on an exercise published by Loertscher *et al.* (2014) to complement the flipped classroom module. It was introduced to a large-enrollment introductory biochemistry course with an average enrollment of 500 students. In the laboratory exercise, students carefully studied different one-dimensional representations of α-helices and β-strands in combination with three-dimensional physical models they could handle and examine. The three-dimensional models of the α-helices and β-strands were obtained from 3-D Molecular Designs (Alpha Helix-Beta Sheet Construction Kit) and from Carolina (Molymod® Protein Alpha Helix Set, Item #840205).

Use of the flipped classroom module in combination with the peer-learning laboratory exercise improved students' understanding of concepts of protein three-dimensional structure, as well as stimulated rich discussions between students as they worked to uncover various properties of secondary structure elements, correctly identify the sequence of peptides and build a tripeptide having proper stereochemistry. The combined use of these exercises appears to have provided students a concrete framework to organize the abstract concepts that are most challenging to learn. We have measured statistically significant differences in scores on the biochemistry concept inventory (Villafañe *et al.*, 2011) on items relating to protein structure; students who completed the flipped classroom module and the peer-learning laboratory exercises achieved higher scores than those who only completed the flipped classroom module.

Literature Cited

Loertscher, J., S.M. Villafane, J.E. Lewis, and V. Minderhout. 2014. Probing and improving student's understanding of protein α-helix structure using targeted assessment and classroom interventions in collaboration with a faculty community of practice. *Biochemistry and Molecular Biology Education*, 42(3): 213-223.

Villafañe, S.M., C.P. Bailey, J. Loertscher, V. Minderhout, and J.E. Lewis. 2011. Development and analysis of an instrument to assess student understanding of foundational concepts before biochemistry coursework. *Biochemistry and Molecular Biology Education*, 39(2): 102-109.

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