

Can A Flipped-Classroom Approach in Combination with Inquiry-Based Learning Foster Content Acquisition and Hypothesis Testing in Introductory Biochemistry?

Isabelle H. Barrette-Ng¹ and Carol Berenson²

¹ University of Calgary, Department of Biological Sciences, ² Educational Development Unit - Taylor Institute for Teaching and Learning, 2500 University Dr. N.W., Calgary AB, CAN T2N 1N4
(mibarret@ucalgary.ca; caberens@ucalgary.ca)

Extended Abstract

Hypothesis testing is central not only to the scientific method but also to understanding the nature of scientific knowledge. Although it is widely appreciated that students should develop hypothesis testing skills early in their undergraduate careers, there are many challenges in large-enrollment classes that can prevent them from deeply understanding the process of scientific inquiry. The hypothesis of this study is that a flipped-learning design will create a more effective environment than a traditional lecture format in which to foster both content acquisition and an understanding of the process of scientific inquiry. To measure the relative impact of these two approaches on learning, our study compares cohorts of students in different sections of the same large-enrollment course who have been exposed either to a flipped design or a lecture-based approach. In the flipped version of the course (cohort A), four inquiry-based modules were introduced. Each module consisted of podcasts reviewing essential concepts, in-class peer-learning activities based on formative assessment principles and/or interactive student-centered JAVA computer simulations in which each student is provided with the opportunity to design a virtual experiment, formulate a hypothesis, and record and interpret the results of the simulation. In the traditional version of the course (cohort B), the same material was covered, but without the use of podcasts, in-class peer-learning activities and computer simulations.

To assess the impact of the flipped-learning design on content acquisition and the understanding of the process of scientific inquiry, three approaches were developed. First, a Biochemistry Concept Inventory (Villafañe *et al.*, 2011) was administered to assess content acquisition in cohorts A and B. Preliminary data indicate a significant difference between the two cohorts. Second, the *Views About Scientific Inquiry (VASI)* (Lederman *et al.*, 2014) was administered to assess understanding of the process of scientific inquiry in cohorts A and B. Third, focus groups were held to more deeply probe students' views on their own learning and understanding of the process of inquiry. Although the project is still at an early stage, preliminary data suggest that the use of a flipped-learning design fosters both the acquisition of content and the development of scientific inquiry skills.

Literature Cited

- Lederman, J.S., S.A. Bartos, S.L. Bartels, A.A. Meyer, and R.S. Schwartz. 2014. Meaningful assessment of learners' understandings about scientific inquiry – The views about scientific inquiry (VASI) questionnaire. *Journal of Research in Science Teaching*, 51(1): 65-83.
- 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.

Mission, Review Process & Disclaimer

The Association for Biology Laboratory Education (ABLE) was founded in 1979 to promote information exchange among university and college educators actively concerned with teaching biology in a laboratory setting. The focus of ABLE is to improve the undergraduate biology laboratory experience by promoting the development and dissemination of interesting, innovative, and reliable laboratory exercises. For more information about ABLE, please visit <http://www.ableweb.org/>.

Papers published in *Tested Studies for Laboratory Teaching: Peer-Reviewed Proceedings of the Conference of the Association for Biology Laboratory Education* are evaluated and selected by a committee prior to presentation at the conference, peer-reviewed by participants at the conference, and edited by members of the ABLE Editorial Board.

Citing This Article

Barrette-Ng, I.H. and C. Berenson. 2016. Can a Flipped-Classroom Approach in Combination with Inquiry Based Learning Foster Content Acquisition and Hypothesis Testing in Introductory Biochemistry? Article 68 in *Tested Studies for Laboratory Teaching*, Volume 37 (K. McMahon, Editor). Proceedings of the 37th Conference of the Association for Biology Laboratory Education (ABLE). <http://www.ableweb.org/volumes/vol-37/?art=68>

Compilation © 2016 by the Association for Biology Laboratory Education, ISBN 1-890444-17-0. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the copyright owner.

ABLE strongly encourages individuals to use the exercises in this proceedings volume in their teaching program. If this exercise is used solely at one's own institution with no intent for profit, it is excluded from the preceding copyright restriction, unless otherwise noted on the copyright notice of the individual chapter in this volume. Proper credit to this publication must be included in your laboratory outline for each use; a sample citation is given above.