Implementation of a Global Health Perspective in a Content Heavy Biochemistry Course

Louise Wrensford, Ph.D.
Albany State University, Georgia

Abstract

This project focused on integrating an international component into the one-semester biochemistry course, a required course for biology, chemistry, and forensic science majors at the institution. A driving question was how to integrate the international component into the course while showing direct relevance to the course and students' lives. Therefore, it was decided to use global health as a focus. Students were required to analyze current or historic events or issues of global significance with direct or indirect impacts on health. In addition, a specific component required students to make connections to the course content and its relevance to biochemistry and their career interests. Student learning outcomes for the project are that students will be able to a) demonstrate knowledge of course concepts and how they apply to global health, b) evaluate and compare the forces shaping global issues, both now and in the past, and c) compare and contrast global events/issues and impacts internationally and domestically. The process of course revision and implementation, and outcomes are described.

Keywords: course internationalization; science curriculum; undergraduate curriculum; biochemistry; global health

There has been considerable focus on the inadequacy of traditional approaches for preparing students to meet the needs of the 21st-century workforce, which is becoming increasingly diverse. In response, higher education institutions are integrating international/intercultural dimensions into the undergraduate curriculum to provide students with the global attributes that prepare them to live and work in a global and culturally diverse environment (Green & Whitsed, 2015; Williams & Lee, 2015).

As subject matter experts, the primary concern of many higher education faculty is the course content, and even though they understand

the value of course internationalization, many are hesitant to revise their courses. As a result, deep engagement with the Internationalization of the Curriculum in the disciplines remains an activity of internationalization scholars that often occurs on the periphery of other academic requirements (Leask, 2013). Several reasons are suggested for this. One is that the concept of internationalization in higher education is not well understood (Green and Olson, 2003; Clifford, 2009). Another reason put forth is that faculty lack the pedagogical knowledge and skills to develop quality curriculum internationalization (American Council on Education, 1996; Saroyan & Amundson, 2004).

Except in a few cases (Atweh et al., 2007; Douglas, et al., 2010; Okonkwo, 2017), there is no significant evidence of widespread internationalization in science disciplines. These cases often involve applied science courses or approaches. Even so, academicians in these fields understand and agree with internationalization's educational and professional benefits (Clifford, 2009, Williams & Lee, 2015). There is also the belief among some that scientific content is culturally neutral and that internationalization of the curriculum is, therefore, irrelevant or low priority (Clifford, 2009). A survey of faculty indicated that it would be difficult given other demands of the course and that they would have to consider if they could do it without compromising the time for the current course content (Bond, Qian & Huang, 2003). However, the increasingly globally diverse nature of the STEM workforce demands that students entering STEM careers develop the competencies needed to work in this environment (Etherington, 2013). Given the benefits to students of course internationalization and the focus of the institutions' Office of International Affairs on curriculum internationalization, efforts were made to integrate an international component into the Biochemistry course. This article describes the process of internationalizing this course, an upper-level course required for our STEM majors.

Methodology

Educational Context

The biochemistry course, CHEM 3250, is an upper-level course typically taken by juniors and seniors. Like most science courses targeted at science majors, the course is content-driven and content-heavy. Students who

major in Biology, Chemistry, and Forensic Science must complete this course to satisfy their degree requirements. In addition, students require the course to satisfy the prerequisite requirements for entry into professional programs of study, including preparing for the required admissions tests. Many students taking the course aspire to advanced studies in graduate school and professional programs in medicine, dentistry, and pharmacy. The course is a 4-credit course that includes a lecture and lab component. Current research on student learning and retention in STEM subjects (Science, Technology, Engineering, and Mathematics) includes student-centered evidence-based teaching strategies. These strategies, including active learning (e.g., cooperative learning, flipped lecture sessions, case studies, think-pair-share), are sometimes included as part of the course. Though overall, the course retains a primarily traditional lecture format to ensure the time is available for the content needed in preparation for advanced study to be covered.

In Spring 2019, after attending a presentation on curriculum internationalization offered by our Office of International Education, I seriously began thinking about how I could integrate international elements into the course beyond previous efforts, which were limited to a few questions. With the significant amount of content covered in the course, a major concern was what could be left out or sacrificed to bring the internationalization component into the class. In addition, given the hierarchical nature of the course content, students need to understand foundational concepts. Therefore my approach was to think about a project that would allow students to reinforce some of the content that they learn in class while gaining new knowledge as a result of the international focus. For this reason and that many students aspire to careers in health, the overarching theme of global health was an appropriate choice. In addition, with the emergence of new and reemerging infectious diseases on a regular basis, there is applicability to all students.

The implementation was conducted in the Spring 2019 and Spring 2020 semesters. The 2019 cohort consisted of 46 students, and in Spring 2020, 33 students. Students taking the course were primarily African American. In total, 57 % of students were biology majors, 11 % chemistry majors, and 32 % Forensic Science Majors.

Project Goal and Expected Learning Outcomes

The project goal was for students to analyze a current event or issue of global significance using course concepts. Students were provided a list of potential topics, as indicated in Table 1.

Table 1

Internationalization Project Instructions

Project Guidance
a) Identify an international country to complete this assignment on global health impacts. b) Select a health-related topic from among the following to research for the country chosen • *air quality/air pollution* • *water quality* • *maternal and child health* • *health care availability* • *hunger and nutrition* • *Infectious diseases- identify specific (e.g., HIV/AIDs, measles, influenza, COVID-19, etc.)* • *Identify another other problem/event of your choosing (see me for approval)* c) Provide a summary describing the country, its population, demographics, and a map indicating its location relative to the US. d) Provide data about the country (location, population information (data, statistics, etc.) about the event/issue e) Describe the cause of the disease and how it impacts health f) What are other impacts (social, economic and environmental, political)* that may be impacted, and how? g) Compare and contrast this issue in the international country with the US or your community including prevalence, and how the issue is addressed. h) Discuss how the event that is occurring internationally impacts the US and/or your community. i) Using **course concepts,** explain how biochemical-related knowledge/research is involved in the disease and/or used to help resolve issues that may arise from the event. j) Imagine that you have graduated and are working in your chosen profession. Identify your chosen profession and discuss how you in your chosen career would be engaged or involved in solving or addressing this global health crisis and/or matters that may arise from it. Be specific in your response.

Expected student learning outcomes are that students 1) demonstrate knowledge of global issues, 2) demonstrate knowledge of an

international country, and 3) demonstrate knowledge of course concepts and how they apply to global events. Additionally, students were asked to discuss how they could contribute to solving or addressing the issue in their chosen careers.

Student Group Selection

The project was completed in groups of three to four students. In Spring 2019, student groups and topics were self-selected. Students were provided a variety of topics to choose from but were also able to suggest their own topics. Groups that selected the same topic were required to select a different country. In Spring 2020, the instructor randomly assigned student groupings and topics. This change was instituted to facilitate the project implementation as the course was switched from face-to-face to online format due to the COVID-19 pandemic, a challenging adjustment for both instructor and students. Group cohesiveness proved to be a problem in the spring 2019 implementation. Therefore in 2020, each group was required to determine specific roles for each member to ensure the project was carried out in a timely manner and that everyone contributed fairly to the project. Roles included 1) responsibility for initiating and sustaining communication with the rest of the group, 2) coordinating schedules and organizing meetings, 3) recording ideas generated and decisions made at meetings, and 4) keeping the group on task and on time to meet required deadlines. Groups were required to submit their roles to the instructor along with their final topic.

Description of Activity

For the activity, students were asked to 'Reflect on current issues in the world that impact global health, relevance to biochemical concepts, and career interests. Students could choose from among these topics or suggest a topic of their own for approval. Table 1 (above) shows the assignment instructions and guidance provided and the list of potential topics.

Assessment

An oral PowerPoint presentation, a written report, peer assessment, and a student evaluation survey were required to assess the project. Rubrics were used to assess student learning gains for the oral presentation

(Appendix B) and the paper (Appendix C). The oral presentation rubric assessed seven areas: Content, organization, mechanics, subject knowledge, quality of the activity, oral presentation style, data graphics, and evidence of cooperation and teamwork. The written report rubric assessed proficiency in five categories: content, clarity and purpose, structure/development, language and mechanics, and documentation of sources. In both of these assessments, content and subject knowledge were weighted 2-5 times more than each of the other categories. This weighting was used to convey the importance of these components in the overall project. All rubrics were provided to students at the beginning of the project, and at the same time as the project instructions.

Oral Presentation

One of the institutional student learning outcomes is that students will demonstrate effective oral communication skills. The oral presentation requirement for the project addressed this learning outcome. Each group was required to give a PowerPoint presentation of 5 -7 min on their topic. Specific guidance was provided to the students for the organization and content of the oral presentation, including a requirement that each member of the group participates in the oral presentation.

Paper

A group paper of no more than ten double-spaced pages, including tables and figures, was required. Each group member was responsible for different aspects of the paper; however, group members were encouraged to coordinate subject matter with each other, share findings, and work together on editing and finalizing the paper to produce a cohesive and well-organized paper.

Peer Review

Group members evaluated each other on the extent to which each group member 1) attended meetings regularly and on time, 2) was cooperative /agreed on tasks, 3) contributed meaningfully to ideas/planning, 4) was available for communication, 5) prepared work in a quality manner, 6) provided work in a timely manner, 7) demonstrated a cooperative and supportive attitude and 8) contributed to the overall

project success. Each was evaluated on a scale of 1 to 5, with 1 being the lowest and 5 the highest. Comments and or justification were required for any score of 1 or 5.

Student reflections

Finally, in Spring 2020, students were asked to complete a survey on their perceptions and reflections about the project. This element allowed the instructor to assess the course beyond students' performance on the presentation and paper to gain feedback on their perceptions of the project's usefulness. Specifically, they were asked to rate the extent to which the project, 1) increased their knowledge about the assigned topic, 2) provided an opportunity to explore a topic or concept from the biochemistry course more deeply, 3) improved their understanding of one or more biochemical concepts more thoroughly and 4) improved their knowledge about the country they selected/were assigned. Additionally, they were asked if they would recommend that an international component be included in other courses in their curriculum.

The contribution of each component to the overall grade for the project was oral presentation 100 points, written paper 75 points, and peer evaluation 25 points. The project accounted for 25% of the lecture grade.

Findings and Discussion

The rationale for the project was to enhance global awareness by focusing on a health-related topic in a specific country and its impacts globally and relating the subject to course concepts and future careers. A list of the topics selected by students in each cohort is provided in Appendix A. Through the oral and written reports, students demonstrated learning gains in two specific areas of the project: knowledge of the disease and connections with core concepts of the course. For example, one group that focused on HIV/AIDs in Zimbabwe discussed treatment for HIV/AIDS that utilized reverse transcriptase inhibitors and related it to the enzymes and inhibition content covered in the course, including details on types of inhibition in the basic mechanism of interaction. Another group that studied COVID-19 in Italy discussed the Spike protein and made connections with cell membrane structure and properties also covered in the course. In the evaluation survey responses, several students

commented on this aspect of the project as a benefit. One student indicated that the project allowed her to make connections and improved her analysis skills. Another indicated that they would like to have similar projects in other courses because it helped them understand how the course can tie into everyday life. Yet another student said, "This was a great idea, and I hope to see other courses use this type of project for their students! I like the freedom you gave the students to look into something they are interested in and is related to the course because we can put what we learn into real-world scenarios. It also allows for critical thinking when we have to find a possible solution." Some groups were more effective at making the connections to the course content than others, which was expected, but the results show that this approach is promising. With refinement and additional guidance and direction, perhaps more students will be able to connect the course material for increased depth of understanding of course concepts.

Students also demonstrated knowledge of the international country, the impact of the disease on that county, and how the situation compares with the US. When asked what they liked about the project, one student responded, "I learned a lot about another country that I never knew previously." Another student whose project was about the disease Ebola said that "I liked the fact that we got to explore Ebola in a more in-depth view as opposed to just viewing on the news; the data was interesting to understand."

Working in groups was one aspect of the project that students indicated they liked. The assignment of roles provided specific responsibilities to each group member which was evident in the collaborative group presentations that, for most projects, showed contributions from each group member in an organized fashion and with fluid transitions between subtopics. In addition, the peer evaluations were helpful to the instructor in assessing each student's contribution to the project.

When asked if they would like to have a similar type of international project such as this as part of other courses, the majority of students responding to the survey indicated that they would. Students' reasons included the opportunity to learn about current events, learn about a new country, and to be able to learn how the course can tie into everyday

life. One student responded, "It would not hurt the course. It is an opportunity to learn about situations that affect other countries around the world. It would help us to have a better world view." Some students also liked the different options as they provided another assessment that helped improve their grades in the course. A smaller group of students indicated that they would not want to have this type of project, one reason being that they thought the project was too time-consuming. Another student did not like having to do the project in an online format that was necessary due to the COVID-19 shutdown in Spring 2020. In future semesters, at the beginning of the project, some time will specifically be devoted to explaining the international aspect of the course and its value to students' education and preparedness for success in the STEM workforce.

After the midterm, the project was introduced in the last half of the course, which provided students at least six weeks to complete it. Unfortunately, time did not permit the collection of students' perceptions and attitudes about the internationalization component in Spring 2019. Therefore, the information provided here is for the Spring 2020 implementation, and no comparison between these two cohorts of students was possible. Also, students were required to work on the project primarily in their groups. The instructor provided no additional guidance unless students sought further clarifications or assistance, which limited the overall experience of the internalization between students and the professor. Also, it became apparent that a few groups procrastinated on their project and did not adequately address the required components. In addressing these issues in the future, the plan is to utilize the course online discussion board for student groups to post regularly to specific prompts that will require them to demonstrate ongoing work on the project leading up to the final presentation date. This will also allow students to reflect on their research findings as they read and respond to others' posts. The instructor will also be able to provide strategic guidance to assist students in critically analyzing the information they have obtained through their research and making connections to the course content.

Conclusion

Like most of the hard sciences, the biochemistry course is a content-driven and content-heavy course that is prerequisite knowledge for further studies

upon graduation. To add another component to the course by internationalizing the course, I needed to determine how to implement this project in a way that ties into the course material so that students' knowledge and application of course concepts could be expanded and/or enforced. The global nature of health and its relevance to biochemistry, the community, and students' career interests provided the impetus to move forward with the implementation, which included an intentional directive to relate the topic to course concepts. Summative assessments in the form of oral and written reports demonstrated that students gained knowledge on their selected topic, the international country, and the global impact. Also, students were able to make connections between classroom content and real-world situations. This approach lowered the barrier and hesitancy of the instructor to utilize class time for an international project. The students gained a global perspective that will help them move forward in their careers. The multidimensional nature of the project, working in groups, and oral and written presentations provided opportunities for students to build on interpersonal communications skills, teamwork, and oral communication skills, which will also be useful. Given the documented benefits to students for course internationalization, it is worth the time for faculty to integrate an international dimension into their courses. For science courses, particularly those that are not applied-science courses, finding ways to link internationalization to course content where possible can provide a viable means to do so.

References

American Council on Education. (1996). Educating Americans for a world in flux: Ten ground rules for internationalizing higher education. *American Council on Education.*

Atweh, B., Barton, A.C., Borba, M.C., Gough N, Keitel, C., Vistro-Yu, C., & Vithal, R. (2007*). Internationalization and Globalization in Mathematics and Science Education.* Springer.

Bond, S.L., Qian, J., & Huang, J. (2003). The role of faculty in internationalizing the undergraduate curriculum and classroom experience. *Canadian Bureau for International Education*.

Clifford, V.A., (2009). Engaging the disciplines in internationalizing the curriculum. *International Journal of Academic Development*. 14:2, 133-143.

Douglas, S.A., & Farley, A.M., Arthur & Lo, G., & Proskurowski, A., & Young, M. (2010). *Internationalization of Computer Science Education*. 411-415. https://dl.acm.org/doi/10.1145/1734263.1734404

Etherington S. J. (2014). But science is international! Finding time and space to encourage intercultural learning in a content-driven physiology unit. *Advances in physiology education*, 38(2), 145–154. https://doi.org/10.1152/advan.00133.2013

Reimers, Fernando. (2014). Bringing global education to the core of the undergraduate curriculum. *Diversity and Democracy*. AACU. 17.

Green, M., & Olson, C. (2003) Internationalizing the Campus: A user's guide. *American Council on Education*

Green, W., & Whitsed, C. (Eds.). (2015). *Critical perspectives on internationalizing the curriculum in disciplines: Reflective narrative accounts from business, education and health.* Sense. https://www.springer.com/gp/book/9789463000857

Leask, B. (2013). *Internationalization of the Curriculum and the Disciplines: Current Perspectives and Directions for the Future*. Journal of Studies in International Education. 17. 99-102. https://journals.sagepub.com/doi/10.1177/1028315313486228

Leask, B. (2014, December 12). *Internationalizing the curriculum and all learning*. University World News. https://bit.ly/3g3nUWc

Osakwe, Nneka Nora and Michael Smithee, (Eds). (2017, Spring). Internationalizing the Curriculum, 6 (2). *International Research and Review.* https://bit.ly/3ar8CK1

Okonkwo, Z., (2017, Spring). Internationalizing the Mathematical Finance Course. *International Research and Review*, 6 (2) 103-119.

Saroyan, A., & Amundsen, C. (eds). (2004). *Rethinking Teaching in Higher Education.* Stylus.

Williams, R. D. & Amy Lee, eds. (2015). *Internationalizing Higher Education: Critical Collaborations across the Curriculum.* Sense.

About the Author

Dr. Louise Wrensford is a Professor of Chemistry at Albany State University and current Director of the Office of Research and Sponsored Programs. She received her Bachelor's degree in Chemistry with Physics from the University of the Virgin Islands and her doctorate in Chemistry

from Brown University in Providence, Rhode Island. Dr. Wrensford has over thirty years of experience in higher education and has taught chemistry courses at the University of the Virgin Islands and Albany State University. She also served previously as Chair of the Department of Natural Sciences and Dean of the Graduate School at Albany State University.

Appendix A
A list of the topics selected by students in each cohort

Spring 2019 Topics	
Topic	**Country Selected**
Air Pollution	China, Qatar
Climate Change	Japan
Famine	Sudan
Herpes	France
HIV/AIDS	South Africa, Zimbabwe
Hunger and Nutrition	Haiti, Nigeria
Herpes	France
Maternal Mortality	Nigeria, Sierra Leone
Maternal and Child Health	Nigeria
Oil Spills/Pollution	Nigeria
Water Quality and Pollution	India
Spring 2020 Topics- Infectious Diseases	
Topic	**Country Selected**
Cholera	India
COVID-19	China, South Korea, Italy
Ebola	Africa (Multiple Countries)
H1N1	South Africa
HIV/AIDS	Kenya
Zika	Mexico

Appendix B
Project Assessment
Individual and Group Presentation Rubric

Category/Weight	4	3	2	1
Content/ Effectiveness (2x)	Content well researched and presented succinctly, presentation well prepared. All required criteria for the project were met. Includes enough material to gain an understanding. All references are provided in correct format (APA).	Content is well prepared for the most part; research and preparation are evident. Includes most material needed to gain an understanding of the topic presented. Most references are provided in correct format (APA).	Content shows problems with research and succinct preparation. More preparation is necessary. Missing more than 2 key elements needed to gain an understanding of the topic presented. Some references provided, most in incorrect format.	Presentation of content is disjointed and incoherent; little evidence of preparation missing several key elements needed to gain an understanding of the topic. No references provided.
Organization	Audience can follow the presentation because information is presented in logical sequence.	Audience can follow most of the presentation because information is presented in logical sequence.	Audience has difficulty following presentation because group jumps around.	Audience cannot understand presentation because there is no sequence of information.
Mechanics	No more than 1 spelling error and/or grammatical errors	No more than 2 spelling errors and/or grammatical errors	3 spelling errors and/or grammatical errors	4 or more spelling errors and/or grammatical errors

Appendix B

continued

Category/Weight	4	3	2	1
Subject Knowledge (2x)	All facts are correct. Student demonstrates comprehensive knowledge and answers all questions correctly with explanations and elaboration. Notes are not used, and/or slides were not read.	Most facts are correct, and the student is at ease with the information and answer most questions correctly with explanations and elaboration. Notes are used infrequently. Slides were not read.	Many facts are incorrect, OR student has a limited understanding of the subject and has difficulty answering questions. Notes and/or slides are read.	Most facts are incorrect, and the student does not appear to understand the subject and cannot answer questions. Notes and/or slides are read.
Quality of Activity	The activity is engaging for the entire class and aligns with the concepts presented.	The activity is engaging for most of the class and aligns with the concepts presented.	The activity is engaging for only a few students and aligns with the concepts presented.	The activity is not engaging and/or is not in line with the concepts presented.
Oral Presentation Style	Presenter is confident, speaks very well and clearly, and maintains excellent engagement with the audience. Presenter stands or sits up straight and establishes eye contact with the audience.	Presenter is confident, speaks well, and is somewhat engaged with the audience. Presenter stands or sits up straight but lacks eye contact with the audience.	Presenter lacks confidence, voice is low and unclear, and has difficulty engaging the audience. Presenter appears too casual and establishes little eye contact with the audience.	Presenter lacks confidence, does not speak clearly, and is not engaged with the audience. Presenter appears too casual and establishes no eye contact.

Data Graphics (tables, charts, graphs, etc.)	Graphics were included, clearly related to the presented material, and **explained.**	Graphics were somewhat related to the material and were explained, OR graphics are clearly related but **were not explained.**	Graphics were somewhat related to the material but **were not explained.**	Graphics were not related to the material and **were not explained, or** graphics were not included.
Cooperation/ Teamwork	Presenters worked as part of a team, providing effective transitions to next/previous speakers or making references to previous/next speakers.	Evidence of teamwork; transitions made to previous/next speaker or topics.	Some evidence of teamwork; some transitions made to next/previous speaker or topics.	No evidence of teamwork; no transition made to next/previous speakers or topics.

Appendix C
Written Report Rubric

Category/ Weight	5 Highly Proficient	4 Proficient	3 Acceptable	2 Needs Improve-ment	1 Unacceptable
Content (5X)	Writing meets **all** assignment content requirements *(Topic and the international country).*	Writing meets **most** assignment content requirements *(Topic and the international country).*	Writing meets **minimum** assignment content requirements. *(Topic and the international country).*	Writing meets **some/few** assignment content requirements. *(Topic and the international country).*	Writing **does not** meet assignment content requirements. *(Topic and the international country).*

Clarity/Purpose (5X)	Writing is clear and appropriate for the purpose of the assignment. **All** evidence and examples are effective, specific, and relevant.	Writing is **generally** clear and appropriate for the purpose of the assignment — with some exceptions. Evidence and examples are **generally** effective, specific, and relevant— with some exceptions.	Writing is **adequate** in terms of clarity and appropriateness for the purpose of the assignment. Evidence and examples meet **basic** requirements for being effective, specific, and relevant.	Writing may be unclear and/or inappropriate for the purpose of the assignment. Evidence and examples may require further development to be adequately effective, specific, and relevant.	·Writing is unclear and inappropriate for the purpose of the assignment. Evidence and examples are **not** effective, specific, and/or relevant.

Appendix C (Continued)

	5	4	3	2	1
Category/ Weight	**Highly Proficient**	**Proficient**	**Acceptable**	**Needs Improvement**	**Unacceptable**
Structure/ Development (4X)	Ideas are coherently and logically organized with well-developed paragraphs and effective transitions.	Organization of ideas is **generally** coherent and logical. In addition, **most** paragraphs are well-developed and use effective transitions.	Organization of ideas meets the **minimum** requirement for being coherent and logical. **Some** paragraphs may be well-developed and use effective transitions, while others do not.	Organization of ideas does not meet the **minimum** requirement for coherence and logic. Paragraphs lack development and/or fail to employ transitions effectively.	Ideas are **incoherent** and **illogically** organized. Paragraphs are **undeveloped** and need transitions.

Language and Mechanics (4X)	**All** sentences are well-written with varied sentence structure and virtually free of errors in grammar, punctuation, and spelling.	**Most** sentences are well written with varied sentence structure and virtually free of errors in grammar, punctuation, and spelling.	Language is accessible to readers; however, many sentences may lack variation in structure. **Minimally** acceptable number of errors in grammar, punctuation, and/or spelling.	**Some/few** sentences are well-written with **little** variance in structure and/or **numerous errors** in grammar, punctuation, and/or spelling.	Language may be inaccessible to readers. Sentences are incomplete and/or contain grammar, punctuation, and/or spelling errors.
Documentation of Sources (2X)	All sources are **credible** and formatted following standard format (APA).	**Most** sources are **credible** and documented following a standard format. (APA)	Sources meet the minimum requirements for **credibility** and documentation following a standard format (APA).	Sources do not meet the minimum requirements for **credibility** and documentation following a standard format (APA).	**Insufficient** sources and/or **insufficient** quality and documentation. Standard formats **not** followed.