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# Open Educational Resources in Science Education: A Case Study from an American University

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***Abstract***

*The high cost of textbooks and educational resources presents a significant barrier to student success, particularly in science education, where course materials can be prohibitively expensive. Open Educational Resources (OER) provides a promising solution by offering free and accessible learning materials. This paper presents a case study on the implementation of OER in several science courses at Georgia Southern University, USA. It highlights the state and institutional efforts that promoted and supported OER initiatives, discusses the specific courses that created and adopted OER and their impact on student outcomes. The paper outlines some important considerations in how to make OER initiatives sustainable.*

***Keywords:*** *OER; science education; affordability, library support*

## 1. Introduction

The need for affordable learning resources is well established, as are the benefits of leveraging open resources in the classroom. In 2023, Smith et al. published a profound work detailing the connection between affordable course materials and student pedagogical enhancement. Additionally, OER has been shown to mitigate the financial burden associated with acquiring textbooks among first-generation students (LeMire et al., 2024) and facilitate students' financial well-being (Lo et al., 2023). Cho and Permzadian (2024) further highlighted the academic benefits of using OER, such as higher course completion rates and increased accessibility to higher education. A brief review of the literature demonstrates the revolutionary potential of OERs in the classroom and beyond. From making higher education more affordable to increasing student success rates and grades, OER is a powerful force whose benefits extend into the workforce. If the goal of higher education is to prepare students to be critical thinkers in the workforce, then OER has the potential to diversify the workforce. This is crucial for all professions, but the

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sciences especially benefit from OER's advantages. According to Vichare et al. (2024), "Diversity in the health care workforce is essential for addressing racial health inequities. Policies need to address problems in pathways to medical education, including failures to recruit, nurture, and retain URiM [underrepresented in medicine] students" (p. 383). OER directly addresses that need. This proposal, then, is situated within two scholarly paradigms: OER and sciences. The authors hope to bridge the discourse and demonstrate how OER can be implemented successfully in science education.

## 2. Strategies for promoting and sustaining OER use in higher education

### 2.1. Institutional effort

The Open Educational Resources Team at Georgia Southern University is a university-level-committee dedicated to promoting and supporting OER and Open Educational Practices (OEP) within the institution. The committee plays a key role in advocating for OER adoption and serving as a resource for faculty and staff engaging in OER initiatives. The committee is formed of both faculty and staff from diverse academic backgrounds and represents a grassroots effort, indicative of faculty leadership in the field. The goals of the committee include:

- Increasing awareness and institutional support for OER through events such as OpenEd Week and Open Access Week.
- Monitoring OER adoption and usage in university courses by gathering data from Affordable Learning Georgia and faculty reports.
- Supporting faculty in recognizing OER's role in tenure and promotion processes
- Encouraging faculty research initiatives related to OER.

Committee members actively contribute to achieving semester-specific goals through collaborative efforts between meetings. As a team, members presented on-campus and at national and international conferences, developed a rubric identifying how OER can contribute to teaching, research and service areas and strengthened institutional commitment to affordable and inclusive education while supporting student success and faculty development.

### 2.2. State effort

Affordable Learning Georgia (ALG) started as a pilot initiative in the state of Georgia, USA, to reduce the cost of course materials for students and enhance the discovery of library materials through GALILEO (GeorgiA LIbrary LEarning Online). This is a University System of Georgia initiative that provides subscription-based access – via public schools, academic libraries, and public libraries – to a wide variety of digital resources, which would otherwise be inaccessible to the general public. ALG aims to promote the use of no-cost and low-cost educational resources in place of commercial textbooks and mirrors the University System of Georgia's

strategic plan to address affordability. To achieve these goals, ALG offers grants that support faculty, librarians, instructional designers, and other staff in transitioning to more affordable course materials. These grants help expand the adoption, adaptation, and creation of OER, encourage the use of free materials available through the libraries, and ultimately contribute to student retention, progression, and graduation by lowering material costs (Affordable Learning Georgia, n.d.). ALG offers two main grants for OER adoption.

- Transformation Grants: These grants assist individual instructors, teaching teams, or entire departments in replacing commercial textbooks with no-cost or low-cost learning resources. By facilitating the transition to alternative educational materials, Transformation Grants help improve affordability without compromising educational quality.
- Continuous Improvement Grants: Focused on the sustainability and enhancement of existing OER, these grants support projects that involve significant revisions, the development of supplementary resources, or the replacement of current OER with improved versions. This category ensures that open educational materials remain relevant, high-quality, and effective for student learning.

Several years ago, ALG added a third type, a research grant, whose main goal is to research the impact of OER. By providing these grant opportunities, ALG fosters the growth of affordable learning initiatives across institutions, supporting faculty and staff in their efforts to create a more inclusive and cost-effective academic environment. Since its inception in 2014-2015, ALG have saved students more than $195 million, affected more than 1.4 million students and funded projects at all 26 USG institutions (800 applications received and over 600 projects funded). In the last ten years, our institution was awarded 57 grants for a total of $766,956. These grants led to total savings of over $8mln and benefited over 52,000 students (Affordable Learning Georgia, n.d.)

## 3. OER in science classes

We discuss two examples of funded ALG projects at our institution that focused on two science classes.

### 3.1. Forensic Chemistry

#### *3.1.1. Course Context*

The Forensic Chemistry course is an undergraduate specialized course that is offered only in the face-to-face format, once per academic year. The prerequisites are a full year of general chemistry, organic chemistry, and analytical chemistry courses, one of which already uses OER materials (organic chemistry). The course enrolls 31 students (undergraduate and graduate level)

on two separate campuses and for that reason was offered on a site-synchronous platform. In addition, the course is set to align with the techniques of a Course-based Undergraduate Research Experiences (CURE) learning environment. Students were able to describe and define the major topics in forensic science such as demonstrating lab safety, processing a crime scene, collecting, and analyzing evidence, critique the use of forensic evidence in historical crime scenes and finally drawing conclusions based on collected data and key findings.

### *3.1.2. Goals of the Project*

The goal of our project was to develop online OER material for the course and provide supplementary materials such as case studies, investigative approaches, technique videos, etc. that align with the course materials, and departmental and institutional needs. All developed resources were shared with the department, as well as on the OER commons platform.

### *3.1.3. Process*

The project team consisted of three faculty members from two departments, one of which was our assessment lead, three professional staff (libraries and teaching center) and two undergraduate students. One more faculty member from the chemistry department was involved in the content creation of the course to identify, align, prepare, adapt, and assess videos for the Forensic Chemistry course. All the material for the course material was generated in the department. Some material was also adopted from libretexts or Merlot websites. The materials were linked with the library guide (see Figure 1) as modules (15 weeks) during the semester on the GS library webpage and on various OER platforms. The libguide was also shared on USG – Affordable Learning Georgia website under the CC BY 4.0 license.

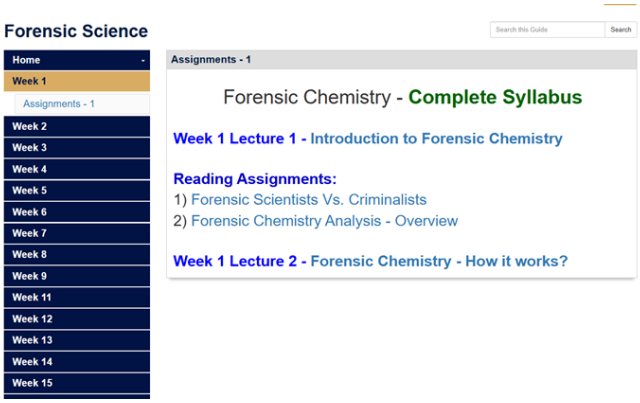


*Fig. 1. Library guide for the forensic chemistry course (https://georgiasouthern.libguides.com/forensicchemistry)*

*3.1.4. Results*

The forensic chemistry course was offered to both undergraduate and graduate students through hands-on experience in a lab (a lab component was part of the course). All students had to engage in a forensic chemistry project and presented their findings at the annual Georgia Southern University Research Symposium (2022). The topics ranged from studying lab grade caffeine's effect on DNA preservation to characterizing fingernail surface morphology exposed to common household cleaning agents using Scanning Electron Microscopy. Almost every student enrolled in the course mentioned that the research component and the ability to present were the portion of the course they enjoyed the most.

*3.1.5. Strengths of the project*

The project's primary achievement was the development and presentation of a CURE course using newly created OER materials. This course covers fundamental concepts in forensic chemistry, including physical evidence examination, crime scene processing, and the application of chemistry principles to evidence analysis, toxicology, and microscopy. It also benefits other forensic science disciplines at our university, such as Forensic Anthropology, Forensic Biology, and Introduction to Forensic Nursing and the Law. Additionally, the course has supported the planning of a separate Center for Forensic Science. Providing free access to course materials enhanced student success, as reflected in improved retention, progression, and graduation rates.

**3.2. Human Anatomy and Physiology course**

*3.2.1. Course Context*

The Human Anatomy and Physiology (HAP) lab course is a two-semester undergraduate requirement for health majors, including nursing, exercise science, biology, nutrition, athletic training, and public health. The course is offered in both face-to-face and online formats, enrolling 30 students per section. It introduces and reinforces topics from lecture classes, covering anatomical structures through models and human cadavers, as well as physiological concepts through lab activities. HAPI focuses on cells, tissues, the integumentary, skeletal, muscular, and nervous systems, while HAPII covers the circulatory, endocrine, digestive, urinary, immune, and reproductive systems.

*3.2.2.Goals of the Project*

The goal of our project was to redesign the HAP laboratory course at our institution and create no-cost learning resources for all students. The project aimed to improve curricular alignment between lecture and lab courses, standardize the course across sections normally taught by teaching assistants, and provide students with freely accessible resources by eliminating the need for a traditional textbook. The initiative also sought to enhance student success, particularly

in HAPI, where failure rates were high, and to offer materials that could be used beyond the HAP course for review in advanced health classes.

### *3.2.3. Process*

The project team consisted of five faculty members from one department (Health Sciences), two professional staff (libraries and teaching center) and two undergraduate students. Faculty members teaching advanced kinesiology courses were involved with the purposes to emphasize the course's relevance beyond the introductory level. The project adopted OpenStax Human Anatomy and Physiology as the primary textbook (OpenStax, n.d) and developed weekly modules that included structured learning outcomes, ancillary materials and assignments. This approach reduced cognitive overload by structuring content into manageable weekly segments. The newly designed modules were integrated into a library guide (see Figure 2) that was made publicly available under a Creative Commons license (CC BY-NC-ND) on the institution's library page. For ancillary materials, we created 31 videos of lab models, and adopted a low-cost digital platform to add virtual physiology labs into the course curriculum. The videos were uploaded to YouTube on the course channel, meeting accessibility standards and ensuring students had access to resources outside regular class time.

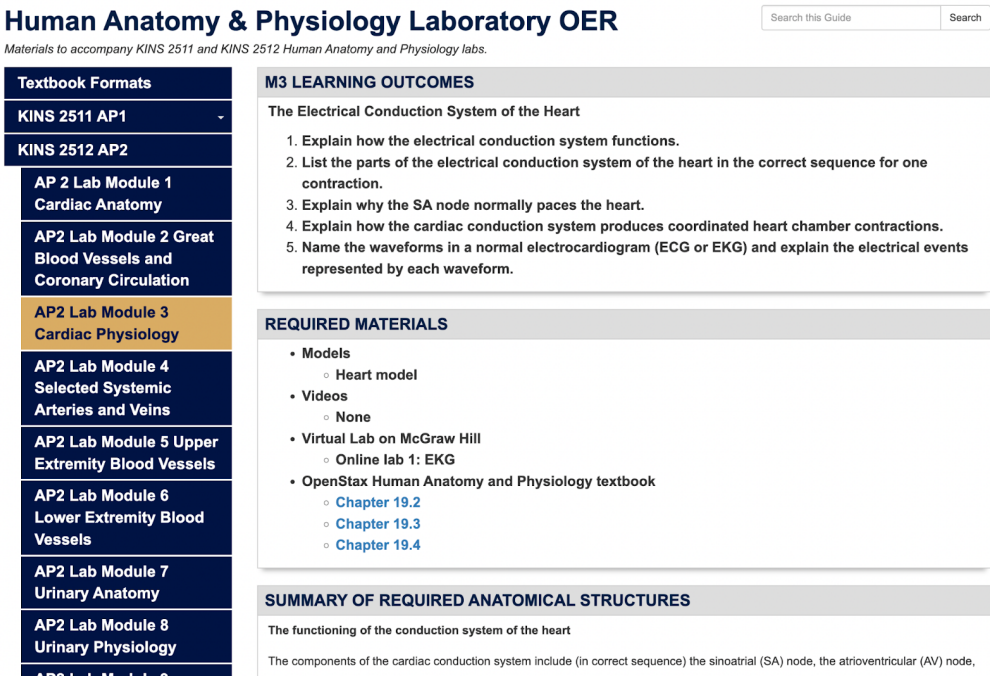


*Fig. 2. Library guide for the HAP course*

*3.2.4. Results*

The project impacted 2,700 HAP students annually, saving them at least $53,000 per year. A survey conducted in Spring 2022 received 528 responses (response rate of 74%) from 710 students, with the majority expressing positive feedback. Between 73-78% of students found the search capabilities better than traditional textbooks, 80-84% rated the visuals as high-quality, and 72-74% found the materials helpful for studying. Additionally, 66-75% reported that the OER materials helped them retain information, while 68-76% felt better prepared for class activities. The standardized course format improved consistency across sections and instructors. During the first semester of implementation, the HAP library guide became the most viewed guide at our institution with 28,000 views.

*3.2.5. Strengths of the Project*

A key strength of the project was its pedagogical transformation. The shift to a modular structure improved organization and enhanced alignment between lab and lecture components. The integration of videos, virtual labs, and freely accessible materials ensured access to high-quality educational resources. The collaborative approach, involving faculty, library professionals, and student assistants, contributed to the project's success. By scaling the initiative department-wide, the project not only improved the student learning experience but also set a precedent for future OER adoption in other courses.

## 4. Conclusion

The successful adoption of OER in our institution was achieved through a three-pronged approach that incorporated both state-level and institutional support. First and foremost, it has been largely driven by the dedication and passion of our instructors. Their commitment to improving student learning experiences and reducing costs through OER adoption has yielded significant benefits to students. Secondly, at the state level, initiatives such as ALG played a crucial role in providing grants that facilitated OER adoption and development. However, for long-term sustainability, higher education institutions must prioritize internal funding mechanisms that can ensure the continuous improvement and expansion of OER initiatives. Lastly, mentoring played a vital role in the successful implementation of OER at the institutional level. Faculty members often face time constraints and workload challenges that limit their ability to engage in OER development and implementation. Librarians, instructional designers, and OER committees can provide invaluable assistance in curating and developing OER materials, navigating copyright and licensing issues and ensuring compliance with open-access guidelines. Institutions should consider investing in supporting on-campus OER mentoring groups to facilitate smoother adoption and long-term sustainability.

A key challenge in OER implementation is ensuring the consistent updating and maintenance of materials. One effective solution is department-wide OER adoptions, which promote uniformity in instructional resources and facilitate collective responsibility for updates. This approach also fosters a collaborative environment in which faculty members share best practices and contribute to the ongoing refinement of OER materials.

The adoption of OER has resulted in pedagogical improvements within our courses. Faculty members who have transitioned to OER reported increased flexibility in tailoring course materials to better align with learning objectives and student needs and encouraged more interactive and student-centered teaching approaches. These benefits extend beyond cost savings for students. While much of the existing research on OER focuses on its benefits for students, there is a critical need to study its impact on instructors and teaching practices. We believe that faculty members who dedicate time and effort to creating, curating, and maintaining OER should receive institutional recognition for their contributions. Higher education institutions should consider integrating OER-related activities into promotion and tenure guidelines, recognizing them as valuable scholarly and pedagogical contributions. Establishing clear policies that reward faculty engagement with OER will encourage broader participation and sustained commitment to open education initiatives.

The successful implementation of OER in higher education requires a multifaceted approach that includes financial support, mentorship, professional staff support, and institutional recognition. While passionate educators are at the heart of OER initiatives, their efforts must be complemented by robust support systems that ensure sustainability and continuous improvement. If adopting these recommendations, higher education institutions can foster an environment in which OER flourishes, ultimately benefiting both faculty and students.

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