Publishing Teaching Tips Articles

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Opportunities for BME/BIOE Education Scholarly Advancement

	Peer Review	Format/Costs	Timeline	Information Sharing	Strengths
Biomedical Engineering Education Springer BMES	✓	Full Journal Paper	Continuous (free)	Special Issues (DEI, Experiential Learning)	Special Issues, rigorous review, teaching tips
ASEE BED Division ASEE American Society for Engineering Education	✓	Full Conference Paper (copyrighted)	Annual ASEE Meeting (June) Membership ~ $89 Conf Reg~ $725 (free reg for students w/advisor; $35 w/o)	Bi-weekly Newsletter	Curriculum sharing Specific Networking, peer-reviewed and published online
BMES BMES	✓	Abstract	Annual BMES Meeting (October) Membership ~ $200 Conf Reg~ $500	ABET Webinars	Networking, Information sharing of educational projects, ABET Information
Biomedical Engineering Educators Community BEEC		Virtual Online	Continuous (free)	Monthly Share and learns	Networking, feedback and idea sharing

Biomedical Engineering Education

Biomedical Engineering Education publishes **five article** types. Articles should have wide appeal to address issues related to teaching and learning in bioengineering, biomedical engineering, and allied fields. Research questions, innovations, and teaching practices should be supported by prior educational research, as documented in the literature.

- Research
- Innovation
- Teaching Tips
- Perspectives
- Reviewers

https://www.springer.com/journal/43683/submission-guidelines

Teaching Tips

Teaching Tips are **short tutorials** that support faculty development by reviewing pedagogical frameworks and illustrating how to implement related **evidence-based practices** in the BME classroom, curriculum, or extra-curricular program. Teaching Tips articles provide examples of best practices for both new and established instructors learning how to design BME student experiences rooted in pedagogical research.

Teaching Tips articles should:

- Clearly describe the challenge associated with teaching and learning in BME education;
- Describe a novel implementation or teaching practice that addresses the challenge and benefits students;
- Provide a clear and compelling rationale for key implementation choices;
- Include evidence and reflection to assess the success of the initiative;
- Connect the implementation of the novel initiative to evidence-based practices and/or student-learning theory, with relevant supporting literature;
- Describe the novel teaching or learning implementation in a way that readers could apply the idea to their class or situation.

Teaching Tips (1,500-2,000 words)

- **Challenge Statement** – Clearly describe the specific challenge associated with teaching and learning. Example challenges include teaching design or lab courses in a hybrid or non-traditional format, fostering teamwork during course or lab projects, supporting student motivation, and ensuring accessibility and equity in courses and programs.
- **Novel Initiative** – What did you do? Why was this initiative done? Describe the novel implementation or initiative in a manner that allows readers to adapt your approach to benefit students in their courses or programs. Include specifics on hardware or software choices, if applicable. Discuss the rationale for your choices in implementation.
- **Reflection** – What went well? What did not go well? What will you change or improve in future implementations? Connect your implementation to evidence-based practices and student learning theory, and consider what evidence you have collected or will collect to assess the success of your initiative.
- **References** – Citations should connect your implementation to evidence-based best practices and student learning theory with a target of five.

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Teaching Tips

Development and Implementation of a Biometrics Device Design Project in an Introductory BME Course to Support Student Wellness

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BMES BIOMEDICAL ENGINEERING SOCIETY

Teaching Tips - Special Issue (COVID)

Development and Implementation of a Virtual Cell Culture Lab Practical for an Introductory BME Lab Course

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BMES BIOMEDICAL ENGINEERING SOCIETY

Teaching Tips

LabMate: Development and Implementation of a Novel Livestreaming Platform for Hybrid or Remote Laboratory Course Delivery

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BMES BIOMEDICAL ENGINEERING SOCIETY

Teaching Tips - Special Issue (COVID)

Reconceptualizing BME Authentic Learning in the Age of COVID-19 and Remote Learning

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Challenge Statement

Students in our department report longstanding challenges with their identity as biomedical engineers, and their perceptions of BME education and future career opportunities

- BME students often do not understand what BME is and have difficulty seeing how other engineering disciplines integrate in BME;
- BME students want early career guidance;
- the current BME curriculum is not traditionally adaptive to the changing needs of BME-in-practice; and,
- BME students want more diverse, hands-on experiences specific to BME early in their academic careers.

Objectives:

- broadening students' exposure to the scope of biomedical engineering beyond biotechnology to help them define the evolving discipline of biomedical engineering as they plan their careers;
- demonstrating the role of the engineering design process in healthcare; and
- assessing the hybrid learning model in which extensive in-person experimentation is limited.

Novel Initiative

TABLE 1. Overview of course.

		Knowledge	Skills	Semester-long project
Semester	**Phase I: Foundational Understanding**			Work in teams to use course developed skills to develop a healthcare solution for clinical sponsors
	What is engineering design?	Engineering design process: understand, explore, and implement *Contact Tracing Solutions*	Front-end design skills (interviewing, stakeholder maps, ecosystems)	
	What is COVID-19?	Epidemiology, symptoms, and treatment of COVID-19	Reading and interpreting scientific papers	
	Phase II: COVID-19 Case Studies			
	Medical diagnostics	Diagnosing COVID 19	Gene expression testing (e.g., biomarker selection and detection, specificity and sensitivity)	
	Patient monitoring	Oxygen saturation and COVID-19	Microprocessors and sensors (*Arduinos*)	
	Medical devices	PPEs and infection control	Computer aided design (*Fusion360*)	

Novelty

1. Explicit application of the authentic learning environment framework to BME course design;
2. Creation of a course focused on the role BMEs play in healthcare in the context of COVID-19;
3. Scaffolding the design course to reinforce the role of engineering design and problem solving in BME;
4. The integration of technical communication skill development in the context of COVID-19; and,
5. The shift to ensuring remote design hands-on learning opportunities and deliberate development of specific knowledge and skills.

Framework: Authentic Learning

Elements

1. Authentic context
2. Authentic tasks
3. Access to experts
4. Multiple roles and perspectives
5. Collaborative construction of knowledge
6. Reflection
7. Articulation
8. Coaching and scaffolding
9. Authentic assessment

Herrington J, Reeves TC, Oliver R. Authentic learning environments. In: Spector JM, Merrill MD, Len J, Bishop MJ, editors. Handbook of research on educational communications and technology. New York: Routledge; 2004. p. 401–13.

TABLE 2. Elements of practice as related to nine aspects of an authentic learning environment.

Elements of an Authentic Learning Environment	Elements in Practice
Authentic context	The entire class will focus on COVID-19-motivated problems
Authentic tasks	The course will focus on three different case studies and a semester long team project. The case students will challenge students to develop skills in computer aided design, microprocessors and molecular diagnostics such that these skills can be applied to their semester long project. For each case, students will be tasked with a COVID specific design problem as they develop their technical skill: (1) CAD design of a medical instruments, (2) construction of a pulse oximeter, and (3) gene expression for medical diagnostics. The semester long project will require the development of a prototype and professional communications expected in industry (e.g., memorandums and executive summaries)
Access to expert performances and modeling of processes	BME design alumni and clinical sponsors will be consultants to the teams, offering feedback and just in time consulting as they explore their solution space. Students will be guided in how to identify appropriate alumni to approach, establish contact, and engage in an online meeting
Multiple roles and perspectives	The course is team taught, including two BME faculty with expertise in different areas, and two technical communications faculty, one of whom has a doctorate in pharmacy
Collaborative construction of knowledge	Students will work in teams to develop a healthcare solution for a clinical sponsor. Students will have at least 3 online meetings with their clinical sponsors and use their front-end design tools (interviewing, stakeholder maps, *etc.*) to understand and explore the problem and get feedback for iteration on their proposed solutions
Reflection	Reflective exercises will be integrated into each case assignment to not only reflect on the specific case but compare and contrast the design process across cases. While each case study will be delivered asynchronously, providing students access flexibility, lectures will be paired with engagement assignments that ask students to reflect on questions posed to the students throughout the asynchronous lecture. Instructors will be able to use student responses for identifying muddiest points and just in time teaching[3]
Articulation	Students will have individual assignments for each case study where they will be required to articulate their findings and reflections. Additionally, students will be responsible for at least one laboratory report, two oral presentations, a progress report, and a final report for their team clinical project
Coaching and scaffolding	The entire course is scaffolded to reinforce the importance of the design process in BME. At the beginning of the course, students will be introduced to the design process with respect to contact tracing. The following three cases will each be discussed with respect to the design process
Authentic assessment	Technical skills assessment will be directly associated with the successful solution of each task related to each case using CAD, microprocessors, and gene expression. Students will also be assessed for the successful development of a healthcare solution for their clinical sponsor
	Communication skills will be assessed through written reports (progress and final) and oral presentations. Teamwork will be assessed by the two team peer evaluations and the final team assessment report

Reflection

(1) How do students' motivation for biomedical engineering change with course enrollment;

Glynn et al.'s Science Motivation Questionnaire (intrinsic motivation, self-determination, self-efficacy, career motivation, and grade motivation)

(2) How do student's understanding of biomedical engineering in practice change with course enrollment?

Concept maps and identity surveys (Peters and Ramo et al.)

1. *Glynn SM, Brickman P, Armstrong N, Taasoobshirazi G. Science motivation questionnaire II: validation with science majors and nonscience majors. J Res Sci Teach. 2011;48(10):1159–76.*
2. *Peters A-K. Learning computing at university: participation and identity. Digital comprehensive summaries of Uppsala Dissertations from the Faculty of Science and Technology, 2017.*
3. *Ramo NL, Huang-Saad A, Belmont B. What is biomedical engineering? Insights from qualitative analysis of definitions written by undergraduate students. In: ASEE annual conference and exposition, Tampa, Florida, 2019.*

Thanks

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