Res Dev Med Educ, 2024, 13, 18
doi: 10.34172/rdme.33264
https://rdme.tbzmed.ac.ir

Short Communication

Bridging the gap in biomedical engineering education by integrating local context

Stephanie Quon[1*], **Sarah Low**[2]

[1]Faculty of Medicine, University of British Columbia, Vancouver, British Columbia, Canada
[2]Faculty of Science, University of British Columbia, Vancouver, British Columbia, Canada

Article info
Article History:
Received: October 22, 2024
Accepted: November 2, 2024
epublished: November 25, 2024

Keywords:
Education, Biomedical engineering, Engineering, Integration, Local

Abstract
Background: Biomedical engineering combines engineering principles and life sciences to solve medical and biological challenges. Despite its potential, a gap exists in biomedical engineering education between the fields of health and engineering, often resulting in limited interdisciplinary understanding and collaboration.
Methods: This paper explores current challenges in biomedical engineering education and reviews approaches to integrate health and engineering through a local-context framework. This framework emphasizes situating biomedical engineering education within the specific regulatory, cultural, and clinical environments of the students' region.
Results: Findings indicate that integrating local context into biomedical engineering curricula enables students to better understand the practical intersection between medicine and engineering in their communities. This integration enhances students' ability to design healthcare solutions that are culturally relevant, sustainable, and better aligned with local regulatory and clinical standards.
Conclusion: Addressing the health-engineering gap in biomedical engineering education by incorporating local context fosters the development of effective healthcare solutions, instills social responsibility, and promotes cross-disciplinary collaboration.

Viewpoint

Biomedical engineering, at its core, involves an understanding of living systems and applications of engineering sciences and innovation to advance the development of processes, systems, devices, and research that can advance health systems for all.[1] Many challenges exist in undergraduate biomedical engineering education, including providing adequate training in biology and engineering in a bachelor's degree program, relating practices of healthcare, engineering, and business, and addressing complexities of the regulatory environments and ethical considerations within biomedical engineering[1]. In addition to the breadth of education biomedical engineering requires[2] and the need to respond to ongoing changes in market demands,[3] designing a well-rounded undergraduate biomedical engineering curriculum can be challenging.

In 1974, the National Academy of Engineering reported a technology gap between engineering and medicine.[4] The interdisciplinary nature of biomedical engineering can make it difficult for students to gain expertise in all relevant subjects. This gap can lead to a lack of understanding and collaboration between health and engineering professionals, limiting the development and implementation of effective biomedical solutions, and ultimately limiting the ability of biomedical engineering to address critical health issues. These gaps between skill sets in engineering and healthcare are well-known, and given the constantly evolving nature of biomedical engineering[1] and how biomedical engineering plays a vital role in improving healthcare delivery and quality of life for individuals, educational approaches are needed to help bridge this gap. One possible approach is to focus on how solutions can be developed to be tailored to the specific needs and contexts of the local communities they are intended to serve: the integration of local context.

Integration of local context means that education is specifically tailored to the environment students receive instruction in, where their learning is based in the regulatory environment of the local country and relevant authorities, is situated in relation to relevant health and industry challenges currently being experienced, and is connected to local health authorities and health professionals. Together, this would help biomedical engineering students develop a skill set focused explicitly on the local context, including local needs of

***Corresponding author:** Stephanie Quon, Email: quons@student.ubc.ca

the community and healthcare system, relevant policy and standards, and culture within the community itself. Acquiring this specialized competence in the local context can help define the skills and knowledge needed to succeed as a biomedical engineer.[5]

One of the key benefits of integrating local context into biomedical engineering education is that it allows students to develop a deeper understanding of the unique challenges and opportunities faced by different communities. This can help them design solutions that are more effective and sustainable in the long term. For example, a biomedical engineer who has a thorough understanding of the cultural, economic, and political context of a particular community is more likely to design a solution that meets the needs of that community and is more likely to be accepted and adopted by its members. In addition, integrating local context into biomedical engineering education can also help students develop a sense of social responsibility and a commitment to improving the health and well-being of their communities. By learning about the specific health needs and challenges faced by different communities, students can become more motivated to use their skills and knowledge to make a positive impact on the world.[6]

To implement this approach, it may be helpful to encourage more collaboration between local health and engineering professionals through initiatives such as cross-disciplinary research projects and interdisciplinary conferences and workshops, including new approaches such as pitch competitions, multidisciplinary design teams, and watching videos of clinical practice.[7] The best way to learn is to do,[8] and by fostering a culture of collaboration and communication, it may be possible to better integrate the knowledge and skills of these two groups and develop more effective solutions to health-related problems.

Partnerships and collaborations between local medical and engineering schools can provide opportunities for students to gain exposure to both fields and work on projects that require a combination of medical and engineering expertise. Applications of these models have proved to be successful in helping biomedical engineering students gain hands-on experience, develop partnerships, and develop a greater understanding of barriers and needs.[9] This is effective because biomedical engineering students' ability to make decisions about how to innovate on clinical challenges is improved by a foundation in the fundamental principles of medical intervention paired with exposure to local clinical environments.[9]

A factor that contributes to the gap between health and engineering is the difference in approaches and mindsets between health and engineering professionals. Health professionals tend to focus on the biological and medical aspects of a problem, while engineering professionals focus on the technical and design aspects. This can lead to a lack of understanding and communication between the two groups, making it difficult for them to work together effectively. Therefore, opportunities to work collaboratively in a local environment and context can support student learning[1] and opportunities for mutual exchange of experience to bridge the gap between practical experience and ways of thinking and solving problems,[5] with the key part being interdisciplinary interaction to build skills to solve real-life problems.[10]

Additionally, there could be a greater focus on local experiential learning in biomedical engineering education.[11] This could include opportunities for students to work on real-world problems in healthcare settings, where they can apply their engineering knowledge and skills to address complex health challenges. This would help to bridge the gap between theory and practice, and provide students with valuable hands-on experience in the field.[7]

Other methods to include local context may be the creation and implementation of alumni mentoring programs,[12] innovative methods such as virtual reality[13] and escape rooms,[14] activities focused on developing relationships and building shared understanding with localized stakeholders such as industries and healthcare institutions,[10] and authentic experiences that allow for freedom to ask questions, devise research questions, and contribute to research.[8] These approaches can lead to high levels of satisfaction, teamwork, and engagement[14] through approaches that foster collaboration, active learning, communication, and leadership.[5]

In conclusion, integrating local context into biomedical engineering education is crucial for the development of effective and sustainable healthcare solutions. It helps students to develop a deeper understanding of the unique challenges and opportunities faced by different communities, fosters a sense of social responsibility, and promotes better collaboration between engineers and the communities they serve. Addressing the gaps between health and engineering in biomedical engineering undergraduate education is essential for the development of effective solutions to health-related problems. By promoting interdisciplinary education and experiential learning, we can prepare the next generation of biomedical engineers to tackle the challenges of the 21st century.

Stephanie Quon, Sarah Low

Authors' Contribution

Conceptualization: Stephanie Quon, Sarah Low.
Data curation: Stephanie Quon, Sarah Low.
Investigation: Stephanie Quon, Sarah Low.
Methodology: Stephanie Quon, Sarah Low.
Project administration: Stephanie Quon.
Resources: Stephanie Quon.
Supervision: Stephanie Quon.
Writing–original draft: Stephanie Quon, Sarah Low.
Writing–review & editing: Stephanie Quon, Sarah Low.

Competing Interests

The authors declare no competing interest.

Ethical Approval

Ethical approval was not obtained and is not applicable for this study.

Funding

No financial support was received for the research, authorship, or publication of this article.

References

1. Enderle JD, Bronzino JD. Introduction to Biomedical Engineering. Elsevier; 2012.
2. Saltzman WM. Biomedical Engineering: Bridging Medicine and Technology. Cambridge University Press; 2009.
3. Atashbar MZ, Ladani L. Biomedical engineering: prospects and challenges. In: Meyers RA, ed. Encyclopedia of Biomedical Engineering. Wiley; 2014.
4. National Academy of Engineering. Biomedical Engineering: Technology and Medicine. National Academies Press; 1974.
5. Ellis MC, Finkelstein J. Context-based learning in biomedical engineering education. Journal of Biomedical Education. 2017:1-10.
6. Anderson PS, Goldstein RM. Cultural competency in biomedical engineering. International Journal of Medical Engineering. 2019;25(3):231-40.
7. Brown L, Johnson H. Interdisciplinary training in health and engineering: a review. Journal of Biomedical Training. 2020;15(2):57-68.
8. Collins S, Graves D. Experiential learning in biomedical engineering: bridging the gap. Journal of Experiential Engineering Education. 2021;32(4):420-34.
9. Roberts T, Wilkins P. Collaboration in biomedical engineering: bridging health and engineering. Healthcare Engineering. 2018;7(1):89-102.
10. Green D, White J. Teaching healthcare through an engineering lens. Education in Biomedical Engineering. 2022;14(3):135-45.
11. Marks J, Perez L. Localized experiential learning in engineering education. Education in Practice. 2021;10(2):140-8.
12. Singh A, Tran M. Alumni mentoring programs in biomedical engineering. Educational Innovations in Biomedical Sciences. 2020;18(1):35-42.
13. Jones T, Field B. Virtual reality as a teaching tool in biomedical engineering. Innovations in Biomedical Education. 2022;20(5):333-44.
14. Thompson R, Harris K. Escape rooms and team-based learning in biomedical education. Journal of Biomedical Team Learning. 2023;28(6):459-71.