

Innovation Oriented Biomedical Engineering — Curriculum Discussion and Workshop with Students and Educators

Michael H. Friebe^{1,5} Thomas Wendler² Bruce Wheeler³ Abhishek Appaji⁴

¹ HealthTec Innovation Lab, Faculty of Medicine, Otto-von-Guericke-University, Magdeburg, Germany ² TU München, Computer Aided Medical Procedures, Munich, Germany ³ University of California, San Diego, US ⁴ B.M.S. College of Engineering, Bangalore, India ⁵ IDTM GmbH, Recklinghausen, Germany

Abstract— In this special session we will present and discuss the non-technical part of different biomedical engineering related curricula. Non-technical, because the key 21st century skills will likely be in this area as essential differentiators and core elements for successful programs that are geared towards innovation generation. Novel online learning methodologies are needed that teach global perspectives and enable students to create future perspectives converging technology developments and their effect on business models with health stakeholder empathy. After presentations from four different institutions on three continents we will discuss a future curriculum by listing current issues, foreseeable needs, and skills that are relevant.

I. INTRODUCTION

The effectiveness, efficiency, availability, agility, and equality of global healthcare systems are in question. The COVID-19 pandemic have further highlighted some of these issues and also shown that healthcare provision is in many parts of the world paternalistic, nimble, and often governed too extensively by revenue and profit motivations.

The 4th industrial revolution - the machine learning age - with data gathering, analysis, optimisation, and delivery changes has not led to a future oriented adaptation of Biomedical Engineering education.

II. METHODS

Exponential technologies (Artificial Intelligence, Advanced Sensorics, Robotics, 3D Printing, Blockchains, ...) are likely essential contributors to upcoming disruptions that need to be identified, analysed and taught in combination with 21st century skills (among others: Entrepreneurship, Problem Solving skills, Empathy).

We are still treating patients when they are sick rather than to use advanced sensors, data analytics, machine learning, genetic information, and other exponential technologies to prevent people from becoming patients or to help and support a clinicians decision.

And, we are still educating Biomedical Engineering based on a very technical curriculum. Education of future

stakeholders from the clinical and from the technology side has not been updated to Health 4.0 demands and the needed 21st century skills.

III. SESSION AGENDA

In this special session we want to discuss with Students, Educators, and other stakeholders - and subsequently develop and propose - a novel curriculum for a university and innovation lab based interdisciplinary education of HealthTEC innovation designers..

I. PRESENTATION TABLE

Biomedical Eng. Curriculum - Special Session Agenda		
	Presentation Title	Author
10 Min.	Introduction to future Biomedical Engineering Skills	Michael Friebe
10 Min.	Current Biomedical Engineering Master curriculum - UCSD	Bruce Wheeler
10 Min.	Current Biomedical Computer Science Master curriculum - TU München	Thomas Wendler
10 Min.	Current Biomedical Engineering curriculum - B.M.S. CE, Bangalore	Abishek Appaji
5 Min.	Medical Systems Engineering Master at OVGU, Magdeburg, Germany	Michael Friebe
10 Min.	Innovation Game based on presentations - preparation for Group work	All
30 Min.	Group work extracting essentials and prioritising	All
5 Min.	Wrap-Up and Summary of Discussion, and future Action Plan	Michael Friebe

IV. DISCUSSION & CONCLUSION

The results will be summarised and made available.

REFERENCES

1. Michael Friebe (2020). HealthTEC Innovation Design - a proposal for a novel Master degree program based on Unmet Clinical Need, global Healthcare Challenges, and 21st century skills, *Current Directions in Biomedical Engineering*, 6(3), 599-603. doi: <https://doi.org/10.1515/cdbme-2020-3153>