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Innovative Learning Environments in STEM Higher Education

Opportunities, Challenges, and Looking Forward

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For my parents, Kyung-sik and Jeong-Kang, wife, Hyeseon, and children, Hojin, Eugene, and Youngjin

Jungwoo Ryoo

For my wife Catherine and daughter Mary

Kurt Winkelmann

Foreword

Imagine a world in which innovation is allowed to drive the educational learning environment. Whether it be the ability to reach out around the globe and have virtual access to the experts or to be able to feel like you are immersed into the actual environment, such a future can exist. It is important to keep these possibilities in mind as we continue to explore in-depth the concepts supporting Innovative Learning Environments.

My initial encounter with the authors of this book stemmed from an invitation to be the opening presenter for a workshop on Innovative Learning Environments. As I prepared the charts to present, I pondered on what would be the appropriate message to share with the participants of this workshop, individuals who have spent a lifetime grounded in integrating emerging technologies and innovations into learning spaces. In preparing the presentation, I thought it is best to share my experiences (as an educator, engineer, and STEM motivator) about learning environments that craved for change, that craved for fresh thought and new perspective, and environments that craved for innovation. The best way I could think of to impact and motivate the participants was to allow the voices of those students I had encountered to speak through me.

One story was that of Patrick who enrolled in my Summer Science Academy disinterested in science. His mother was trying to expose him to STEM to spark an interest while also seeking to improve his math and science skills. However, Patrick resisted applying himself. He hated math and science because (in his eyes) it was too abstract, boring, irrelevant, or as he says "stupid." Once I was able to create activities that simply connected science to everything in his life (his favorite foods, his clothes, his tennis shoes, his bicycle, his video games, etc.), Patrick adjusted his perspective and opened his mind to learning.

There are countless other stories such as the following: the stories of students who resisted group projects because of the frustrations from slackers or the inability to see the value of said projects; or the stories of STEM teachers who were struggling with finding engaging and cohesive content and strategies designed to make learning fun; or even my own disappointment in knowing that the same challenges I faced in the engineering learning environment in 1982 were exactly the same as those faced by my daughter in 2017; and countless others who complained or were disinterested because the learning environment was simply too mundane, too disconnected from the real

world, and lacked the benefits of modern technology. What I found in all those experiences was that the students/teachers were unable to connect what they learned/taught in class in a way that allowed them to value learning, to experience learning, to apply the knowledge gained to feed innovation. So, imagine how elated I was to be able to interact and engage with the participants, who are the experts and contributors of this book, as they worked so diligently to create this blueprint for the future of Innovative Learning Environments (ILE). Technologies included in that blueprint are personalized and adaptive learning, multimodal learning formats, extended cross reality, and artificial intelligence and machine learning. These technologies are constantly pushing the envelope in their application in learning environments.

We, as educators and scientists, have to remain vigilant. It is not just about how we learn but also about how that learning impacts the educational environment, the work environment, and moreover the world globally. As a retired NASA engineer, I can envision students learning about the solar system and the stars while virtually existing in the world of outer space. I can also imagine them being able to virtually tour space vehicles and learn about the function of the many instruments and controls on the vehicle. I can even anticipate students being virtually present to learn about the sequences and operating procedures involved in preparing a vehicle for flight real time and so many other scenarios that positively impact learning.

With the recent invasion of the COVID 19 virus causing a push for more virtual learning spaces, the utility of Innovative Learning Environments can no longer be questioned or delayed. We are being thrust into this direction of virtual learning and cannot continue educating our students using traditional methods only. I am convinced that Innovative Learning Environments offer the opportunity for learning to be ever-reaching, richer, deeper, more expansive, and can serve to meet the needs of students and teachers in the future.

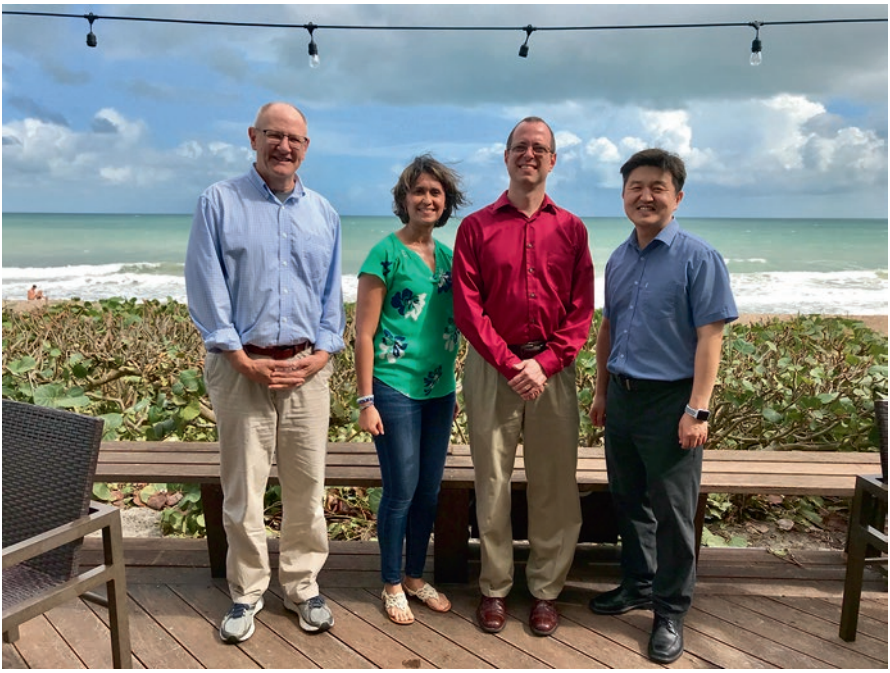
We already know the impact of learning experiences that are informative, engaging, and fun. We know that such environments are the foundations for creativity, productivity, and growth and allow learners to feel like they are a creative part of the

world that surrounds them. The building blocks for such an environment are what is detailed in this book and will have an impact on STEM learning for years to come.

NASA, STEM Virginia Cook Tickles
Washington, DC, USA

Acknowledgments

The editors of this book set out to explore the boundless possibilities available through Innovative Learning Environments (ILEs) in STEM Education in 2018. One major goal of ours was to develop a community of like-minded scholars and practitioners along the process. We are closer to that goal as of this writing, and this book is an embodiment of what such a community can accomplish when inspired and nurtured through a project like X-FILEs (sites.psu.edu/xfiles/). We feel so honored and proud to be leading such a talented group of enthusiastic and passionate educators, administrators, and industry leaders.



X-FILEs organizers: from left to right, Lawrence Ragan, Lorraine Ramirez, Kurt Winkelmann, and Jungwoo Ryoo

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