

The early pandemic's effect on engineering students' learning

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Sandeep Krishnakumar, an industrial engineering doctoral candidate, led research on how the shift to virtual learning impacted students' education in March 2020. Credit: Kelby Hochreither/Penn State

In March 2020, students at countless universities suddenly began taking classes online as the COVID-19 pandemic swept across the globe. But what students experienced during this time was not online learning, but telework, according to Sandeep Krishnakumar, an industrial engineering doctoral candidate—and that distinction can inform best practices for both online and physical classrooms.

Krishnakumar and a team of interdisciplinary researchers investigated the experience of first-year engineering [students](#) during the shift to online learning and its effect on their capacity to thrive. Their findings were made available online in the *Journal of Engineering Education* ahead of official publication.

"In online learning, people choose to learn online, and there are specific practices followed for courses intended to be taught online," said Krishnakumar, first author on the paper. "But the pandemic forced both students and instructors to adapt to online classes suddenly and involuntarily. By viewing the students' experience as telework instead, we could better understand the impact of this sudden shift to online learning."

The researchers then used workplace thriving theory for drawing conclusions about students' learning experiences. Thriving, as defined by the theory, is a state of engagement requiring both vitality,—a person's capacity to feel energized by their work—and learning, in which a person feels they are developing knowledge and skills.

To understand students' educational engagement in the new, telework-like circumstances triggered by the pandemic, the researchers surveyed students in an introductory engineering course. This hands-on, project- and teamwork-oriented course is required for first-year engineering students. The research team surveyed 121 students and conducted follow-up interviews with 13 students.

When interviewing via Zoom, the team asked questions about how the participants' learning and teamwork were impacted by the transition and followed up with specific questions to understand the initial answers in detail.

Analyzing the interview transcripts, the researchers used an iterative process to identify four main themes that characterized students' experiences after the shift to [online learning](#). The themes were interpersonal relationships, building and sharing of knowledge through interactions, perceptions of experiential learning and individual behaviors. Each theme had subthemes that connected to other subthemes. For example, the subtheme "sense of camaraderie," rooted in the interpersonal relationships theme, was also related to the "perceptions of motivation" subtheme for the individual behaviors theme.

The responses relating to each theme showed differences among students. While some students felt a sense of loss due to limited access to certain learning opportunities, for example, others stated that the transition pushed them to problem-solve in novel ways and helped them build flexibility for such unexpected situations.

"It's really important for students to frame these obstacles as a form of problem-solving," Krishnakumar said. "For the students who viewed the challenges thrown at them in this way, it encouraged them to think outside the box—which, as a form of learning that's vital to engineering, is a means to thriving."

The researchers also found that while many students' social relationships suffered due to the pandemic, some students compensated for the loss through teamwork. This underscores the need for [interpersonal relationships](#) in the engineering classroom, because vitality—and therefore thriving—depends in part on the capability to relate to others,

Krishnakumar said. Relationships with instructors were also affected by the shift, and students who could not preserve a connection with their instructors during the remote learning period found their engagement in the class decreased. The researchers noted, however, that instructors may not have been equipped with adequate resources to teach online during the rapid transition.

Jessica Menold, Hartz Family Career Development Assistant Professor in the School of Engineering Design, Technology and Professional Programs, said that this research can help educators and students find strategies for enhancing educational experiences for other unexpected situations.

"This work confirmed things I had been observing in my own classes," Menold said. "In an online environment you have to consider things you wouldn't have before. The research Sandeep led showed how much more complex the introduction of technology makes teaching."

More information: Sandeep Krishnakumar et al, Using workplace thriving theory to investigate first-year engineering students' abilities to thrive during the transition to online learning due to COVID -19, *Journal of Engineering Education* (2022). [DOI: 10.1002/jee.20447](https://doi.org/10.1002/jee.20447)

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