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WIP Paper: Engineering Materials Related Courses at the University of Puerto Rico in Mayagüez (UPRM) after Hurricane Fiona Crossed the Island in September 2022

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Engineering Materials Related Courses at the University of Puerto Rico in Mayagüez (UPRM) Before and After Hurricane Fiona Crossed the Island in September 2022

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ABSTRACT

On September 18, 2022, a Sunday afternoon, hurricane Fiona entered Mayagüez with a tangential speed of 150 mph and dwelled for longer than five hours since she moved with a linear velocity of only about 5 mph. Our campus was totally devastated and there were neither class lectures nor labs for over two weeks. Immediately thereafter, the campus was again closed for a week due to student and worker strikes.

The hurricane and strikes seriously hampered all our undergraduate and graduate courses, and particularly those related to materials science and engineering, because such courses are offered in several departments, including mechanical, civil, industrial, chemical, and electrical, as well as in the other departments of the faculty of science. For example, in our mechanical engineering department, we offer a course on Biomaterials, an interdisciplinary approach with the Biology Department.

The present paper illustrates how we are handling the obstacles of losing three weeks of all academic activities, including teaching, research, and services, in order to finish the current semester on time

Key words and phrases: natural and man-made phenomena, pollution-free materials and processes, sustainable manufacturing

Introduction: Historical Antecedents (Background):

The campus of the University of Puerto Rico at Mayagüez (UPRM) started as a College of Agriculture and Mechanical Arts (CAAM in its Spanish abbreviation) over a century ago. Hence, the emphasis on *materials*, both organic and inorganic, is of utmost importance here. While the College of Agriculture today has a Department of Agricultural Engineering, our Faculty of Engineering also has a newly created Department of Engineering Sciences and Materials. Besides, all other engineering departments, namely, Mechanical, Civil, Electrical, Chemical and Industrial, have courses on materials, both at the undergraduate and graduate levels as well as funded research projects in materials. Furthermore, the Faculty of Arts and Sciences has similar emphasis in materials, in the departments of Physics, Chemistry, Biology and Geology. In sum, the Division of Materials of ASEE is of great interest for our academic improvement [1]. Hence, this paper!

Over the last few years, several natural and man-made phenomena have affected any progress of this small island. While the earthquakes and the hurricanes are natural phenomena, not disasters, COVID-19 was certainly a man-made cataclysm. We had a severe earthquake, over 7 on Richter's Scale, plus COVID-19 started its roots here in January 2020 and then Hurricane Fiona crossed the island in September 2022.

All these three catastrophes, whether man-made or natural, severely affected the city of Mayagüez, and our university campus situated in the heart of the city.

COVID-19 and Fiona Effects:

At the onset of our semester in January 2020, we had to switch over to a new online instruction method to avoid the conglomeration of too many students in the closed space of a class room, and the instructors and their students had to learn the new method of delivering lectures online in a quick succession. We were used to *Zooming* for attending conferences remotely, but not for offering class lectures on *Moodle*. Especially the elder instructors had to go through a greater challenge! Another problem was conducting labs and workshops. How do you teach online how to hold a welding torch or grind a cutting tool? It was really a painful task for the lab instructors! Fortunately, we didn't miss too many classes in this transition.

Then came hurricane Fiona on September 17, 2022, with 150 mph wind speed and stayed over Mayagüez for over five hours before invading the neighboring country of Dominican Republic. Our UPRM campus was totally devasted and the campus was closed for two weeks for cleaning and for some very essential repairs. We had no classes, no labs, no research experiments, no services. Only in the Biology Department and in the Agricultural Stations, one had to enter to feed the animals and nurse the plants. All other labs, workshops and workstations were totally closed. This affected very much our *materials* courses and lab sessions in teaching and research in three major faculties: Agriculture, Science and Engineering. It took almost three weeks to start instructions in normal conditions for our materials labs. It took longer to start the labs sessions than the lecture classes for cleaning the labs and repairing and reinstalling some equipment.

Workers Strike and Students Strike:

A week after the classes started regularly, suddenly all the five gates of the campus were closed again from very early in the morning! The Workers Federation shut all the gates and were picketing in front of them for their salaries and social benefits. Only some technicians/caretakers were allowed to enter to feed the animals and clean the plants. This was for three consecutive days. However, with some verbal understanding with the Chancellor/Rector of UPRM campus, the gates were opened on the fourth day, a Thursday, and we had two days of classes after almost another week of inaction.

The following Monday, after a peaceful weekend, the gates were closed again at 4 AM, even before daybreak! This time it was not the Students Union, but groups of students blocked the five entrances. Most of the students were freshmen and sophomores. No Seniors or Graduate students were involved! These particular groups were demanding more flexible curricula for the undergraduate programs [2]. In sum, they wanted a more *student-oriented* and less *instructor-oriented* approach in any academic endeavor! Again, the same cycle of talks with the Chancellor temporarily solved the problem.

Students' Perspectives:

Every student at every university is going to have stories of how hard their degree was, and what adversities they had to surpass in order to achieve excellence, but not everybody is going to face several environmental and political factors in their respective college experience as a student from UPRM. In Puerto Rico we live in the hurricane corridor of the Americas, so having an atmospheric event pass through us, is in a sense, is normal and part of our every year live. This year was different, it was the first time in five years that the Island suffered a direct hit from a storm, and this time it was different. Hurricane Fiona

did not bring the highest winds, but it arrived as a heavy rain system that poured over 20 inches of rain in just under two days. This impact completely severed the electrical system of the island along with an invisible adversary that made the recovery even worse, humidity in electrical systems. All in all, we went two weeks without classes; and just when we came back from the Hurricane, a political strike from the workers, left us with more days without access to classes and laboratories. This might have been a perfect recipe for being left behind and not completing our courses, but thanks to the dedicated professors, we made it work. We pushed through to complete the semester in its entirety with only 12 weeks of class instead of the usual 15. When you are reading this you must be thinking, "what an awful thing, these students have to live with", but in my opinion these are the things that make our students grow, and prepare for the real world, where things are bound to happen that will hamper progress. However, only you, and your ability to go through those adversities determines the impact on you and your process.

Future Trends

With all the natural and man-made obstacles, finally the semester of January – May 2022 was saved. There was a proposal from the UPR Central Administration that all academic instructions, including lectures and labs, would be halted at 12PM on Wednesdays and Wednesday afternoons would be devoted to "*Extracurricular Activities*" as well as administrative meetings. Fortunately, this proposal did not pass in our UPRM Academic Senate!

The emphasis on materials related instructions in lectures and labs for both undergraduate and graduate courses is now on biomaterials, micro and nano materials and their sustainable development. In our Mechanical Engineering Department, there are several young and bright faculty members who are experts in Biomaterials and Biomechanics. They have close cooperation with our Biology Department. Some of them are working in *tissue and cell mechanics*, particularly the ones affected by cancer and other conditions.

Similarly, in the newly created Department of Engineering Sciences and Materials, several faculty members are working on sustainable fabrication of materials and their use in pollution-free mass manufacturing. One example is bamboo as a material for pollution-free manufacturing of the articles of daily use. Indonesia, Malasia, Thailand and other Far East Asian countries have produced toothbrushes and cutlery sets from bamboo. The dry sugarcane, after extracting the sugar out, is another such nonpolluting material for mass production of light everyday useable commercial products. We have some COOP students working as trainees in Asian countries [3].

Closing Remarks:

Our Faculty of Engineering is created in a bilingual and multicultural environment. Bilingual, because both Spanish and English are allowed for instruction; multicultural, because many students of the neighboring French, Creole and Dutch speaking islands come here for studying engineering at the undergraduate and graduate levels. They all need mentoring: faculty mentoring as well as peer mentoring [4 -6]. Unfortunately, and sadly, pre-Columbian native Amerindian culture hardly exists in Puerto Rico. The

languages and cultures of *Taino, Igneri* and *Caico* do not appear significantly in our engineering, science, arts or socio-humanistic curricula!

Because of predominantly Spanish and English languages as well as both Latin American and North American hereditary influences, two courses of each of these two languages are offered in all engineering programs. Besides, there are courses of history and culture of both the continents: Anglo-Saxon North and Latin-American South. Furthermore, engineering students must take some other socio-humanistic courses as mandatory. This takes our Bachelor's degree in Engineering a minimum of five years (ten semesters) to complete vis – a – vis four years in USA , Canada, the UK , and all other ex-colonies of Great Britain like Australia, New Zealand, India, Pakistan, Bangladesh, Hong Kong, etc. Our five-year undergraduate programs in all engineering departments are closer to those of the Central European schools in France, Germany, Austria, Switzerland as well as Italy, Spain and Portugal. They also need five years to complete an undergraduate degree in engineering, like *Diplom Ingenieur* (Dipl. Ing.) in Germany, Austria and in the German language universities in Switzerland, such as the Technical University of Zurich.

Due to the five-year undergraduate program in engineering, we have more emphasis in *materials science* related courses. For example, even in Industrial Engineering we offer courses in metallurgy, materials and manufacturing processes as compulsory courses. Thus, any disruption and discontinuity in the class lectures and lab sessions, whether due to natural or man-made causes, produce long-term effects. Since January 2020, closing the university campus due to COVID-19, earthquake, hurricane Fiona, Worker Federation's strike, students' strike, one after another for about a month, had seriously affected the materials related areas in classroom lectures and lab sessions, including undergraduate studies and graduate as well as post-Doctoral studies and research. We are currently in the process of recuperation, devoting additional time and extra classes.

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