Problems with how higher education works have hit the headlines again and again over the last few years – but how can universities update their offering to meet modern needs? Educator and academic Professor Fatma Mili highlights the challenges facing the sector, and discusses the solutions she has in store to shift from an industrial-style education to one that is dedicated to creativity, diversity and equity.

What challenges do educators face in the modern-day higher education sector?

Recently, the continuing inequity in education and the persistent experience of racial segregation by students across the US has sparked protests from minority students demanding to be heard, respected and adequately served by their institutions. It also prompted the Million Student March movement, which demands access and affordability for all.

These and similar news stories can feel overwhelming and beyond our control as educators. It can be very tempting to brush them aside and carry on with our planned and familiar activities. We have, after all, tightly scheduled syllabi to follow, research projects and deliverables for which we are accountable, and a very special area of expertise for which we are hired.

On the other hand, these challenges and events are of a magnitude that cannot be ignored. How can we expect our students to be fully present and engaged if they are aware of issues and concerns of a much larger scale than the topic of the current lecture? How do we expect our graduates to care about society and the world when we only model monodisciplinary isolated thinking?

Do higher education institutions play different roles in different cultures and countries?

From your experience, have you found good models that can be applied across cultures and borders?

The system of higher education is a relatively new institution that developed in a globalised world. In this respect, there are no culturally specific higher education models, only different adaptations, priorities and political choices. These differences, however, are sometimes significant enough to dramatically affect the outcome. Two examples come to mind: Finland and South Korea. In both cases, each country deliberately decided to invest in educating the masses and, in both cases, the quality and the equity of the outcome is an example for all of us.

You have led a major transformation in the form of the Purdue Polytechnic Institute – an incubator for undergraduate education in STEM initiated at Purdue University and funded by the President. Could you provide some background to the project?

The project emerged as a response to the growing sense that after three decades of consistent reports identifying unmet needs in higher education in general and STEM in particular, the state of the practice has changed very little – but the magnitude of the problems and the urgency with which we must address them has increased. There are three dimensions to consider: relevance, scientific grounding and social equity.

The gulf in relevance stems from the fact that education remains focused on producing competitive, technically competent, solo performers, while the professional, social and political challenges we face are increasingly complex and multifaceted. The gulf in scientific grounding is manifest in the extensive body of research findings in the domains of cognition, learning and motivation in the last two decades. These findings are often not adopted by higher education, or not adopted fast enough. Finally, the gulf in social equity stems from the exponential growth in demand for postsecondary education that is not matched by the offerings.

You moved from heading the Purdue Polytechnic Incubator to creating a trans-institutional centre. Why?

The Center for Trans-Institutional Capacity Building and Education Equity in STEM is a natural growth of the Purdue Polytechnic initiative as a means to diversify innovation experiences, nurture them and multiply them within and across institutions. It was very important to us to maintain the sense of innovation and highlight the process (ie. faculty development) over the product (degree created).

There is a national and international movement of faculty who recognise the urgency of re-examining what we do and how we do it. They are eager to apply the highest form of scholarship to our core mission: education. The mission of the centre is to connect these efforts and support them. The centre’s focus on capacity development is a recognition of the central role that faculty play in this endeavour.

How do you promote openness, collaboration and cooperation across institutions?

This is an excellent question. In his book, Checklist for Change, educational research Robert Zemsky states that change will not happen because of a single institution creating a successful model that is then emulated by others; change will only happen if multiple institutions come together and do it collaboratively. This tells us what needs to happen, but unfortunately, it does not tell us how to actually make it happen.

We strongly believe that the creation of orthogonal structures to the institutional hierarchies are essential to enable innovation and diversity. The centre was created to support such structures. It brings together a network of 20 teams (team of teams) from different universities which are all engaged in transformational projects.
Towards a wholehearted education

Faculty members at Purdue University in Indiana have been at the forefront of what may become a revolution in higher education. They are training students using cross-disciplinary, experiential methods that are key to preparing them for the modern workplace.

**WHAT IS THE** purpose of a university? In general, to provide higher education to students – but beyond that, the answer is largely influenced by who you ask, what their role is and where they are.

The University of al-Qarawiyyin in Morocco is the oldest in the world and requires prospective students to be Muslim, male and to have memorised the Qur’an and other religious texts in full. England’s University of Oxford asks students to adhere to institutional traditions and may refuse them entrance to examinations if they do not wear a carnation of the correct colour. In Florida, you can major in Citrus Studies, and in North Carolina you can focus on Motorsports Science – but probably not the other way around. These examples show that higher education is increasingly globalised, and such regional distinctions highlight the range of subjects and procedures that might be considered integral to a complete and appropriate education.

As with all institutions, universities are also subject to the varied expectations of those they serve: society expects them to produce useful professionals for the workforce, government and academia; students expect them to provide academic fulfilment and relevant training in the form of grades and experiential components that can be considered integral to a complete and appropriate education.

The Purdue Polytechnic Incubator has already made a big difference to the student cohorts it serves, but Mili and her collaborators are realistic about the scale of the work that is yet to be done. “The innovation and transformation of the educational system starts with the transformation of the mental models, assumptions and roles of the faculty,” she explains. “This is a lengthy and risky process, but it is a necessary process.” It is also a process that requires action in not just one team, but from a consortium of faculty teams at different institutions across the US – and it was this realisation that led Mili to establish the Center for Trans-Institutional Capacity Building and Educational Equity in STEM (transSTEM.org).

**THE CENTRE OF ACTIVITY**

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The Center’s aim is threefold: firstly, to perform research on educational transformation with particular regard to STEM and to gather together such research in one place; secondly, to build awareness and capacity both within
Purdue and amongst its extended network; and, finally, to expand the scope and success of faculty groups aiming to undertake transformational change. Previously, such groups were forced to work in isolation with little documentary evidence to guide them; however, the challenges they face manifest themselves in different ways, they spring from systemic roots that are shared and can be considered collectively. The Center, and its STEM network, provide the perfect opportunity to accomplish this.

**WIDER PROGRESS**

The research element of Mili’s work at the Center is served through a number of projects, each focusing on an important topic within educational transformation. The Partnering to Promote STEM Success for Low Income Initiative, for example, brings together faculty from three separate institutions to examine new learning environments that can promote equity. In the MIGLA initiative, a multidisciplinary team explores the potential of Competency Based Education. Finally, STEM Faculty Community of Practice in Equity and Diversity interrogates the hypothesis that the root cause of the lack of diversity in higher education and the reluctance of institutions to embrace innovation lies in the unexamined beliefs, mental models and values of STEM culture.

By developing her work at the transformSTEM Center in this way, Mili has ensured that the innovation that she and her colleagues have fostered will not be limited to one institute, one cohort of students or one place in time. A growing initiative, pressing for meaningful and sustainable change, is rising around the Institute and through the Center for Comprehensive Educational Transformations in STEM; it seems that this is one message whose time has come.

**INNOVATION IN HIGHER EDUCATION**

**OBJECTIVES**

- To rethink the premises of higher education: its scope, its methods and its reach
- To create an international network for higher education institutional transformation
- To collaborate in creating a diversity of innovations in STEM education

**KEY COLLABORATORS**

- **Professor Sorin Matei**, Discovery Park Fellow and Purdue Polytechnic Founding Fellow, Purdue University, USA
- **Professor Robert Herrick**, Purdue Polytechnic Founding Fellow, Purdue University, USA
- **Professor Linda Vanasuppa**, Head of SUSTAIN programme, Professor Lizabeth Schlamer, co-lead of SUSTAIN programme, California Polytechnic State University, USA

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**PROFESSOR FATMA MILI** is the Founder and Director of the TransformSTEM Center in the Discovery Park at Purdue University. She also cofounded and led the Purdue Polytechnic Incubator, a $35 million initiative funded by Purdue President that operates within Purdue Polytechnic Institute. These are the latest initiatives in a career focused on broadening participation in computing and STEM. She obtained both her PhD and MS in Computer Science from Pierre and Marie Curie University in Paris, France. Her technical research is in software verification and validation, distributed computing and bioinspired algorithms.

**PROFESSOR FATMA MILI ON WHY A PARADIGM SHIFT IS NEEDED IN EDUCATION:**

“We want to shift away from the industrial model where you control the input and you expect an identical output. Students are not materials that we put in a system. The insistence on predictability kills diversity, innovation, creativity and individuality. It produces a very narrow model of a successful student. This is why we haven’t been successful in breaking the lack of diversity and equity in the education system. We are looking at too narrow of a profile, and we lose the students who look differently and think differently.”

Today’s workplace is the home of interdisciplinary collaboration, teamwork and innovation, and training that encourages students to make safe decisions, work alone and focus on a specialism does not reflect that. What is more, most institutes are up against a shifting paradigm of further education – which is in greater demand since it is now a necessity rather than a luxury – and outpaced in their innovation by the scientific understanding of human learning and cognition.