Materials Education SYMPOSIA

12th International Materials Education Symposium

Clare College, University of Cambridge
Cambridge, UK

April 4-5, 2023

This symposium is jointly coordinated by

Ansys & University of Cambridge

We are grateful for the help and advice of the Symposium Academic Advisory Committee

www.materialseducation.com

12th International Materials Education Symposium

Program-At-A-Glance

Section 1: Welcome

Dear Colleagues and Friends, Welcome!

It is our utmost pleasure to welcome you, on behalf of the IMES 2023 Scientific Committee, to the 12th International Materials Education Symposium, at Clare College in Cambridge. We are grateful to the University of Cambridge and Ansys for supporting and organizing this event again, as we used to before the pandemic, in the spirit of Mike Ashby and at his old stomping ground in Cambridge, where he is now Professor Emeritus. If you are returning to the Materials Education Symposia, we hope that you can recognize the familiar format and efforts to create an inclusive and engaging atmosphere for sharing ideas and experiences. If you are new to the Symposium, we hope that you will find it inspiring and can enjoy both days of the single track sessions.

There is certainly no shortage of topics to discuss, since the world has changed significantly since the last IMES in 2019. The sudden or accelerated changes to our teaching towards online remote or flexible delivery imposed by the pandemic, the rise of inflation challenging both students and faculty with consequences to higher education as well as the recent appearance of open source artificial intelligence, such as ChatGPT, forcing a change in assessment practices. There will be ample time to discuss these issues at the Symposium dinner at the fabulous Old Hall of Queens' College or in one of the generous breaks in the speaker program, designed to allow meaningful interaction. This year, we have included a 20-minute discussion slot at the end of all four sessions (led by the respective chair) to enable exchange of thoughts and ideas.

The sessions this year are chosen by the Scientific Committee to reflect relevant topic areas: *(1) Innovative teaching*, that is something that unites most of the attendants of the symposium, *(2) Sustainability and energy*, which are high on the agenda everywhere in society today, *(3) Design and simulation*, representing important developments for engineering education in particular and, finally, *(4) Specialist topics and educational practices*, that allow us to share novel ideas and approaches in many areas of teaching. Sincere thanks to everyone that has been involved in setting up the event and, of course, to everyone attending this year. The Program, as usual, is filled with engaging talks by some of the most prominent speakers in the field of materials education. Together, we are ready to continue building our community and look for forward to the journey.

Claes Fredriksson, Ansys UK
Graham McShane, University of Cambridge

We are grateful for the support from our event organizers and sponsors:

and for the help and advice of the following organizations:

Section 2: Agenda

TIME	EVENT	VENUE
Monday, April 3: Presenters' Dinner		
12:00-1:00pm	Registration Opens	At workshop venue
1:00-5:00pm	Basic and Advanced Material Selection with Granta EduPack	University of Cambridge, Department of Engineering
1:00-5:00pm	Design and Simulation- Linking Material Selection to Finite Element Analysis	
1:00-5:00pm	Teaching Sustainable Development using Ashby's 5-Step Method	Ansys Cambridge Office
7:00 PM	Presenters' Dinner **by invitation only*	Trinity Hall
Tuesday, April 4: Symposium Day One		
8:00am	Registration opens*	Clare College Gillespie Centre, Memorial Court *Registration in Garden Room
8:45-10:05am	Symposium Day One Session 1a	
10:05-11:10am	Coffee Break & Poster Session	
11:10am-12:30pm	Symposium Day One Session 1b	
12:30pm	Symposium Photograph	
12:35pm	Lunch	
1:45-3:10pm	Symposium Day One Session 2a	
3:10-3:50pm	Coffee Break & Poster Session	
3:50-5:20pm	Symposium Day One Session 2b	
7:00pm	Symposium Dinner	Old Hall, Queens' College
Wednesday, April 5: Symposium Day Two		
8:30am	Registration opens*	Clare College Gillespie Centre, Memorial Court *Registration in Garden Room
9:00-10:05am	Symposium Day Two Session 3a	
10:05-10:50am	Coffee Break	
10:50-11:50am	Symposium Day Two Session 3b	
11:50am	Lunch	
1:00-2:05pm	Symposium Day Two Session 4a	
2:05-2:50pm	Coffee Break	
2:50-4:10pm	Symposium Day Two Session 4b	

Please see ***Section 6*** for maps, and more venue details

Symposium Day One: Tuesday, April 4, 2023

Welcome Address	
8:45am	**Graham McShane,** Associate Professor, University of Cambridge **Claes Fredriksson,** Ansys Academic Development Team
8:55am	**Dipankar Choudhury,** Office of the CTO, Vice President, Research at Ansys
9:00am	**Session 1: Innovative Teaching** *Chair: Noel Rutter, University of Cambridge*
9:05am	**William D. Callister[1]* & David G. Rethwisch[2],** [1]University of Utah & [2]University of Iowa *A new paradigm for learning the fundamentals of materials science and engineering*
9:25am	**Bosco Yu[1] * Liza Dicecco[2],** [1]University of Victoria & [2]McMaster University *Gamified design-led materials science education*
9:45am	**Andrew Rodda[1], Noel Rutter[2] & Thales Ferreira[3]** [1]Monash University, [2]University of Cambridge, & [3]University of Oxford *Student engagement and skills development via extracurricular student teams*
10:05am	*Poster Session Teaser*
10:25am	*Coffee Break & Poster Session*
11:10am	**Ulrike Wegst**, Northeastern University *The Discover Materials! project: from materials speed dating to research and materials thinking for sustainability*
11:30am	**Pischedda Vittoria*, Jean Colombani, Pauline Schlosser, Damien Le Roy, Antoine Berut, Oriane Bonhomme, and Estelle Homeyer,** Institut Universitaire de Technologie *Innovative pedagogical practices for teaching material science at the Mechanical and Production Engineering Department of the University of Lyon 1*
11:50am	**Núria Salán,** Polytechnic University of Catalonia *Myths and lies of metallurgy in cinema*
12:10pm	*Session Discussion, Chair*
12:30pm	*Lunch Break & Symposium Photograph*
1:45pm	**Session 2: Sustainability and Energy** *Chair: Darshil Shah, University of Cambridge*
1:50pm	**Darshil Shah,** University of Cambridge *Teaching materials impact assessment as a design tool for tomorrow's built environment designers*
2:10pm	**Ronald Kander,** Thomas Jefferson University *Life cycle assessment and the circular economy: a teaching case study*
2:30pm	**Heather Driscoll & Itai Vutabwarova*,** The University of Sheffield *Teaching sustainability for manufacturing apprenticeships*
2:50pm	**Rodrigo Motoharu Kobayashi[1], Mauricio Dwek[2]*, José Carlos Zart[3], & Carlos Andrés Olivares Garrido[3],** *[1]University of São Paulo, [2]Ansys Academic Field Team, & [3]ESSS* *Driving ecodesign forward: the new challenge of SAE Brasil*
3:10pm	*Coffee Break & Poster Session*
3:50pm	**Tim Huber[1]*, Ali Reza Nazmi[2], and Hossein Najaf Zadeh[2],** [1]Luxembourg Institute of Science and Technology & [2] University of Canterbury *Teaching material recycling through a Dragons' Den project*
4:10pm	**Fred Veer* & David Peck,** TU Delft *Designing a course in eco-friendly materials selection for design students*
4:30pm	**Ana Urbieta* & Paloma Fernández Sánchez,** University Complutense Madrid *Building the house of our dreams with advanced materials*
4:50pm	*Session Discussion, Chair*
5:20pm	*End of Day 1*

Symposium Day Two: Wednesday, April 5, 2023

9:00am	**Session 3: Design and Simulation** *Chair: Bosco Yu, University of Victoria*
9:05am	**David Mercier[1]*, Fabien Volpi[2], & Guillaume Parry[2]** [1]Ansys CR&D Team & [2]Grenoble Université *Data management courses implementation in a master degree simulation projects*
9:25am	**James Ren[1] & Li Wang*[2]** [1]Liverpool John Moores University & [2]Queen Mary University of London *Flexible data-led approach for fostering concepts on synergy of different properties in materials teaching and projects*
9:45am	**John Robertson-Begg,** University of Derby *Introducing data science concepts into materials teaching*
10:05am	*Coffee Break*
10:50am	**Steffen Ritter,** Reutlingen University *SCHOOLTOOL- thrive their drive; education and training rethought*
11:10am	**Flavia Papile[1]*, Mariapia Pedeferri[1], Barbara Del Curto[1], & David Mercier[2]** [1]Politecnico di Milano and [2]Ansys CR&D *Material Science and Design NEXUS: A Case Study*
11:30am	*Session Discussion, Chair*
11:50am	*Lunch Break*
1:00pm	**Session 4: Specialist Topics and Education Practices** *Chair: Paloma Fernández Sánchez, University Complutense Madrid*
1:05pm	**Ana Maria Gonzalvez-Pons* & Javier Orozco-Messana** Colegio el Armelar & Universitat Politècnica de València *From Roman coins to multidisciplinary metallurgy*
1:25pm	**Emilio Castro*, Francisco Javier Gil, & Román A. Pérez** Universitat Internacional de Catalunya *Engaging bioengineering students in materials science and engineering through active learning and interactive classroom activities*
1:45pm	**Li Wang,** Queen Mary University of London *Implementing industrial practice of engineering quality management into classroom to increase students' ownership*
2:05pm	*Coffee Break*
2:50pm	**Susan Gentry,** University of California, Davis *Creating a Learning Assistant program to support project mentorship*
3:10pm	**Jessica Sandland[1]*, Maxwell L'Etoile[1], & Cécile Chazot[2]** [1]MIT & [2]Northwestern University *MICRO- - The Materials Initiative for Comprehensive Opportunity*
3:30pm	**Laurent Gautron,** Université Gustave Eiffel *New ways for teaching materials science at University Gustave Eiffel*
3:50pm	*Session Discussion, Chair*
4:10pm	*End of Day 2*

Section 3: Participants

Name	Affiliation	Presenting			Country
		Workshop	Talk	Poster	
Bertwin Albers	Saxion University of Applied Science				Netherlands
Nick Ball	Ansys				UK
Rosita Bannert	The London Interdisciplinary School			Yes	UK
Ouzine Boussaid	University of Annaba				Algeria
Daniela Butan	Technological University of the Shannon: Midlands Midwest - TUS				Ireland
William Callister	University of Utah		Yes		USA
Emilio Castro Otero	Universitat Internacional de Catalunya		Yes		Spain
Dave Cebon	Ansys				UK
Neha Chandarana	University of Bristol				UK
Peiyu Chen	University of Cambridge				UK
Dipankar Choudhury	Ansys				USA
Bill Clyne	Plastometrex, University of Cambridge			Yes	UK
Susannah Cooke	Ansys			Yes	UK
Sam Cruchley	University of Birmingham			Yes	UK
James Dean	Plastometrex				UK
Barbara Del Curto	Politecnico di Milano				Italy
Zhili Dong	Nanyang Technological University			Yes	Singapore
Annett Dorner-Resiel	Hochschule Schmalkalden				Germany
John Durrell	University of Cambridge				UK
Evy Dutheil	Falmouth University			Yes	UK
Mauricio Dwek	Ansys		Yes	Yes	France
Thales Ferreira	University of Oxford		Yes		UK
Xiaolei Feng	Nanyang Technological University			Yes	Singapore
Paloma Fernández Sánchez	University Complutense			Yes	Spain
Eoin Fitzgerald	Technological University of the Shannon: Midlands Midwest - TUS				Ireland
Claes Fredriksson	Ansys	Yes			UK
Sergejs Gaidukovs	Riga Technical University			Yes	Latvia
Andrea Gassmann	EXPERIMINTA gGmbH			Yes	Germany
Laurent Gautron	Université Gustave Eiffel		Yes		France
Susan Gentry	University of California, Davis		Yes		USA
George Giannopoulos	University College London				UK
Stephane Godet	Université libre de Bruxelles				Belgium
Ana Maria Gonzalves-Pons	Colegio el Armelar		Yes		Spain
Stéphane Gorsse	University of Bordeaux			Yes	France
Wenchen Gu	Plastometrex				UK
Jessica Gwynne	University of Cambridge				UK
Peter Hammersberg	Chalmers Technology University			Yes	Sweden
Tim Huber	Luxembourg Institute of Science and Technology		Yes		Luxembourg

Name	Affiliation	Presenting			Country
		Workshop	Talk	Poster	
Elisabeth Hülse	Ansys			Yes	Germany
Piers Ireland	University College London			Yes	UK
Kathryn Jackson	University of Sheffield				UK
Ronald Kander	Thomas Jefferson University		Yes		USA
Juliane Karneboge	Hochschule Bonn-Rhein-Sieg, University of Applied Sciences			Yes	Germany
Danka Katrakova-Krüger	TH Köln			Yes	Germany
Sebastian Limberg	Reutlingen University			Yes	Germany
Karsten Lund	University of Southern Denmark				Denmark
Claudia Luppertz	Hochschule Bonn Rhein Sieg, University of Applied Sciences			Yes	Germany
Amalie Lyneborg	Plastometrex				UK
Navid Manai	Ansys			Yes	UK
Nicolas Martin	Ansys	Yes			France
Graham McShane	University of Cambridge				UK
David Mercier	Ansys		Yes		France
Lakshana Mohee	Ansys				UK
Olly Morris	Plastometrex				UK
Leonard Ng Wei Tat	Nanyang Technological University			Yes	Singapore
Mengyan Nie	University College London				UK
Bridget Ogwezi	Ansys				UK
Javier Orozco-Messana	Universitat Politècnica de València			Yes	Spain
Kate Osborne	Ansys				UK
Alfred Oti	Ansys				UK
Flavia Papile	Politecnico di Milano		Yes	Yes	Italy
Mariapia Pedeferri	Politecnico di Milano				Italy
Jan Pedersen	University of Southern Denmark			Yes	Denmark
Gerald Pilz	University of Leoben			Yes	Austria
Vittoria Pischedda	Institut Universitaire de Technologie (IUT) Lyon1		Yes		France
Ilija Rašović	University of Birmingham			Yes	UK
Steffen Ritter	Reutlingen University		Yes		Germany
John Robertson-Begg	University Of Derby		Yes		UK
Andrew Rodda	Monsash University		Yes		Australia
Guillermo Rubén Facal	University of Buenos Aires			Yes	Argentina
Noel Rutter	University of Cambridge		Yes		UK
Núria Salán	Universitat Politecnica de Catalunya		Yes		Spain
Jessica Sandland	MIT		Yes		USA
Madhumita Saravana Kumar	Ansys	Yes			Germany
Mercè Segarra Rubi	Universitat de Barecelon				Spain
Fjodor Sergejev	Tallinna Tehnikaülikool / Tallinn University of Technology (TalTech)				Estonia
Darshil Shah	University of Cambridge				UK

Name	Affiliation	Presenting			Country
		Workshop	Talk	Poster	
Jenny Sheperd	University of Leicester				UK
Hocine Sissaoui	University of Annaba				Algeria
Nick Stefani	Ansys, Open University	Yes			UK
Sofia Steffenoni	Marangoni, Central Saint Martins				UK
Cord Henrik Surberg	Eastern Switzerland University of Applied Sciences				Switzerland
Penny Thomopoulu	Ansys				UK
Rob Thompson	University of Cambridge				UK
Antoine Tour	Ensad Lab				France
Kaitlin Tyler	Ansys			Yes	USA
Ana Urbieta	Universidad Complutense		Yes	Yes	Spain
Tatiana Vakhitova	Ansys	Yes			UK
Fred Veer	TU Delft		Yes		Netherlands
Itai Vutabwarova	University of Sheffield		Yes	Yes	UK
Li Wang	Queen Mary University of London		Yes		UK
Ulrike G. K. Wegst	Northeastern University		Yes		USA
Bosco Yu	University of Victoria		Yes		Canada
Wen Zhao	Ansys	Yes			UK

Section 4: Presentation Abstracts

A New Paradigm for Learning The Fundamentals of Materials Science & Engineering

William D. Callister*[1] & David G. Rethwisch[2]
[1] *University of Utah* & [2]*University of Iowa*

For several reasons, the learning and understanding of the fundamentals of materials science and engineering is difficult and non-engaging for many students. This paper discusses a new approach that incorporates two features not found in traditional introductory courses. One is the inclusion of assigned questions that require the students to explain materials concepts found in the course textbook. The other involves the paradigm of materials science and engineering, which consists of the four components material performance, properties, structure, and processing. Assignments are made wherein the student is required to explain, for a specific material or phenomenon, how one paradigm component relates to another component. For example, provide an explanation as to why the mechanical properties (relatively low strength and high ductility) of a spheroiditic iron-carbon alloy are related to its microstructure.

Gamified design-led materials science education

Bosco Yu[1]* and Liza Dicecco[2]
[1]University of Victoria and [2]McMaster

“As the field of materials science and engineering (MSE) has expanded tremendously in recent decades, we now face a unique challenge: how to teach the ever-increasing volume of in-depth, specialized knowledge and constantly changing technical skills. The majority of materials engineering educational curriculums today still take the traditional lecture-style format that focuses on one-way communication. This approach efficiently delivers teaching content, but it is not effective at generating student engagement. Moreover, the traditional science-led approach is often delivered in a series of standalone physical science courses. The silo-ed nature of traditional course structure does not reflect the increasingly multidisciplinary approach that engineers take in the real world. Given the wide breadth of the MSE discipline and the multiple connections it has with other engineering disciplines, the traditional approach to teaching MSE leaves many students confused about how this wide-ranging and diverse knowledge can actually be put into practice. It is crucial for students to experience early on how MSE can be used to solve real-world multidisciplinary engineering problems. In this talk, I will present an alternative approach to teaching MSE that emphasizes a cohesive engineering design philosophy and teaches students how to “think like a materials engineer” (referred to as design-led materials science). Through a series of multidisciplinary design projects, students can envision themselves as future engineers solving real-world problems with aid of ANSYS - Granta Edupack. To further enhance student engagement, gamified teaching content (interactive demos, games, and activities) is incorporated. Together, “design-led materials science” and “gamified learning” ensure students stay engaged in the classroom, are motivated by envisioning the type of work they could pursue in their future careers, and practice utilizing physical science concepts to solve realistic design challenges.

Student Engagement and Skills Development via Extracurricular Student Teams

Andrew Rodda[1], Noel Rutter[2], & Thales Ferreira[3]
[1]Monash University, [2]University of Cambridge, & [3]University of Oxford

"Monash Engineering supports around 20 extracurricular student teams, in which (primarily undergraduate) students work on long-term open projects. While some teams are based around pre-existing student competitions, the Department of Materials Science and Engineering hosts several teams with goals based around student development, hands-on project work, community engagement and entrepreneurship. This presentation will describe recent progress, specifically concentrating on a team known as "Monash Forge". [1,2] Monash Forge is a student-led initiative, founded in late 2018, that aims to develop fundamental practical and professional skills in Materials Engineering and related disciplines. Students develop technical skills in forging and casting, hand and power tools, welding, design software and 3D printing, but crucially also develop broader professional skills. There is deliberate exposure to open questions and students are supported to be properly equipped to handle aspects such as project management, budgeting, marketing and OHS (the team undertakes thermomechanical processing with significant hazards).The team engages regularly with community to educate the public about sustainability in manufacturing. This presentation will showcase the work of the team and its value for participants, including (if timezones and technology permit) live interaction with the team members. There will also be broader discussion of lessons learned during the initial setup and the pandemic years, how to assess the value of student teams for various stakeholders, and how to maximize the value of the team beyond the direct participants to benefit a wider cohort of students.

[1] https://www.monash.edu/engineering/departments/materials/monash-materials/home/feature-article/introducing-monash-forge
[2] https://www.facebook.com/monashforge"

The Discover Materials! project: from materials speed dating to research and materials thinking for sustainability

Ulrike G. K. Wegst
Northeastern University

The Discover Materials! Project started as an experiential teaching and learning tool for a cross-disciplinary "Introduction to Engineering" course usually taken during the first or second year of studies. The course encourages innovation and entrepreneurship: students identify a problem or need, learn to design, iterate, and build a looks-like, works-like prototype, develop a business plan, and apply for a provisional patent. While the success of the proposed technical solution hinges on savvy materials and process selection to optimize technical, cost, and environmental performance, most students are, at this point, unfamiliar with materials science and selection. A two-hour Materials Speed Dating event changes this: teams rotate through 14 topical tables to explore with memorable hands-on experiments and all senses (touch, smell, taste, hearing, seeing) the great range of structural, mechanical, thermal, electrical, optical, and aesthetic properties of the different material classes, processing techniques, and how materials are selected and applied in technology, science, art, and music. An additional Tools & Techniques session introduces the students to the Discover Materials! Project resources at their disposal: a 'please touch' collection of bulk materials and products made from these, which via QR codes are linked to the Granta EduPack and EcoAudit tool (thereby integrating intuition with rigor), and the numerous processing techniques available in the various maker spaces on campus. This first introduction to materials, eco-design, and overall Materials Thinking is further developed in various higher level and also interdisciplinary courses, integrating whenever possible examples from ongoing research on, for example, the design and manufacture of eco-efficient, biogenic or bioinspired functional materials; such examples frequently spark student interest in research. However, the Discover Materials! Project not only supports student teaching and learning; with its aesthetically pleasing and informative exhibition and outreach activities it excites also external visitors for the material world that surrounds them.

Innovative pedagogical practices for teaching material science at the Mechanical and Production Engineering Department of the University of Lyon 1

Pischedda Vittoria*, Jean Colombani, Pauline Schlosser, Damien Le Roy, Antoine Berut, Oriane Bonhomme, and Esstelle Homeyer
Institut Universitaire de Technologie

In the Mechanical Engineering and Production (GMP in French) department at the University Institutes of Technology (IUT in French), we train technicians capable of managing activities related to the full life cycle of a product, from design to production and recycling. The Villeurbanne Gratte-ciel site is the largest department of its kind in France, with more than 700 students in the first and second year of university and professional degrees. For the past ten years, we have been developing active teaching practices in conjunction with the ICAP service (Innovation, Conception, Accompaniment for Pedagogy -of the University of Lyon 1). For example, we have set up flipped classes, introduced voting machines and new pedagogical approaches (learning by groups of different levels, serious games, active approaches). These approaches have been evaluated very positively by students and are drivers for us as teachers to improve student learning and success, as well as to discuss teaching techniques. Inspired by the recent reform of the IUT, we are implementing new pedagogical practices around “Learning and Evaluation Situations” (SAE in French). We put the student in a professional situation where he/she has to use the skills acquired in different disciplines to solve a problem and learn at the same time. This represents a new challenge for students and also for teachers, who must interact more with colleagues from different disciplines. We are discussing the role and how to adapt materials science teaching in this interdisciplinary skills assessment context.

Myths and lies of metallurgy in cinema

Núria Salán
Polytechnic University of Catalonia

In this talk, well known and recognized situations from TV-series and films (Game of Thrones, Money Heist, Lord of Rings, Conan, etc.) are shown and taken as a starting point for discussions on materials science. These scenes represent idealized visions, far removed from reality, which have contributed to myths and misconceptions of metals. The situations can instead be used to explain why they are wrong and misleading. In doing so, a solid knowledge of some metals can be developed. In addition, students are encouraged to search for and locate material "lies" in movies or TV-series, and comment on them, by explaining why they cannot be true. It is an alternative and engaging way of learning metallurgy in the classroom.

Life cycle assessment and the circular economy: a teaching case study

Ronald Kander
Thomas Jefferson University

This presentation is a case study of the successful development and initial offering of a new graduate course introducing students from a broad range of academic backgrounds to life cycle assessment (LCA) and how it can be used as a metric as we move toward a more circular economy (CE).

The goal of the course is to bring perspective to the practical application of the LCA tool and CE concepts to products, processes, and business activities. The course addresses how industry is applying LCA to its products and processes and assesses the potential of LCA as it evolves as an environmental tool and as an ethic in describing CE scenarios. Case studies demonstrate how the use of LCA can lead to beneficial results or, on the other hand, be manipulated and used as a "greenwashing" tool. Throughout the semester, students learn to use an open-source LCA software package (openLCA) and perform their own LCA calculations as they develop a complete LCA analysis on a product or process of their choosing as a final term project.

Course examples range from full, robust LCA models to issues surrounding the development of more streamlined approaches. Applications in life-cycle design and ecolabeling are presented, as well as attempts to include CE concepts in the development of public policy in the United States and abroad. Of course, no discussion of industrial applications would be complete without consideration of life cycle costing and its importance in corporate decision making.

The initial offering of the course in the fall of 2022 was very successful and, based on student feedback, will now be offered annually moving forward and opened to a wider range of graduate and advanced undergraduate students.

Teaching sustainability for manufacturing apprenticeships

Itai Vutabwarova* & Heather Driscoll
The University of Sheffield

The purpose of this research is to review two modules within the apprenticeship degree programmes at the Advanced Manufacturing Research Centre (AMRC), The University of Sheffield in which sustainability was a key focus. Our talk and poster will outline the framework for the modules, explaining the motivations behind the sustainability drive, the aim, objectives and assessment methods of the modules, and the teaching practices employed.

All of the apprentices are employed at engineering organisations and are working towards their apprenticeship standards through undertaking a BEng degree at the AMRC. During the second year of study, the apprentices undertake two modules; 'Multidisciplinary Design' and 'Professional Engineering and Sustainable Manufacturing'. These modules were previously run independently and although sustainability played a small role, it was not the primary focus of the modules. Over the last two years we have revised the learning outcomes and improved the alignment between the modules to ensure that sustainability is at the forefront of the curriculum.

Sustainability has seen an increasing importance in engineering, as reflected in the revised professional engineering standards (AHEP4) and our University's strategy and action plan. We wanted to broaden the apprentices' view of what sustainability means from a social, economic, ethical and environmental perspective. The aim was to avoid shoehorning it into the modules, but to encourage the apprentices to think critically about how it related to their own organisations and the wider society.

The talk will discuss the strategies used to engage the apprentices in exploring the topic using Ansys Edupack for evaluating sustainable developments within the manufacturing industry, whilst also considering the wider implications through the Earthshot initiatives. The poster will detail the learning and teaching approach, including how the modules were structured and the use of peer feedback to assist in developing successful group work communication.

Driving ecodesign forward: the new challenge of SAE Brasil

Rodrigo Motoharu Kobayashi[1], Mauricio Dwek[2*], José Carlos Zart[3], & Carlos Andrés Olivares Garrido[3]
[1]University of São Paulo, [2]Ansys Academic Field Team, & [3]ESSS

SAE Brasil is the organizer of the main student design competitions in Brazil. Sensing the need to foster the adoption of sustainability in the education of future engineers, SAE Brasil partnered with ESSS and Ansys for the latest edition of the Baja SAE tournament, to ask students, for the first time, to address environmental factors and use life cycle thinking in a new challenge. To do so, both student teams and jury members of the competition had to be trained on ecodesign methodologies and tools. The talk will show the efforts that were made in communicating to the students the importance of adding a sustainability angle, not only as a small addition to an overall project but as a transversal subject that can inform each sub-system in a car. This forced students to collect data on a variety of elements in their projects to answer questions on the life cycle stages of their vehicle. This data was then submitted as a new section in their final reports, with guidelines defining the scope and format for the results. The use of Ashby's systematic methodology for material selection was also proposed to improve the overall performance of their prototypes, on several levels. Feedback from both students and jury members was gathered after this pilot project and is also discussed. Including this challenge can potentially work as a Trojan Horse to raise awareness to ecodesign in universities via the student design teams, with also the possibility of making ecodesign methodologies more prominent in the industry in the long term (since Brazil is still lagging behind on this aspect). The results from the teams' reports were extremely useful to generate an overview of supply chains used in the making of the cars, with regional specificities emerging. It also provided the baseline to build the next edition of the tournament. The lessons learned from this first experience will now be used to add ecodesign challenges to other competitions organized by SAE Brasil, such as the Formula Student and Aero Design.

Teaching material recycling through a Dragons' Den project

Tim Huber[1]*, Ali Reza Nazmi[2], and Hossein Najaf Zadeh[2]
[1]Luxembourg Institute of Science and Technology & [2] School of Product Design, University of Canterbury

Typically, Industrial Product Design students select a material to match their design requirements from a catalogue of commercially available, virgin materials. However, students are also driven by a desire to use sustainable and recycled materials. To enable students to work with recycled materials and teach them about the difficulties and opportunities in materials recycling, a material-centred design project was developed, encouraging students to develop new products from a randomly allocated waste material. Students were allocated to groups and at the beginning of the course had to pick a common waste material (thermoplastic polymers such as PP, PET or PLA, paper & cardboard, biological waste such as human hair, leaf matter and food waste) through a lottery system. The project was split in two halves; first students had to research the properties and ideal processing conditions of their waste materials and suggest up to three products they could develop from it. The were supported in their research through a series of lectures on material centred product design as well as laboratory experiments to introduce them to common polymer, pulp and composite processing techniques. In the second half of the project, students were asked to develop a physical prototype and present their final product in a 3-minute "elevator-pitch" style, highlighting its features and business opportunities. 5 – 10 projects were selected to be presented to an external jury of experts for their ecological and economic impact. Prize money was awarded by the jury in a Dragons' Den scenario to help the students develop their ideas beyond the course. The approach was very warmly welcomed by the students and 2 start-up companies were founded by students based on their original projects. Key learnings from the approach from an educators approach will be presented and suggestions for further improvements will be made.

Designing a course in eco-friendly materials selection for design students

Fred Veer* & David Peck
TU Delft

In a world where sustainability is in the news, with high profile reports of; the UN COP negotiations, just stop oil, nitrogen crisis, geopolitical resource tensions, cost of living crisis, and the tragic war in Ukraine, means that the reliability of supply & demand of energy and raw materials is also pushed to the forefront. Enhanced environmental awareness is becoming the norm, for researchers, students, professionals and leaders. The reality is that with such complexity, information overload often occurs. The amount of information, often contradictory, that is presented to people, can close minds rather than open them. In a search for easy fixes students start to use wood in designs under the assumption that wood is de facto environmentally better by definition, neglecting the demand - supply issues and End Of Life scenario challenges. To deal with these challenges, an elective course in eco-friendly materials selection has been designed, built around Ansys/Granta Edupack, used as an enabling tool, where students are first 'de-educated' from their initial media induced concepts and then re-taught a methodical approach where answers are evaluated based on facts and calculations rather than presumptions. The course is designed to cross design disciplines and national boundaries and has been introduced into the academic year 2022/2023. The methodology used is outlined, the specific exercises are shown and the student responses to the novel course format are presented.

Building the house of our dreams with advanced materials

Ana Urbieta* & Paloma Fernández Sánchez
University Complutense Madrid

One of the most effective ways of catching students' attention to a particular subject is to approach it to their daily life. Nowadays, Advanced Materials are used in a wide variety of everyday applications and will be used more and more in the near future with new functionalities, making our life easier. Based on this, a course of advanced materials is developed with the aim of bringing students closer to the possibilities that these materials can provide them in their daily lives. A virtual model of dreamed house is "built" in a cooperative work for all the students in the course. Each group is in charge of a room (kitchen, bathroom, garden, living room...) and among all common elements such as walls, windows, roof, floor etc. The final model must meet just two requirements: be energy efficient and make the most of the waste generated. To get all the students involved in the work of the rest of the groups, an initial activity with two questions is proposed: How is your dreamed house? What can we find inside? The answers will be the starting point to the groups to work in the assigned room. Each group choses the format for the final presentation of its room. The formats are very different, there are videos, decision games, files..... but during the course the students have expanded their research capabilities and their knowledge in Materials Science.

Data management courses implementation in a master degree simulation projects

David Mercier[1], Fabien Volpi[2], & Guillaume Parry[2]
[1]Ansys CR&D Team & [2]Grenoble Université

Data management, as well as multiscale and multiphysics modelling are key skills required by companies recruiting "Materials science" engineers today. In this context, it has been proposed to complete an already existing teaching program in numerical modelling in the frame of a master degree in Phelma engineering school of Grenoble University, by adding new courses on these topics. The initial structure of this numerical modelling course is composed of 2 main teaching units:

- First, a 20h-lecture dedicated to key-concepts in modelling is given (ab-initio, molecular dynamics, discrete elements, finite elements, AI, machine learning,...). Basics on numerical methods have already been addressed at Master 1 level.
- Then, students work by groups of 2-4 on long-term projects over 4 months under the close supervision of professors that are specialists in each domain. 4-hour sessions are held on a weekly basis.

Overall, students spend 48h in face-to-face sessions with supervisors, and the equivalent time on their own. Each student group works on a research topic proposed by academic researchers mostly in relation with PhD works in progress in partner laboratories (SIMaP, LEPMI, CEA,...). These projects are carried out on high-standard numerical platforms. On the top of this initial teaching package, an innovative pedagogical project on data management is implemented:

- A first course is a lecture/tutorial that presents basics on data management for material science.
- Then a data management framework linked to simulation is deployed during the long-term project, where students work on an Ansys database, perform numerical modelling and populate the database with the results of their modelling, in order to capitalize their results and run optimization routine on their simulations.

Finally, we will discuss the learning outcomes for the students, how students experienced this implementation and what can be improved for next year.

Flexible data-led approach for fostering concepts on synergy of different properties in materials teaching and projects

James Ren[1] & Li Wang*[2]
[1]School of Engineering, Liverpool John Moores University & [2]Queen Mary University of London

Synergy of properties (e.g. multiple mechanical properties, mechanical-physical properties) is an important and critical issue in materials engineering education. This is a challenging topic for teaching and learning in general mechanical and/ or manufacturing programs and materials focused projects. It is also a difficult task for professional training in healthcare (e.g. orthotics design), for which the materials selection need to fit multiple constraints or individual patient needs.

In this work, we explored the development of a data-led inclusive framework integrating experimental, analytical models, engineering simulation and machine learning system to help learner developing and evaluating the conception of synergy of properties associated with material structures. Two main case studies will be presented focusing on synergy of different mechanical properties and synergy between mechanical and physical (thermal, electrical) properties in layered systems, composites and duplex phased systems.

Analysis of the approach through case studies and reviews showed that the integrated approach provides the students with a flexible data system to quickly visualise the results, analyse their ideas and make critical choice(s). The efficiency (time, cost, resources, flexibility) of such an approach in fostering data competence, interests and problem-solving capacity in materials at different levels is analysed. The potential and critical issues of using such an approach in HE, industries and public engagement is also systematically analysed.

Introducing data science concepts into materials teaching

John Robertson-Begg
University of Derby

Traditional materials developments were made by experimentation, theory, or computation, also known as the 1st, 2nd and 3rd paradigms. We are now in the era of the 4th paradigm which is a data driven approach and uses techniques such as machine learning to help find and develop new materials. The author is preparing his students for the 4th paradigm by incorporating various aspects of data science into the curriculum of a Materials Science Technologist Degree Apprenticeship. In the first-year students are introduced to the concepts with a module called 'Materials Data Skills and Personal Development Planning'. They study Python programming based on Jupyter notebooks (a medium where both text and runnable code is available in the same document) and shown how to access online repositories such as Mendeleev and pymatgen. They are also shown the Materials Project which contains properties of elements and compounds derived using Density Function Theory (DFT). In the second year, students are introduced to the concept of machine learning in a module called Advanced Materials Properties and Processes. One of their assessments is to investigate a database containing 312 high strength steels and investigate whether strength and elongation properties can be predicted from composition. A variety of machine learning algorithms are applied and evaluated using MATLAB and other software. In the final year it is planned to suggest project work in this area. The topics must be work related to fulfill the requirements of the apprenticeship. The talk will include examples of teaching materials and student outputs and reflect on the impact these concepts have had on their learning experience.

SCHOOLTOOL- thrive their drive; education and training rethought

Steffen Ritter
Reutlingen University

Every day, billions of molded plastic components are produced worldwide. This makes particular sense because the environmental footprint of polymer components overwhelmingly outperforms many other solutions.

Creating state of the art plastic parts and products nowadays require material know how, process know how and engineering know how. All these aspects need to be taken into account to achieve economically and ecologically best results for the given development. In a complex manner materials and their use in products are very much connected how they are processed and how the product is finally manufactured. Mutual understanding between the product designer, the moldmaker and the polymer part injection molder is crucial for good injection molded parts.

SCHOOLTOOL is a modular teaching and learning concept that combines both craft training and academic engineering education. Colleges, vocational schools and in-company training are to use it to prepare future experts for developers of molded parts, molding tools and injection molders for their tasks and an understanding of related disciplines.

With a consistent mix of different teaching and learning methods, the blended learning approach aims to achieve intrinsic motivation. Through many activating learning elements and the participation of the learners, a practical hands on transfer of knowledge is guaranteed.

Overall the SCHOOLTOOL concept as an archetype should be an inspiration which can be applied to many other materials and processes. Any material which is processed requires specific production and design know how.

Material Science and Design NEXUS: A Case Study

Flavia Papile[1]*, Mariapia Pedeferri[1], Barbara Del Curto[1], and David Mercier[2]
[1]Politecnico di Milano and [2]Ansys CR&D

Over the years, materials have been studied through a multitude of lenses: from the technical analysis and characterisation of their intrinsic properties, to aesthetic and sensorial material attributes, until their extrinsic, intangible and cultural properties, mainly depending on the study field of investigation. Nowadays, knowledge becomes interdisciplinary, research becomes open and intersections between different fields of study is certainly evaluated as a positive attitude, to enrich studies and researches with several points of view on the threatened topic.

Therefore, based on this consideration, the proposed work has been structured with the objective of bridging research activities conducted on materials studies emerging from different departments of Politecnico di Milano, to envision research on materials not as a multitude of silos, but as a prolific network. In doing this, a collaboration between Politecnico di Milano and ANSYS has been established to envision and structure a preliminary activity with the objective of building a network to share knowledge in a horizontal way. Through the study and application of the GRANTA MI software, it has been possible for the authors to build a working space in which diverse studies conducted in different university departments can converge. Finally, the usage of both case studies to support education projects will be discussed.

Two case studies will be presented: one, preliminary, based on an iterative research activity. The second, showing the possibility of interlacing similar researches with different objectives. This exercise shows how, sometimes, researchers that build on a common knowledge background, when put together, can open up towards new scenarios and envisioning new research patterns, facilitating knowledge transfer between peers or to provide background knowledge for thesis works or superior teaching activities.

From Roman coins to multidisciplinary metallurgy

Ana Maria Gonzalvez-Pons[1]* & Javier Orozco-Messana[2]
[1]Colegio el Armelar, Valencia & [2]Universitat Politècnica de València

Archaeometallurgy is a typically multidisciplinary discipline that studies metals and their use in past societies. Metal artifacts and objects related to their production, such as crucibles, casting molds, and alloys, are introduced to students for understanding the relevance of metals and processes from the way in which they were made (the so-called operational chain) and in their function in different human societies, Therefore, from a historical metals have always had significant social and economic importance. Archaeometallurgy helps the students to learn in a multidispciplinary context the relevance of metals and the importance of materials on the development of society and technology. Results on an archeometallurgy workshop prepared for new university students demonstrate how the contextual delivery of material science helps not only on understanding scientific principles but also enthusing students onto materials science.

Engaging bioengineering students in materials science and engineering through active learning and interactive classroom activities

Emilio Castro*, Francisco Javier Gil, and Román A. Pérez
Universitat Internacional de Catalunya

In the best universities in the world where bioengineering is taught (University of Berkeley, Cornell, Sheffield or the Ecole Polytechnique Fédérale de Lausanne), a core of subjects is related to materials science and engineering. And it could not be otherwise at the International University of Catalonia where we teach. Subjects such as Biomaterials and Biocompatibility, Advanced Materials, Materials Selection, Materials Shaping Technologies, Biomaterials Characterization Techniques or Micro and Nanotechnology are part of the integral formation of a bioengineer.

Since the beginning of the degree program 6 years ago, professors have been implementing interactive activities and active teaching methodologies that promote the learning of our students and involve them in the field of materials science and engineering:

- A 3-minute elevator pitch in which the student prepares and presents in class a fantastic or science fiction material of their choice from a list. It works quite well because it relates the course contents to the students' favourite comics, movies or series.
- A debate regarding the importance of the method in the selection of materials with which to see in detail all the existing methodologies for the selection of materials that due to lack of time cannot be included in the syllabus of the course. It takes place in a different environment from the classroom -such as an auditorium or a mobile classroom- and allows to discover soft skills in some students.
- The idea arose to organize among the students a virtual machines-tools trade show in which they would record a 5-minute video presenting the material shaping technology used in a company of their choice.

Proof that it works is that several of our first graduates are now doing master's degrees abroad to complete their training in the field of materials science and engineering applied to the healthcare sector. "

Day Two, 1:45pm

Implementing industrial practice of engineering quality management into classroom to increase students' ownership

Li Wang
Queen Mary University of London

The importance of quality management in engineering sector has been growing considerably in recent years. To give students a bit of more understanding in this area, an industrial case was used in the teaching. Adapting its process and knowledge, the students were asked to select a project to work with, implementing the DAMIC quality control process, then submit their learning into a video format. The introducing of real industrial case has increased student's motivation and encouraged them to apply the quality management approach into their projects. Being able to make the choice themselves for the project to work on allowed them to develop interest/passion in those areas. Capturing their learning with their own voice in a video format has also made the subject more interesting, and also improved their technical and soft skills at the same time. After the submission, the students were also trained to develop the assessment criteria, then given the opportunity to participate into marking other groups' videos. So in a sense, they have not only learned from their own projects, but also from other groups' videos, covering a big range of material engineering in the industry. This whole learning and assessment process has encouraged students' reflection, with the lecturer acting as a facilitator, rather than an assessor. Hence, it has increased dramatically students' ownership in learning, as a vital component in their growth mindsets. The response from the students has also confirmed this.

Creating a Learning Assistant program to support project mentorship

Susan Gentry
University of California, Davis

Oral presentations and team projects are essential parts of the undergraduate engineering curriculum and are required by employers and ABET accreditation. At the University of California, Davis (UC Davis), these skills are developed in a junior-year Materials in Engineering Design course and reinforced in the senior-year capstone design course. In the Materials in Engineering Design course, students complete quarter-long group projects with interim and final presentations that align with the course units on materials selection, processing methods, and sustainability.

I have created a learning assistant (LA) program to support student teams. LAs are undergraduate students who serve as peer mentors alongside the Teaching Assistant (TA) and Instructor. I solicit LA applications from top undergraduates from the prior year. I met with the LAs weekly to train them in giving constructive feedback and the common errors exhibited at different stages of the projects. The LAs serve as audience members for presentations and meet with groups to share their suggestions for completing the assignments. Students in the class report that the LAs provide helpful feedback throughout the project, particularly regarding recommendations and pitfalls that LAs encountered the prior year. LAs earn course credit and are trained in teaching and leadership skills, which helps students who are applying to graduate school. The LA program is a mutually beneficial program that strengthens and develops undergraduate engineering students and could be designed for a broader set of classes.

MICRO- - The Materials Initiative for Comprehensive Opportunity

Jessica Sandland[1]*, Maxwell L'Etoile[1], & Cécile Chazot[2]
[1]MIT & [2]Northwestern University

Students from certain demographic backgrounds are chronically underrepresented in engineering education, particularly at the doctoral level. The field of materials science and engineering (MS&E) faces additional challenges when it comes to attracting graduate students from underrepresented backgrounds because 1) MS&E is rarely taught in secondary schools and 2) it is not commonly offered as a major at the undergraduate level.

In this talk, we introduce MICRO—the Materials Initiative for Comprehensive Research Opportunity, an online research and education program directed at undergraduates in the U.S. who are members of groups historically underrepresented in science and technology. The MICRO program consists of three components: 1) an online research experience (typically modeling, simulation, or data analysis), 2) an introductory MS&E curriculum and 3) the mentoring of professional skills necessary for success as a materials researcher.

The MICRO program has several related goals. First, it aims to get students well-acquainted with the field of Materials Science and Engineering so that they can consider MS&E as a potential area for their future careers or doctoral studies. Furthermore, the program aims to give participants a meaningful experience conducting research in close collaboration with a university laboratory, allowing the undergraduates to grow and develop as materials researchers. Finally, the program aims to grow the students' professional networks, expand their communication and proposal-writing skills, and help them further develop the soft skills that are essential for professional success.

The MICRO program completed its pilot year in the '21-'22 academic year, and is currently in its second year of operation. In this time, we have demonstrated that students can conduct meaningful work via remote research opportunity while forming valuable professional relationships. As the MICRO program continues to grow and evolve, we hope that it can provide a model to other organizations who are interested in expanding their outreach to students from historically under-served groups.

New ways for teaching materials science at University Gustave Eiffel

Laurent Gautron
Université Gustave Eiffel

The University Gustave Eiffel was created on January 1, 2020, by combining a university, a research organization, a school of architecture and three engineering schools. Its major theme is dedicated to the city of the future, in particular on sustainable construction materials. Its specificity is that it is the leading university in France in terms of the proportion of students in apprenticeship training. This presentation will be devoted to two important axes of materials education, in engineering training in apprenticeship, and in masters in initial training. Apprentice engineers spend half of their training (6 months per year over 3 years) in a company: they thus have a unique and very enriching field experience. Many courses are based on concrete examples of materials encountered by students on their industrial sites: they are presented by the apprentices and the teacher uses these examples to progress through the course. On the other hand, projects (real concrete cases) are put forward by the companies, and teams meet to solve the problem related to the proposed materials. The "materials" team therefore works with the "mechanical design" or "maintenance" team to search and propose solutions. Peer evaluation is also a strong marker of this project-based pedagogy. The lessons of the Advanced Materials and Nanomaterials master's degree are based on two fundamental pillars: elaboration and characterization. The pedagogy in this master is based on experimentation: generally in pairs, the students work on a specific material which they will synthesize, then characterize on two aspects: the microstructure (crystallinity, texture), the relevant properties for the functional material manufactured. They can then try to optimize the properties by re-synthesizing the targeted material. The teachers also work in collaboration with the Center for Pedagogical and Digital Innovation, in particular on new teaching tools and with the observatory of teaching practices.

Section 5: Poster Overview and Abstracts

Poster Overview

#	Poster Presenter, Affiliation, and Title
1	**Guillermo Rubén Facal* and José María di Iorio** Facultad de Ingeniería Universidad de Buenos Aires *Design and Simulation of a Multiplier Gearbox Using CAD-CAE Systems*
2	**Evy Dutheil[1,2]* & Hélène Lenormand[3],** [1]Studio Evy-Design, [2]Falmouth University, & [3]UniLaSalle *By-bio-plant based material and Design Opportunities*
3	**Javier Orozco-Messana* and Ana Maria Gonzalvez-Pons**, Universitat Politècnica de València Transdiciplinary Doctoral Research at ENHANCE EU University Alliance
4	**Heather Driscoll and Itai Vutabwarova***, The University of Sheffield *Teaching sustainability for manufacturing apprenticeships*
5	**James Ren[1]*, Li Wang[2], Vince Herencia[3], Tammam Kaid[1]** [1]Liverpool John Moores University, [2]Queen Mary University London, [3]Leaf Hospital Brighton *Flexible Data-led approach for Fostering Concepts on Synergy of Different Properties in Materials Teaching and Projects*
6	**Danka Katrakova-Krüger[1]* and Gergana Panova-Tekath[2],** [1]TH Köln & [2]Folkwang University of Arts *Implementing industrial practice of engineering quality management into classroom to increase students' ownership*
7	**Rosita Bannert**, The London Interdisciplinary School *An Interdisciplinary approach to Materials and Making*
8	**Navid Manai* & János Plocher**, Ansys Academic Development Team *Teaching Digital Manufacturing: A Look at Processing-Properties Charts for Additive Manufacturing*
9	**Paloma Fernández Sánchez* and Ana Urbieta**, University Complutense Madrid *Materials Science in the Botanical Garden*
10	**Ana Urbieta* and Paloma Fernández Sánchez**, University Complutense Madrid *Building the house of our dreams with Advanced Materials*
11	**Jan Pedersen* and Karsten Lund,** University of Southern Denmark *ECO audit used as a main factor in project work for undergraduate, first year students*
12	**Peter Hammersberg,** Chalmers Technical University *Exploring lack of interest of material engineering*
13	**Gerald Pilzv,** Montanuniversitaet Leoben *From Single- to Multi-point – The Variable Properties of Polymers*
14	**Piers Ireland[1]*, George Giannopoulos[1], Chris Howard[1], Tatiana Vakhitova[2], and Alfred Oti[2]** [1]University College London & [2]Ansys Academic Development Team *Framework for criticality assessment using Ansys Granta EduPack: a case study of Fairphone*
15	**ZhiLi Dong**, Nanyang Technological University *Training Final Year Undergraduate Students through Research Projects*
16	**S. Cruchley*, H. Leach, J. Griffiths, E. Medcalf, G. Chahni, L. Medlock, A. Nicum, A. Cruchley, and M.J. Jenkins,** University of Birmingham *Synoptic assessment as an authentic learning approach – student co-creation*
17	**Mauricio Dwek[1]* & Elisabeth Hülse[2]** [1]Ansys Academic Field Team & [2]Ansys Academic Development Team *Add an edge to your student's projects - Past, present and future of the Ansys Materials Selection Challenge*
18	**Sebastian Limberg* and Steffen Ritter**, Reutlingen University *POLYMATTER - a learning part for plastic properties*
19	**Juliane Karneboge* and Corinna Thomser** Hochschule Bonn Rhein Sieg, University of Applied Sciences *"Bioplastics: What is that and is it compostable?" Getting first semester engineering students started in the field of sustainability and material science*

Poster Overview (cont.)

#	Poster Presenter, Affiliation, and Title
20	**Claudia Luppertz*, Ali Khalil, Christian Kössler Irene Rothe, and Corinna Thomser** Hochschule Bonn Rhein Sieg, University of Applied Sciences *Project work with engineering students in the field of material science using agile project management*
21	**Leonard Ng Wei Tat**, Nanyang Technological University *Teaching AI to Materials Science Students: Challenges and Best Practices from NTU*
22	**Elisabeth Hülse* & Kaitlin Tyler**, Ansys Academic Development Team *Materials used for musical instruments: an inspirational topic to teach basic concepts in science and technology*
23	**Ilija Rašović**, University of Birmingham *Materials: A More Central Science*
24	**Xiaolei Feng**, Nanyang Technological University Singapore *Using computational crystal structure prediction as a route to teaching computational materials science*
25	**Sergejs Gaidukovs**, Riga Technical University *On material science and sustainability education at Riga Technical University*
26	**Stephane Gorsse[1]*, Theo Langlois[2,3], & Matthew Barnett[2]** [1] University of Bordeaux, [2] Deakin University, & [3] University of Lyon *Teaching responsible alloy design*
27	**M Burley[1], J Dean[1], A Lyneborg[1], M Coto[1] & TW Clyne[1,2]*** [1] Plastometrex Ltd & [2]University of Cambridge *Use of Profilometry-based Indentation Plastometry (PIP) Technology in Materials Teaching*
28	**Stéphane Godet* & Colin Aughuet**, Université Libre de Bruxelles *Design and building of a mini-house with low environmental heating system*
29	**Andrea Gassmann*[1], Susanne Kremeier[2], & , Nina Gipperich** [1]EXPERIMINTA gGmbH & [2] Humanizing Technologies GmbH *ScienceCenters – How to spark the love for STEM disciplines by hands-on experiments and digital tools*
30	**Susannah Cooke**, Ansys Academic Product Manager *Ansys Granta EduPack Evolution since IMES 2019*
31	**Kaitlin Tyler*, János Plocher, & Elisabeth Hülse,** Ansys Academic Development Team *Sustainable Product Design via Simulation and Materials Selection*
32	**Flavia Papile[1]*, Mariapia Pedeferri[1], Barbara Del Curto[1], & David Mercier[2]** [1]Politecnico di Milano and [2]Ansys CR&D *Material Science and Design NEXUS: A Case Study*

1

Design and Simulation of a Multiplier Gearbox Using CAD-CAE Systems

Guillermo Rubén Facal and José María di Iorio
Facultad de Ingeniería Universidad de Buenos Aires

Speed multiplier gearboxes are equipment used in mechanical transmissions in wind turbines. Nowadays, wind energy plays a major role in the process of switching towards non-conventional energies. Also, Argentina is trying to change its energy matrix to clean energies, especially in Patagonia region. Computer Aided Design (CAD) and engineering (CAE) is a fundamental part of any mechanical design. In this sense, this work wants to contribute to the development of methodologies for the design and simulation of speed multipliers using CAD and CAE tools. To achieve this objective, we have used KISSsoft (CAE; KISSsoft AG) for the dimensioning of machine elements, such as gears of planetary and ordinary trains, shafts, selection of bearings, etc.; SolidWorks (CAD; Dassault Systemes) for the component assembly, detail engineering and design of boxes, and ANSYS (CAE; Ansys Inc.) for the structural and dynamic simulation of components and assemblies by finite elements method.

2

By-bio-plan based material and Design Opportunities

Evy Dutheil[1,2]* & Hélène Lenormand[3]
[1]Studio evy-design, [2]Falmouth University, and [3]UniLaSalle

This project emerges from global concerns relating to the use of finite resource materials. There are general issues relating to the environmental harm, the impact and recyclability of using plastics or other intensive materials in terms of sustainability. Within the industry, bio-plant-materials have shown some measurable positive outcomes in terms of lowering the impact, valuing local resources, renewability and low toxicity. We are differencing biomaterial, interacting with biological systems and by-bio-plant based material which is issued from renewable plant material and by-products from the agro-industry.

Today these world problems demand new perspectives, adaptation and should be encouraging students to work on a new typology of 'eco and regenerative' materials. This is important to consider as an alternative resource, new ways of behaviour and a meaningful shift for the future. An existing current successful use is the adoption of hemp and flax. This project aims to investigate how bio-plant-materials and especially by-product, can be explored to provide a sea of opportunities in place of more commonly used industrially manufactured materials.

The process looks at characteristics of the material through manipulation, pedagogical practice, and design thinking approaches. Executed through engaging design masterclasses in an Engineered University, with a mix of marketing and engineering students; connecting their course to their specialist internal research lab focusing on agro-material; this bridge process aims to initiate and familiarise students to these problematics and immerse them in a professional research environment. The challenge was to initiate and develop design outcomes as one of the actions and change their mind-set as future project product manager. Developing stronger network link with prospective mature student in industry and cutting edge research was one the aim.
Circular and systems design thinking to improve the lifecycle of the product or material which were considered and reflected upon.

3

Transdisciplinary Doctoral Research at ENHANCE EU University Alliance

Javier Orozco-Messana* and Ana Maria Gonzalvez-Pons
Universitat Politècnica de València

ENHANCE, the European Universities of Technology Alliance, through developing a transformation agenda for the Alliance aims to develop the role of universities as drivers and enablers of urban sustainable development.

The mode of transdisciplinary research is to increase social relevance and integrate practical knowledge by integrating various stakeholders into research, including the definition of research questions and goals, participation in the research process and the discussion of research results. Transdisciplinary research also includes the evaluation of research processes and outcomes.

The proposed presentation explores the results obtained through a Marie Sklodowska Curie Industrial doctoral network on a urban development project for the city of Valencia where the results for neighbourhood refurbishment showed the excellent performance of new modular materials solutions codesigned in 4 parallel doctoral thesis.

4

Teaching sustainability for manufacturing apprenticeships

Heather Driscoll and Itai Vutabwarova*
The University of Sheffield

The purpose of this research is to review two modules within the apprenticeship degree programmes at the Advanced Manufacturing Research Centre (AMRC), The University of Sheffield in which sustainability was a key focus. Our talk and poster will outline the framework for the modules, explaining the motivations behind the sustainability drive, the aim, objectives and assessment methods of the modules, and the teaching practices employed.

All of the apprentices are employed at engineering organisations and are working towards their apprenticeship standards through undertaking a BEng degree at the AMRC. During the second year of study, the apprentices undertake two modules; ‘Multidisciplinary Design’ and ‘Professional Engineering and Sustainable Manufacturing’. These modules were previously run independently and although sustainability played a small role, it was not the primary focus of the modules. Over the last two years we have revised the learning outcomes and improved the alignment between the modules to ensure that sustainability is at the forefront of the curriculum. Sustainability has seen an increasing importance in engineering, as reflected in the revised professional engineering standards (AHEP4) and our University’s strategy and action plan. We wanted to broaden the apprentices' view of what sustainability means from a social, economic, ethical and environmental perspective. The aim was to avoid shoehorning it into the modules, but to encourage the apprentices to think critically about how it related to their own organisations and the wider society.

The talk will discuss the strategies used to engage the apprentices in exploring the topic using Ansys Edupack for evaluating sustainable developments within the manufacturing industry, whilst also considering the wider implications through the Earthshot initiatives. The poster will detail the learning and teaching approach, including how the modules were structured and the use of peer feedback to assist in developing successful group work communication.

5 Flexible Data-led approach for Fostering Concepts on Synergy of Different Properties in Materials Teaching and Projects

James Ren[1]*, Li Wang[2], Vince Herencia[3], Tammam Kaid[4]
[1]*Prof. of Engineering, School of Engineering, Liverpool John Moores University, UK*
[2]*School of Engineering and Materials Science, Queen Mary University London*
[3]*Clinical Manager of Podiatry Services Leaf Hospital Brighton*
[4]*School of Engineering, Liverpool John Moores University*

Synergy of properties (e.g. multiple mechanical properties, mechanical-physical properties) is an important and critical issue in materials engineering education. This is a challenging topic for teaching and learning in general mechanical and/or manufacturing programs and materials focused projects. It is also a difficult task for professional training in healthcare (e.g. orthotics design), for which the materials selection need to fit multiple constraints or individual patient needs.

In this work, we explored the development of a data-led inclusive framework integrating experimental, analytical models, engineering simulation and machine learning system to help learner developing and evaluating the conception of synergy of properties associated with material structures. Two main case studies will be presented focusing on synergy of different mechanical properties and synergy between mechanical and physical (thermal, electrical) properties in layered systems, composites and duplex phased systems.
Analysis of the approach through case studies and reviews showed that the integrated approach provides the students with a flexible data system to quickly visualise the results, analyse their ideas and make critical choice(s). The efficiency (time, cost, resources, flexibility) of such an approach in fostering data competence, interests and problem-solving capacity in materials at different levels is analysed. The potential and critical issues of using such an approach in HE, industries and public engagement is also systematically analysed.

6 Implementing industrial practice of engineering quality management into classroom to increase students' ownership

Danka Katrakova-Krüger[1]* and Gergana Panova-Tekath[2]
[1]*TH Köln, Germany and* [2]*Folkwang University of Arts, Essen, Germany*

The importance of quality management in engineering sector has been growing considerably in recent years. To give students a bit of more understanding in this area, an industrial case was used in the teaching. Adapting its process and knowledge, the students were asked to select a project to work with, implementing the DAMIC quality control process, then submit their learning into a video format. The introducing of real industrial case has increased student's motivation and encouraged them to apply the quality management approach into their projects. Being able to make the choice themselves for the project to work on allowed them to develop interest/passion in those areas. Capturing their learning with their own voice in a video format has also made the subject more interesting, and also improved their technical and soft skills at the same time. After the submission, the students were also trained to develop the assessment criteria, then given the opportunity to participate into marking other groups' videos. So in a sense, they have not only learned from their own projects, but also from other groups' videos, covering a big range of material engineering in the industry. This whole learning and assessment process has encouraged students' reflection, with the lecturer acting as a facilitator, rather than an assessor. Hence, it has increased dramatically students' ownership in learning, as a vital component in their growth mindsets. The response from the students has also confirmed this. Li Wang, Queen Mary University of London

Using Movement in Materials Science Education Students are actively involved to build up the microstructure and represent the processes within materials as a cooperative movement. For easier anchoring of this experience music and simple folklore dance elements are used. In this lecture the concept and some examples will be shown interactively.

7

An Interdisciplinary approach to Materials and Making

Rosita Bannert
The London Interdisciplinary School

The problems facing humanity are more complex, interconnected, and urgent than ever before. The modern workplace needs people who can tackle these kinds of issues and make a real impact on the world. The current university system can't evolve quickly enough, so we need a new solution. This is where The London Interdisciplinary School (LIS) comes in.

We're building a brand new university that will give students the knowledge and skills needed to address social and global problems via an interdisciplinary approach bringing together multiple disciplines. To learn about materials through making is to learn about the world in a tangible and concrete way. Materials and Making involves rigorous scientific understanding as well as creative engineering and capability with one's hands.

The digital age removes contact with the physical environment. Lost in cyber space? Craving re-connection and re-education of all things material and grounded? By creating and making we transmute our world into joy and energy. Empowering oneself to think like an engineer is freeing our mind and will leave you with the confidence to build and fix the world around you. This course is about finding the motivation to get out there and try things out.

"The aims of this module were ambitious and exciting." - M&M student

"The most radical new university to open in decades." - The Times

8

Teaching Digital Manufacturing: A Look at Processing-Properties Charts for Additive Manufacturing

Navid Manai* & János Plocher
Ansys Academic Development Team

Digital or computer aided manufacturing (CAE) is becoming increasingly important for costly manufacturing techniques like additive manufacturing (AM). Understanding the multi-facetted relationships between material, process and performance is pivotal to inform numerical models and optimize AM-parts using simulation in the early stages of the product design. For the next generation of engineers, it will thus be essential to understand those relationships not just for conventional processes but also of so-called key enabling technologies (KETs) like AM. Thus, this work proposes the integration of this knowledge into material databases and materials education software like Ansys Granta EduPack. A set of experimental data on alloys used in metal-AM have been gathered and post-processed to elucidate how process parameters like laser speed and power, affect relative porosity and melt pool sizes in Laser Powder Bed Fusion processes. Alongside metadata on the underlying assumptions and testing regimes, importance of this data for simulation is highlighted. In line with the similar type of data available in the Property-Process-Profiles (PPP) section of the Materials Science and Engineering database in Ansys Granta EduPack, and in order to enhance the students' understanding of the influence of processing parameters on the properties of the materials that have been additively manufactured, our proposition is to include the aforementioned experimental data as part of the PPPs in EduPack and create teaching resources using this data to support academics that are keen to include AM as part of their curriculum.

9

Materials Science in the Botanical Garden

Paloma Fernández Sánchez* and Ana Urbieta
University Complutense Madrid

A walk through a botanical garden is perfect to find surprising examples of the importance of materials science education on our daily life.
In the botanical garden, you will find all the different types of materials you could think of, from metals to composites. Moreover, you can easily relate functions and properties and study processes spanning from corrosion to crack propagation.
Students are left free to wander through the garden provided with a concise guide comprising four simple questions

- What have you seen? (a tree, a bench....)
- What is it made of? (wood as a composite, metal)
- Fundamental properties (of the main constituent material, if it is a complex object you can select a part, for example if it is a tree the leaves and the trunk have very different properties ...)
- Have you seen something that caught your attention? Why?

10

Building the house of our dreams with Advanced Materials

Ana Urbieta* and Paloma Fernández Sánchez
University Complutense Madrid

One of the most effective ways of catching students' attention to a particular subject is to approach it to their daily life. Nowadays, Advanced Materials are used in a wide variety of everyday applications and will be used more and more in the near future with new functionalities, making our life easier.

Based on this, a course of advanced materials is developed with the aim of bringing students closer to the possibilities that these materials can provide them in their daily lives.
A virtual model of dreamed house is "built" in a cooperative work for all the students in the course. Each group is in charge of a room (kitchen, bathroom, garden, living room...) and among all common elements such as walls, windows, roof, floor etc. The final model must meet just two requirements: be energy efficient and make the most of the waste generated. To get all the students involved in the work of the rest of the groups, an initial activity with two questions is proposed: How is your dreamed house? What can we find inside? The answers will be the starting point to the groups to work in the assigned room.
Each group choses the format for the final presentation of its room. The formats are very different, there are videos, decision games, files..... but during the course the students have expanded their research capabilities and their knowledge in Materials Science.

11

ECO audit used as a main factor in project work for undergraduate, first year students

Jan Pedersen* and Karsten Lund
University of Southern Denmark

ECO audit used as a main factor in project work for undergraduate, first year students. SDU has been using Granta EDUpack as a main part of the material teaching for around 20 years. From the beginning of 2019, The SDU has at a strategical level been working with the 17 sustainable development goals. As a part of this, two lecturers had decided to use Granta EDUpack and its Eco-audit tool, to implement sustainability in a student project on two study lines. The project is designed as a "reverse engineering project", where the students find a used household product, which they dismantle, make a Bill of Material, and uses Granta EDUpack to find out which material, 6 of the components is made of. After that they come up with suggestions for the processes of each of the 6 part. After this, the students make an Eco Audit of the current materials and processes. They analyze the materials and processes with the highest Eco impact, and examine if it is possible to use alternative materials or processes to produce the product in the required numbers. In 2021 we changed the curriculum for the study line, in a way so automation and sustainability got more attention. This meant that the reverse engineering project chanced from only being a part of a theoretical course to being the big semester project. The subject for the project was the first year a hedge trimmer, and the task was the following:

- Dismantle the trimmer
- Describe the actual trimmer
  - Materials
  - Processes
  - Assembly for an annual production of 400.000 items.
- Choose 10 part of the trimmer and make a reduction of the CO2 footprint and the energy absorption.

In 2022 we have continued this project, now with an electric chain saw instead.

12

Exploring lack of interest of material engineering

Peter Hammersberg
Chalmers Technical University, Gothenburg

Material engineering is one of the key skills needed when building sustainable systems of products and processes that can face many of the major challengers in society today, for example related to circularity of materials, energy supply, transfer to electro-mobility and replacing fossil-based polymers, just to mention some of them. Materials engineering is the interdisciplinary arena where material science meets the demand of functions, products, and processes, which contains a lot of interesting jobs for engineers, particularly from design and mechanical engineering.
Therefore, has it been and still is a puzzle that this field attracts such a small amount of the bachelors from these educations, since the opportunities for exciting carriers are many and there is a landslide of news about the problems connected the field every day.
The tacit understanding in the teaching community is traditionally based on the belief that the mechanical and design engineers think it is too much chemistry and physics and only attracts students bound for research, and that it naturally only is a small fraction that is determined enough to do so.

However, during present work with the development of a master program in Materials Engineering within the overall field of Mechanical Engineering at Chalmers, it was discovered that the established understanding of when material selection is done and how the material performance depends on interaction with the processes used, vary considerably between students from different bachelor programs depending on the order of the same specific basic courses. In this presentation these observations are discussed and how it affected the overall master program description and marketing.

13 From Single- to Multi-point – The Variable Properties of Polymers

Gerald Pilz
Montanuniversitaet Leoben, Austria

In the regular educational programs of material science and structural engineering, the comparison of mechanical properties is a basic element for evaluating their potential for structural applications. In a first instance, single-point data sheets with values from standard short-term testing procedures are the basis for a fundamental materials comparison. However, the suitability of plastics for practical applications is strongly dependent on the specific service conditions. Therefore, the properties of polymers, which are directly related to their macromolecular structure and mobility, are not static but highly variable resulting in functional multi-point data depending on the external loading situation as well as environmental parameters. With this perspective as core element of the lecture "material science of plastics" the service behaviour of polymeric materials is discussed based on the wide-ranging variability of the polymeric composition and molecular structure, which is strongly influenced by external parameters in processing and application. Using exemplary service-oriented case studies, corresponding influencing factors such as mechanical stress, temperature profile or moisture and media contact during processing and application are highlighted. The overall goal and main motivation of the course is a deeper understanding of the corresponding structure-property correlations as an important prerequisite for sensible material decisions and responsible use of plastics.

14 Framework for criticality assessment using Ansys Granta EduPack: a case study of Fairphone

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Methods of assuaging climate change are varied; however, many rely on the use of technology. With a need to deploy more technology the increased use of raw materials is ubiquitous. Yet, many emerging and sustainable technologies are high in density of materials that are not abundant, and their supply may possibly have geopolitical and strategic implications. Materials found to have a high supply risk and are of economic importance have been described as critical raw materials (CRMs).

Criticality assessments have been carried out at a range of levels from corporate to global using different criteria such as geopolitics, regulatory structures, social factors and a range of indicators within those to assess it. To better define and assess criticality it is first important to develop consistency in the methodology to evaluate it. Such a framework was developed within a Master-level project (to be submitted in June 2023), using Ansys Granta EduPack. This framework was further applied to analyse a Fairphone case study, this was then adapted for teaching purposes. The Fairphone is a comparatively more sustainable mobile technology. However, components such as the battery must be replaced throughout the Fairphone's lifetime. Thus, it relies on an increased use of CRMs rendering the technology less holistically sustainable. However, the effect of this can be mitigated by minimising the mass of materials that exhibit criticality. This can be achieved by comparing battery technologies with different material compositions using the suggested criticality assessment framework and Granta EduPack.

The results and a methodology are presented in a teaching case study (to be published in June 2023). The aim of the case study is to introduce students to the concept of critical materials, showcase, how EduPack can be used to compare the criticality of materials relative to one another and provide points for further discussion.

15

Training Final Year Undergraduate Students through Research Projects

ZhiLi Dong
School of Materials Science & Engineering, Nanyang Technological University

In the previous Asian and International Materials Education Symposia, I shared my teaching experience for my course: Advanced Materials Analysis, covering crystallography, X-ray diffraction and transmission electron microscopy. Based on the discussions with students, I realised that during my lectures, I should emphasise more on the exploration of crystal structure/electronic structure - property relationships for metal alloys and ceramic materials to provide guidance for optimising materials performance.

Furthermore, I noticed that some students were either facing challenges in understanding the fundamental concepts of crystallography, or struggling with the effective uses of X-ray diffraction and electron microscopy techniques. Therefore, in my textbook "Fundamentals of Crystallography, Powder X-ray Diffraction, and Transmission Electron Microscopy for Materials Scientists" [1], I have systematically explained the fundamentals of crystallography and the theories of diffraction, with some examples provided to assist students with crystal structure analysis.

Our group's research has been supported by the Ministry of Education, Singapore. Hence, I have included some relevant research results in my lectures and demonstrated how to effectively resolve engineering problems using materials structure analysis techniques. Follow-up discussions with final year undergraduate students have shown that the characterisation techniques they have learned can truly help them understand materials structures and material behaviors better. In the project "Enhancement of the high-temperature mechanical properties of tungsten matrix composites by microstructural optimization", various analysis techniques have been employed, which allows us to better understand the structure – property relationships. We have used this project to train our students to interpret the typical structural features in the metal matrix material W-0.25 wt%Al2O3 [2]. We believe that the effective training of final year undergraduate students can equip them with the necessary knowledge, so that they can contribute to the industrial projects immediately after graduation.

[1]. ZhiLi Dong, Fundamentals of Crystallography, Powder X-ray Diffraction, and Transmission Electron Microscopy for Materials Scientists, CRC Press, Taylor & Francis Group, 2022.
[2]. Changji Wang, International Journal of Refractory Metals and Hard Materials, 2022, 108, 105945 1-9.

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16

Synoptic assessment as an authentic learning approach – student co-creation

S. Cruchley*, H. Leach, J. Griffiths, E. Medcalf, G. Chahni, L. Medlock, A. Nicum, A. Cruchley, and M.J. Jenkins
University of Birmingham, UK

In synoptic assessment, teaching and summative assessment are uncoupled, and instead, synoptic assessments are linked to content from multiple modules. This form of assessment has the potential to provide long-term benefit to the students, because it limits compartmentalisation of learning and produces a more authentic form of assessment, by assessing achievement in a 'real-world' situation. In this study, two new synoptic assessments have been co-created alongside our Industrial Advisory Board (IAB) and students from all years of our degree programmes. Student co-creation of assessments has been found to be beneficial and promote the development of instructional rubrics and promotes assessment literacy. While the involvement from our IAB has facilitated the development of an assessment that fosters the skills that are required to meet the needs and challenges of future employers. The students' ability to understand the importance of developing complex skills is improved. A problem-based learning has been used to develop complex practical-based group case studies that students will complete. Evaluation of these modules will take place by another group of students to determine the effectiveness of this new form of assessment. The results of which will be presented here.

17

Add an edge to your student's projects - Past, present and future of the Ansys Materials Selection Challenge

Mauricio Dwek[1]* & Elisabeth Hülse[2]
[1]Ansys Academic Field Team & [2]Ansys Academic Development Team

This educational event gathers students from multiple countries in a competition to showcase the most innovative uses of materials and simulation.

It's a fantastic opportunity for future engineers, designers, or architects to apply the knowledge learned in class and put it to the test in a friendly international, and culturally diverse contest. For professors who are tutoring the teams, it's a great way to raise the stakes of a final project and propose an interdisciplinary brief and a chance to participate in the Final at the Technical University of Madrid.

This year we are opening the challenge to all of Africa, Central America, North America, South America, Europe, and the Middle East.

18

POLYMATTER - a learning part for plastic properties

Sebastian Limberg* and Steffen Ritter
Reutlingen University

Every day, billions of injection moulded plastic parts are produced worldwide. This makes particular sense, among other things, because the environmental performance of plastic parts in the vast majority of cases far exceeds many other solutions.
The production of state-of-the-art plastic parts and products requires material, process and technical know-how. All these aspects must be taken into account in order to achieve the best economic and ecological results for the respective development. Correct material selection is an important decision for moulded plastic parts. In most cases, better design and the right choice of material can prevent failures and significantly improve the parts.
POLYMATTER is an injection moulded part designed for exactly this purpose. Using different geometric features with different functions, different plastics can be practically evaluated and compared with each other. The POLYMATTER is produced as a set consisting of different types of plastic, each with different properties. Thus, this set covers a wide range of the most common thermoplastics. With this part, students and all users "hands on" learn to avoid mistakes and to design functional, durable and thus environmentally friendly plastic products. With a component size of 82 mm x 45 mm x 6 mm, POLYMATTER is a compact learning and teaching component.
Different sprue and gating types can also be realised with the POLYMATTER injection mould. The effects of the respective gating types (film, tunnel, ring or direct gating) on the component characteristics are thereby practically demonstrated and thus made experienceable.

19

“Bioplastics: What is that and is it compostable?” Getting first semester engineering students started in the field of sustainability and material science

Juliane Karneboge* and Corinna Thomser
Hochschule Bonn Rhein Sieg, University of Applied Sciences (HBRS)

First semester engineering students at the Hochschule Bonn Rhein Sieg, University of Applied Sciences (HBRS) have to do project work on a chosen topic on three days throughout the semester. To get them started with material science topics and research about materials and sustainability, we offer the Topic of „Bioplastics: What is that and is it compostable?”. 20 Students chose the topic and get to work freely on questions like what defines bioplastics, compostable plastics and what norms and guidelines are applied in Germany and the European Union. For that they learn first-hand experience on working with databases, namely the material database in Ansys Granta EduPack. In addition, they do scientific research in our library and in the world wide web.

Furthermore, they carry out a lab experiment on how, if at all, biopolymers decompose in a certain environment in a 90 days’ period. The experiment works with guidance on volume and time. What specimens or what medium they want to use is the choice of the student group. They get to experience how hard it can be to identify and find biopolymers in stores and get the chance to watch what happens to their samples with check-in´s throughout the project time, where they can work with our microscopic lab equipment to investigate if structural or colour changes happen. In the end they learn about the theoretical background and applications of biopolymers and get a first-hand impression how decomposition of biopolymers can differ from those.

20

Project work with engineering students in the field of material science using agile project management

Claudia Luppertz*, Ali Khalil, Christian Kössler Irene Rothe and Corinna Thomser
Hochschule Bonn Rhein Sieg, University of Applied Sciences

Material Science is a part of the bachelor degree for engineers at the Hochschule Bonn Rhein Sieg, University of Applied Sciences (HBRS). The department of Electrical Engineering, Mechanical Engineering and Technical Journalism has a special didactic concept which is called the Four-One-Model. This means, the semester is divided into a sequence of four lecture weeks and a practical block week. During the lecture weeks, the normal courses with lectures, exercises and practical training take place. In the block week, the students have time to work on projects independently.

Students, who decide to work on a project in the field of material science are welcome to bring in their own ideas or they can choose one of the given topics. They organize themselves in teams and are introduced to agile project management to structure their work. The topics of the projects vary. Here a project is introduced, where a combination of research in materials databases, simulation processes and lab work is carried out. The students researched materials and production processes for planetary carriers of wind turbines. The approach was as followed: First, suitable materials were identified with the aid of the EduPack materials database from Granta Design. Next, they performed a metallographic analysis of the preselected materials and looked at the differences in microstructure. Finally, the students used two different sorts of simulation software. They looked at temperature dependent material properties with JMatPro and simulated the casting process with MagmaSoft.

The Students got to know different aspects of material science. They experienced the steps that are involved to select a material and produce it into a given form. Thereby they gathered experience in using a material database and simulation software. While organizing, planning and implementing their project their competences in communication, collaboration, creativity and critical thinking were promoted.

21

Teaching AI to Materials Science Students: Challenges and Best Practices from NTU

Leonard Ng Wei Tat

Nanyang Technological University

The Introduction to Data Science and Artificial Intelligence course for first-year undergraduates in the Materials Science and Engineering Department at the Nanyang Technological University aims to provide students with a foundational understanding of the concepts and techniques used in data science and artificial intelligence. The course covers topics such as machine learning, data visualization, and programming concepts and is designed to equip students with the necessary skills to analyze and interpret data in the context of materials science and engineering. To enhance the students' learning experience, we integrated a variety of educational technologies into the course. For example, we used interactive Jupyter notebooks to guide students through coding assignments and provide instant feedback on their progress. Throughout the course, students were encouraged to work on projects that applied the concepts they were learning to real-world materials science and engineering problems. These projects not only allowed students to apply the knowledge they had acquired but also provided them with the opportunity to understand how data science and AI can be used to solve problems in their field of study. To evaluate the effectiveness of these educational technologies, we relied on the student's feedback and informal assessments throughout the course. Our poster aims to share our experiences and lessons of teaching contemporary AI to Materials Science students. This poster will provide an overview of the course structure, the educational technologies used, the evaluation methods, and some of the most interesting projects and outputs developed by the students. It will serve as a valuable resource for educators and researchers interested in incorporating similar technologies into their own courses and teaching AI to students in the field of Materials Science and Engineering.

22

Materials used for musical instruments: an inspirational topic to teach basic concepts in science and technology

Elisabeth Hülse* and Kaitlin Tyler

Ansys Academic Development Team

It is not known for certain when our ancestors first started creating and playing musical instruments. One of the earliest instruments found are from the Geißenklösterle cave in Germany and date back to about 35,000 years ago (Conrad, 2004). What is for certain is that music has played and still is playing an important role in human cultures and societies. The sound created by these instruments is, by a significant part, defined by their shape and the materials they are made of.

Since instruments are such a central part of many of our social lives, the topic of material selection for musical instruments can act as an inspiring and fun tool to teach students basic concepts in material selection, material properties, processing, as well as mechanical principles.

This poster contains two ideas for inspiring case studies that cover a variety of disciplines (i.e. illustrating basic concepts in materials, mechanics, acoustics) and offer an avenue to teach holistic design to students (especially in early courses/STEM). Come vote for your top option, or share other ideas!

23

Materials: A More Central Science

Ilija Rašović
University of Birmingham

Chemistry has long rested on its laurels as “the central science”: the fulcrum about which all scientific endeavours pivot. Yet this view is based on the (arguably outdated) delineation of long-established traditional scientific disciplines and their associated epistemological hierarchy. This is limiting, for it doesn’t take into account the technological dimension of scientific research. Were we to do so, I contend that Materials Science and Engineering (MSE) would be a more viable candidate for “the central science”. This is not only important for raising the profile of the subject, but also for determining how it should be taught.

MSE covers a huge range of length scales and spans all technology readiness levels. It is this explicit link between fundamental scientific understanding (episteme) and technological implementation (techne)—and the complete embedding of the subject in the tangible, physical, material world—that sets MSE apart from all other physical sciences.

MSE was born as a highly interdisciplinary field after the Second World War, and it continues to sprawl across diverse disciplinary boundaries—computer science, medicine, the life sciences, sustainability, conservation, archaeology, and more—propelling the establishment of a crucial new discipline in its own right: nanoscience and nanotechnology.

None of the above is news to an audience of materials science researchers and academic staff. But it would be remiss to assume that undergraduates had such a holistic overview and appreciation of the centrality of MSE in the networks of modern scientific research and contemporary human existence. This is especially true when considering audiences such as first-generation students and those majoring in other disciplines but who might require knowledge of some aspect of MSE. I anticipate that such knowledge would help all students to understand better their chosen subject and succeed in their MSE education.

24

Using computational crystal structure prediction as a route to teaching computational materials science

Xiaolei Feng
School of Materials Science and Engineering, Nanyang Technological University Singapore

Computational structure prediction and its interpretation depends on a combination of skills and techniques from both computational science and materials science. The nexus of these two areas provides a rich area for exploration of cutting-edge materials concepts in an educational setting. Many students are more comfortable with tackling computational materials science challenges than practical experimental projects, especially when they have a general background in gaming and screen-based exploration rather than practical manipulation. Here, I outline some of the insights provided from computational materials science and structure prediction that can be exploited in the curriculum to excite and engage this group of students who are comfortable when immersed in a virtual environment. Undergraduates can contribute effectively and with impact in areas of computational materials science when projects are well-defined with directed expected outcomes.

25

On material science and sustainability education at Riga Technical University

Sergejs Gaidukovs
Riga Technical University

RTU Faculty of Material Science and Applied Chemistry provides an undergraduate study program “Materials science” and master level study program “Material science and Nanotechnology” with a specialization in the following directions - “Material Physics”, “Biomaterials”, “Traditional Inorganic Materials”, “Nanomaterials” and “Polymer materials and composites. The materials education at RTU is adapted to the needs of the industry sectors in Latvia. While students can start to choose the specialization subjects starting from the 2nd year of studies.
For example, the subject “Material science and environmental engineering” of 6 ECTS was introduced two years ago to connect sustainability and material science. Teaching materials and technology are complemented by continuous environmental assessment and recyclability by design methodologies. The students worked in small groups on the case studies of environmental assessment of materials and technologies during the course. Students’ grades and surveys showed satisfaction at the end of the year.

26

Teaching responsible alloy design

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[3]*Univ Lyon, INSA Lyon, CNRS UMR5510, MATEIS, F-69621 Villeurbanne, France*

The poster outlines a material database that includes several hundred records for steels, Ni-based superalloys, high entropy alloys, hydrogen solid storage alloys, thermoelectrics and magnetocalorics enabling to calculate sustainable implications that have the potential to play a critical role in guiding alloy selection, design and development. To make our case, and understand where we are, where we come from and where to go, the poster documents and visualizes nine indicators for commerce, the environment and human well-being that stem from a compositional choice. The indicators we use are readily available at the elemental and country levels or can be inferred from more readily known indicators using AI techniques. To obtain a value for an alloy, we simply weight the indicators according to atomic composition (with a few exceptions).
These new resource and approach aim to support the teaching of societal-informed materials selection and design in ways to raise awareness among students about the various costs of materials. This approach allows to forge connections between structural and functional materials and the three pillars of sustainability: environment, economy, and society.

27

Use of Profilometry-based Indentation Plastometry (PIP) Technology in Materials Teaching

M Burley[1], J Dean[1], A Lyneborg[1], M Coto[1] & TW Clyne[1,2*]
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Profilometry-based Indentation Plastometry (PIP) allows the stress-strain curve of a metal to be obtained from a single (automated) indentation procedure. This offers many practical advantages over conventional tensile testing and (unlike hardness testing) gives an outcome that fully characterizes the metal plasticity and failure. The benchtop machine comprises a loading frame, an integrated profilometer and control software that automatically carries out the iterative FEM simulation of the test needed to obtain the outcome. In contrast to nanoindenters, the equipment is robust and deforms a volume that is sufficiently large for its plasticity characteristics to be representative of the bulk (scale-independent) response. Samples can nevertheless be relatively small, mounted or unmounted, and surface finish requirements are not at all problematic - grinding to something like 1200 grit is usually sufficient. While the methodology is now being widely adopted in industrial circles, the equipment and approach offer considerable scope for useful incorporation into Materials Teaching activities. For example, a practical based on its use has already been devised and successfully trialled. Copies of the script of this practical, which includes information about sourcing of materials etc, will be available at the meeting. Furthermore, there will be an operational machine on the PLX stand and delegates are invited to bring along their own samples for "while you wait" testing – each test takes just a few minutes. (Delegates planning to do this should contact PLX beforehand - m.coto@plastometrex.com - just to confirm a few details about the sample(s) they will be bringing.)

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Design and building of a mini-house with low environmental heating system

Stéphane Godet* & Colin Aughuet
4MAT, Université Libre de Bruxelles

In their second year, engineering students at Université libre de Bruxelles are introduced to the beauty of materials science in different ways. Beside traditional lectures on physical-chemistry, technology and materials science, they are offered a project-based learning approach. In recent years, one project has attracted the enthusiasm of many students. They have to design and build a 'barbie-doll' size house and the associated heating system. The heating system is based on so called 'Phase Change Materials' and more specifically on the crystallization heat of Xylitol. The students are provided with the dimensions of the house that they 3D-print. One side of the house is left open to incorporate glasses with various insulating properties, provided by our industrial partner AGC Glass Europe. In the poster, we will present the different milestones of the project: dimensioning and design of the heating system, Strategies to initiate the crystallization of Xylitol, insulation strategies and materials selection, numerical modelling and experimental validation of the energetic performances of the house with and without insulation and with various glass-windows. Single glazed, double glazed and the new vacuum-based technology Fineo of our industrial partner are tested. In the end, the students have to ensure the heating up of their mini-house of 5° over 1 hour.

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ScienceCenters – How to spark the love for STEM disciplines by hands-on experiments and digital tools

Andrea Gassmann*[1], Susanne Kremeier[2], & , Nina Gipperich
[1]EXPERIMINTA gGmbH & [2] Humanizing Technologies GmbH

In order to tackle the manifold challenges that we as a society are facing today, science, technology, engineering and mathematics (STEM) disciplines are key. In this respect, science centers can be a valuable supplement to the education provided in schools or universities by taking advantage of some unique benefits: As an out-of-school location children and young adults can get in touch with e.g. physical phenomena in a playful and hands-on manner without feeling the pressure or obligation that might be felt in lessons at school. By conducting experiments themselves, repeating and trying to understand the principles behind the scientific effects they are inspired to explore STEM disciplines self-paced, either individually or in small groups.

At EXPERIMINTA ScienceCenter FrankfurtRheinMain, more than 120 experimental stations invite visitors to explore at their own preference. Our approach intends to provide maximal flexibility for an individual learning experience and is far from a schoolmasterly teaching. However, a basic guidance and background information are provided by short explanations: What can be done? What effect is generated? What is the science behind? To keep up with the times, we currently set up avatars that accompany our visitors during their visit. To our knowledge we are the only Science Center in Germany that strengthens the user experience by the use of a digital tool. The avatars are based on a customized web application. Due to our focus on children and young adults as target group, scientific contents are transformed into child-friendly language making the interaction easier while still providing the valuable scientific content. The avatar solution will address visitors emotionally and leave a lasting mark on their user experience. The launch of the avatars is planned for April in a pilot phase and will be extended to the complete collection of exhibits in the museum bit by bit.

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Ansys Granta EduPack Evolution since IMES 2019

Susannah Cooke
Ansys Academic Product Manager

Since the last in-person International Materials Education Symposium in 2019, EduPack has had six official releases with numerous updates and improvements to its data and tools. The new Medical Devices and FDA Examples tables enable design-focused teaching in Bioengineering courses, or the introduction of Biomedical devices as case studies in Design courses. The Products and Designers tables, plus the Designer's View of material datasheets, aim to inspire and engage students on Design-focused courses. A Portuguese translation allows wider teaching of early-years students in their local languages. Battery Cells data, combined with the new Battery Designer tool in Synthesizer, allows students to explore power pack configurations for electric vehicles.

It's now even easier to use the Eco Audit tool to introduce life-cycle considerations into student projects, with the ability to use your own materials and custom processes. Advanced students can tackle industry-level material selection challenges with tools such as Find Similar, Comparison Tables and Engineering Solver, which were previously only available in Granta Selector. Reporting has become more powerful with not only the in-built Selection Report tool, but also the ability to customise family envelopes on charts to show data the way you want to. Materials data, including curve data in some advanced databases, can now be exported to a range of other Ansys tools such as Ansys Discovery, while integration with Ansys Workbench provides an even tighter connection to design workflows using simulation.

Find out about all these improvements and more, as well as new Education Resources to help you deploy EduPack to best effect in your teaching.

31 Sustainable Product Design via Simulation and Materials Selection

Kaitlin Tyler*, János Plocher, Elisabeth Hülse
Ansys Academic Development Team

As the problems the world faces become more complex, so do the tools necessary to find those solutions. Striking a balance between a rigorous technical curriculum and the ever-evolving landscape of industry leaves many new graduates unprepared for the working world [1-3]. Some key topics of interest in this space include: (1) practical problem solving experience, (2) understanding the impact sustainability has on design, and (3) increased usage of technology and software in the workplace[1]. But with curriculum already full and a lack of feedback loop between industry and academia guiding these curriculum changes[2], what do we do? We in the Ansys Academic Development team have set out to try and identify a way to consider design holistically using Ansys software products. We set out to tackle this problem with (1) awareness of the influence simulation and software tools are having on engineering globally, (2) a deep appreciation of the need for fundamentals in engineering curriculum, and (3) experience working with Prof. Mike Ashby and his influential Ashby Materials Selection Methodology. With this mindset, we have set out to expand on Prof. Ashby's methodology and create the Sustainable Product Design Methodology. This method uses multiple Ansys software products to look at the materials, (structural) design, Life Cycle Assessment, and trade-off analysis process needed to holistically design products. This method of working through design problems in academia is new but has so far been met with enthusiasm. We hope, through this poster, we can share this with more educators to receive feedback and explore how we can all better prepare the next generation of engineers for the challenging problems to come.

[1] Goold, E. (2015). Engineering students' perceptions of their preparation for engineering practice. The 6th Research in Engineering Education Symposium
[2] Alboaouh, K. (2018). The gap between engineering schools and industry: A strategic initiative. 2018 IEEE Frontiers in Education Conference (FIE), 1–6
[3] Spang, D. I. (2014). Curriculum design and assessment to address the industry skills gap. 2014 ASEE Annual Conference 38; Exposition, 24–345.

32 Material Science and Design NEXUS: A Case Study

Flavia Papile[1]*, Mariapia Pedeferri[1], Barbara Del Curto[1], and David Mercier[2]
[1]Politecnico di Milano and [2]Ansys CR&D

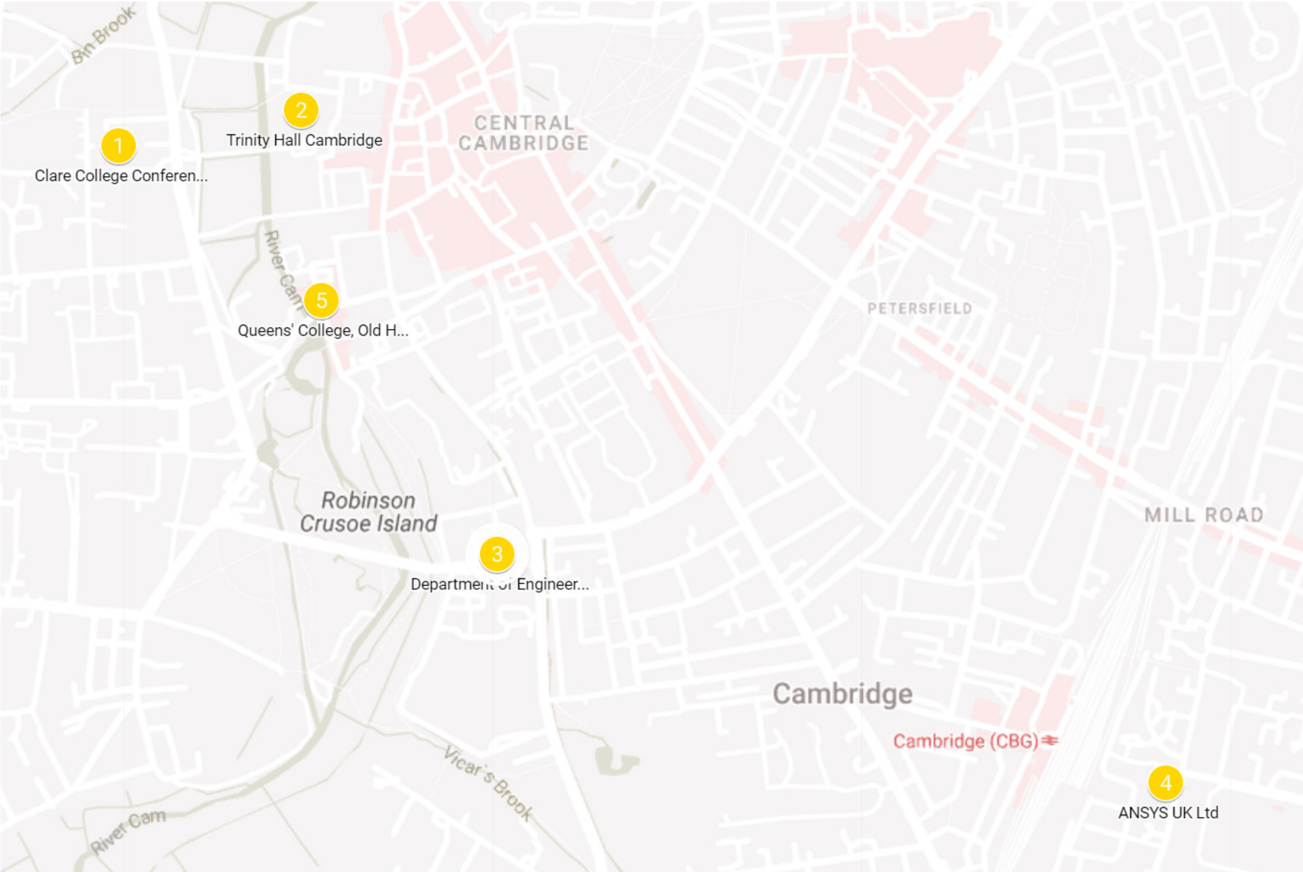
Over the years, materials have been studied through a multitude of lenses: from the technical analysis and characterisation of their intrinsic properties, to aesthetic and sensorial material attributes, until their extrinsic, intangible and cultural properties, mainly depending on the study field of investigation. Nowadays, knowledge becomes interdisciplinary, research becomes open and intersections between different fields of study is certainly evaluated as a positive attitude, to enrich studies and researches with several points of view on the threatened topic.

Therefore, based on this consideration, the proposed work has been structured with the objective of bridging research activities conducted on materials studies emerging from different departments of Politecnico di Milano, to envision research on materials not as a multitude of silos, but as a prolific network. In doing this, a collaboration between Politecnico di Milano and ANSYS has been established to envision and structure a preliminary activity with the objective of building a network to share knowledge in a horizontal way. Through the study and application of the GRANTA MI software, it has been possible for the authors to build a working space in which diverse studies conducted in different university departments can converge. Finally, the usage of both case studies to support education projects will be discussed.

Two case studies will be presented: one, preliminary, based on an iterative research activity. The second, showing the possibility of interlacing similar researches with different objectives. This exercise shows how, sometimes, researchers that build on a common knowledge background, when put together, can open up towards new scenarios and envisioning new research patterns, facilitating knowledge transfer between peers or to provide background knowledge for thesis works or superior teaching activities.

Section 6: Maps, Contact Details, and Venue Information

Key Event Locations



Location #	Address
1	**Clare College Gillespie Conference Centre** (Symposium Venue and Accommodations) Memorial Court, Queens' Rd, Cambridge CB3 9AJ, UK
2	**Trinity Hall College** (Presenters' Dinner) Trinity Ln, Cambridge CB2 1TJ, UK
3	**Department of Engineering, University of Cambridge** (Materials Selection and Design & Simulation Workshop Locations) Engineering Dept, Trumpington St, Cambridge CB2 1PZ, UK
4	**Ansys Cambridge Office** (Sustainable Development Workshop Location) 62 Clifton Rd, Cambridge CB1 7EG, UK
5	**Queens' College, Old Hall** (Symposium Dinner Location) Silver St, Cambridge CB3 9ET, UK

WiFi Access

To access WiFi while on the University of Cambridge campus, you can create a log-in here:

https://help.uis.cam.ac.uk/service/wi-fi/connect-uniofcam-guest

Event Location Details

Symposium Venue and Accommodations

The Symposium will be held at **The Clare College Gillespie Conference Centre** in the University of Cambridge.

Address: Memorial Court, Queens' Rd, Cambridge CB3 9AJ, UK

Directions:

- *From the rail station:* Cambridge rail station is about 1.5 miles from the College—a 10-minute taxi-ride, although it may take longer at peak periods (ask for "Memorial Court, Clare College"). For bus connections, take a bus to the city center.

- *From the bus station:* Cambridge bus station is about a 15-minute walk, or 5-minute taxi-ride (ask for "Memorial Court, Clare College") in clear traffic from Clare College.

- On arrival, report to the Porters' Lodge at the Memorial Court.

Workshop Venues

The workshops on Monday, April 3rd will be split across two locations:

1. Department of Engineering, University of Cambridge
   Engineering Dept, Trumpington St, Cambridge CB2 1PZ, UK

2. Ansys Cambridge Office
   62 Clifton Rd, Cambridge CB1 7EG, UK

Presenters' Dinner

The presenters' dinner will be hosted at Trinity Hall College.

Address: Trinity Ln, Cambridge CB2 1TJ, UK

- Pre-dinner drinks will be in the Graham Storey Room

- Dinner will be served in the Dining Hall

Symposium Dinner

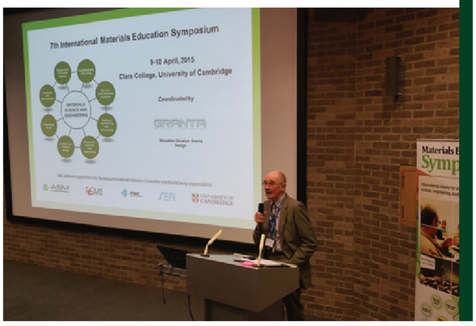
The symposium dinner will be hosted at Queens' College in Old Hall.

Address: Silver St, Cambridge CB3 9ET, UK

Materials Education SYMPOSIA

at CAL POLY

in collaboration with Ansys



NORTH AMERICAN MATERIALS EDUCATION SYMPOSIUM

California Polytechnic State University
San Luis Obispo, CA, USA

August 7-9, 2023

Session Themes

- Inclusivity in materials education
- Learn by doing in materials design
- Teaching manufacturing in material science and engineering
- Core competencies in material science and engineering

MORE INOFORMATION

Important Dates

Jan 16th
call for abstract and registration

April 10th
abstract deadline for presentations

May 1st
final program announced and early-bird registration deadline

May 31st
poster abstract deadline

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