Materials Education SYMPOSIA | International

14th International Materials Education Symposium

Clare College, University of Cambridge
Cambridge, UK

April 10-11, 2025

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

Welcome to the International Materials Education Symposium 2025!

We are happy to have you at Clare College at the University of Cambridge for this two-day event. Hopefully you will be joining us for the Symposium Dinner, held in the newly-renovated Clare College Dining Hall.

Ansys is proud to sponsor the Workshop Day on April 9th, with three workshops hosted by the Materials Science and Metallurgy Department of the University of Cambridge. Two full day workshops with Ansys certification are being offered, one on teaching materials with the Ansys Granta EduPack software and the other on teaching sustainable product design with Ansys tools. We will also be introducing our new Ansys Academic Social Impact Audit Tool in our half day Sustainability and Social Impact workshop. Special thanks to Jessica Gwynne and Rob Thompson from Cambridge University for helping to organize all these events.

The Symposium on April 10th and 11th follows the traditional format, with plenty of time for conversation and discussion. The first day is dedicated to innovative teaching and course design, with several interesting talks linked to work occurring at the University of Cambridge. AI/ML/LLM in materials teaching and how to develop talents for future industry and employment are the topics of the second session, preceded by the traditional poster teaser and poster display. Last, but not least, Sessions on Materials, Sustainability and inclusivity in the curriculum as well as Sustainability in novel materials and design on the final day. New for this year is thematic keynote talks by internationally renowned speakers that we hope you will like.

As usual, we are grateful for continuing support from the materials community, and on behalf of the Scientific Committee and the Advisory Academic Committee, we thank you!

Claes Fredriksson, on behalf of the Advisory and Scientific Committees 2025.

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

Ansys

UNIVERSITY OF CAMBRIDGE

and for the help and advice of the following organizations:

ASEE Division of MATERIALS

SEFI European Society for Engineering Education

14th International Materials Education Symposium

Section 1: Agenda

TIME	EVENT		VENUE
Wednesday, April 9th: Workshops & Presenters' Dinner			
9:00am	Registration Opens		At workshop venue
9:00am-12:00pm	Morning Workshop Sessions	Ansys Granta EduPack Pt1	Department of Materials Science and Metallurgy, University of Cambridge
		SDPM Part 1	
12:00-12:45pm	Lunch & Workshop Registration		
1:00-5:00pm	Afternoon Workshop Sessions	Ansys Granta EduPack Pt2	
		SDPM Part 2	
		Social Dimensions of Sustainability	
7:00 PM	Presenters' Dinner **by invitation only*		Queens' College
Thursday, April 10th: Symposium Day One			
8:00am	Registration opens*		Clare College Gillespie Centre, Memorial Court
8:45-10:30am	Symposium Day One Session 1 Part 1		
10:30-11:20am	Coffee Break & Poster Session		
11:20am-12:40pm	Symposium Day One Session 1 Part 2		
12:40pm	Symposium Photograph		
12:45pm	Lunch		
2:00-3:30pm	Symposium Day One Session 2 Part 1		
3:30-4:00pm	Coffee Break & Poster Session		
4:00-5:20pm	Symposium Day One Session 2 Part 2		
7:00pm	Symposium Dinner		Clare College
Friday, April 11th: Symposium Day Two			
8:45am	Registration opens		Clare College Gillespie Centre, Memorial Court
9:30-10:20am	Symposium Day Two Session 3 Part 1		
10:20-10:50am	Coffee Break		
10:50am-12:00pm	Symposium Day Two Session 3 Part 2		
12:00pm	Lunch		
1:30-2:30pm	Symposium Day Two Session 4		
2:30-3:00pm	Closing Remarks		
3:00pm	Coffee Break/End of Symposium		

Please see ***Section 5*** for maps, and more venue details

Symposium Day One: Thursday, April 10th, 2025

Welcome Address	
8:45am	**Jess Gwynne,** University of Cambridge **Claes Fredriksson,** Ansys Academic Development Team
8:50am	**Dipankar Choudhury,** Office of the CTO, Vice President, Research at Ansys
9:00am	**Session 1: Innovative Teaching and Course Design** Co-Chairs: Noel Rutter, University of Cambridge and Kaitlin Tyler, Ansys Academic Team
9:00am	**Keynote: Harry Bhadeshia,** Queen Mary University of London *Unconstrained Learning from Books*
9:30am	**Jessica Gwynne* & Robert Thompson,** University of Cambridge *DoITPoMS- open access educational resources*
9:50am	**Paloma Fernández *et. al.*,** Department of Materials Physics, University Complutense *What could a superhero do with EduPack?*
10:10am	*Poster Session Teaser*
10:30am	*Coffee Break & Poster Session*
11:20am	**Gerhard H. Olsen**, NTNU *Bridging Disciplines: Developing a New Study Programme in Chemistry and Materials Engineering*
11:40am	**Robert Thompson* & Jessica Gwynne,** University of Cambridge *Alloy Design- an authentic project in Materials Science*
12:00pm	**Vit Jan,** Brno University of Technology *Materials Science: The Textbook or The Lecture - Which Comes First? A Curiouser and Curiouser Journey Through Learning (for the Teacher)*
12:20pm	*Session Discussion, Chair*
12:40pm	*Symposium Photograph & Lunch*
2:00pm	**Session 2: AI/ML/LLM in materials teaching and how to develop talents for future industry and employment** Chair: Alfred Oti, Ansys Academic Development Team
2:00pm	**Keynote: Timo Hannay,** AI/LLM/ML in Education, School Dash *Learning and teaching in an age of intelligent machines*
2:30pm	**Leonard Ng Wei Tat,** Nanyang Technological University *Professor LEODAR: Advancing Higher Education through Personalized RAG-based AI Tutoring*
2:50pm	**Penny Thomopoulou,** Ansys UK *Thoughts on AI and ML in Materials and Education*
3:10pm	**Daphiny Pottmaier* & Edward Causton,** Nottingham Trent University *Sustainability with GenAI for an Inclusive Practice in Engineering Design*
3:30pm	*Coffee Break & Poster Session*
4:00pm	**Yasmine El Gharoussi* & David Mercier,** Polytech Clermont & Ansys *From Classroom to Industry: Applying Data-Driven Science to Multiscale Materials Characterization in an EU Project at Ansys*
4:20pm	**Faith Nightingale,** Queen Mary University of London *Interdisciplinary Professional Engineering Skills at University*
4:40pm	**Guillermo R. Facal**, University of Buenos Aires *Mechanical Element Design, Simulation and Manufacturing Laboratory as a support of bachelor subjects, final assignments and student skills*
5:00pm	*Session Discussion, Chair*
5:20pm	*End of Day 1*

Symposium Day Two: Friday, April 11th, 2025

9:00am	**Coffee and Snacks**
9:30am	**Session 3: Materials, Sustainability, and Inclusivity in the Curriculum** Chair: Tatiana Vakhitova, Ansys Academic Development Team
9:30am	**Keynote: William Callister,** University of Utah *Concept-Based Learning and Understanding for Materials Courses*
10:00am	**Stefano Ferraresi,** Politecnico di Milano *Novel material trends for sustainability: analysis and systematisation of 95 case studies to map innovative options available to design students, design researchers and practitioners*
10:20am	*Coffee Break & Poster Session*
10:50am	**Rui Goncalves,** Nanyang Technological University *Overview of AMDES 2025 and the Virtual Special Issue (VSI) on Teaching Innovation in Materials Science and Engineering Design in the Journal of Chemical Education*
11:00am	**Kathryn Jackson* and Itai Vutabwarova,** University of Sheffield *Preparing the engineers of the future: teaching materials and manufacturing through degree apprenticeships*
11:20am	**Plinio Fernandes Borges Silva *et. al*,** Chalmers Technical University *Empowering Future Designers: Evaluating the Role of the Social Impact Audit Tool in Developing Critical Thinking on Social Sustainability*
11:40am	*Session Discussion, Chair*
12:00pm	*Lunch Break*
1:30pm	**Session 4: Sustainability in novel materials and design** Chair: Nicolas Martin, Ansys Academic Development Team
1:30pm	**Kristin Müller,** Leuphana University *Rethink Textile Production - Developing sustainable concepts for textile industry using production simulation*
1:50pm	**Hannah Kelbel,** RWTH Aachen University *Experimental analytical learning in sustainability assessment education*
2:10pm	*Session Discussion, Chair*
2:30pm	**Claes Fredriksson and Patrick Coulter,** Ansys Academic Program *Looking back on IMES 2009-2025*
2:50pm	**Dipankar Choudhury,** Office of the CTO, Vice President, Research at Ansys *Closing Remarks*
3:00pm	*Coffee Break/End of Day 2*

Section 2: Participants

Name	Affiliation	Presenting			Country
		Workshop	Talk	Poster	
Alain Bataille	Université d'Artius				France
Alfred Oti	Ansys				UK
Alison Harvey	The University of Manchester		X		UK
Andrea Marinelli	Politecnico di Milano				Italy
Bedri Onur Kucukyildirim	Yildiz Technical University				Turkey
Bhanuj Jain	Ansys				UK
Claes Fredriksson	Ansys	X	X		UK
Claudio Tosto	University of Catania			X	Italy
Daphiny Pottmaier	Nottingham Trent University		X		UK
Daria Kieczka	Ansys				UK
Darshil Shah	University of Cambridge				UK
David Mercier	Ansys		X		France
Davide Di Stefano	Ansys				UK
Dipankar Choudhury	Ansys		X		United States
Faith Nightingale	Queen Mary University of London		X		UK
Gerhard H. Olsen	Norwegian University of Science and Technology		X		Norway
Gianluca Cicala	University of Catania			X	Italy
Giuseppe Viola	Queen Mary University of London			X	UK
Graham McShane	University of Cambridge				UK
Guillermo Rubén Facal	University of Buenos Aires		X	X	Argentina
Hannah Kelbel	RWTH Aachen University		X		Germany
Hannes Geist	University of Freiburg			X	Germany
Harriet Parnell	Ansys	X			UK
Harry Bhadeshia	Queen Mary University of London		X		UK
Imran Siddique	Ansys				UK
Itai Vutabwarova	University of Sheffield		X		UK
Ivana Slamova	University of West Bohemia in Pilsen			X	Czechia
James Marrow	University of Oxford				UK
Jessica Gwynne	University of Cambridge		X		UK
John Durrel	University of Cambridge				UK
Juan Doval Roque	Ansys			X	UK
Kaitlin Tyler	Ansys	X		X	United States
Kathryn Jackson	University of Sheffield		X		UK
Kristin Müller	Leuphana Universität Lünenburg IPTS		X		Germany
Lakshana Mohee	Ansys			X	UK
Leonard Ng Wei Tat	Nanyang Technological University		X		Singapore
Luca Paterlini	Politcenico di Milano				Italy
Luke Malone	University of Cambridge				UK
Maksims Jurinovs	Riga Technical University				Latvia

Name	Affiliation	Presenting			Country
		Workshop	Talk	Poster	
Matteo Seita	University of Cambridge			X	UK
Mengyan Nie	University College London				UK
Michael Doherty	Ansys				UK
Niam Willis-Fox	University of Manchester			X	UK
Nick Ball	Ansys				UK
Nicolas Martin	Ansys	X		X	France
Noel Rutter	University of Cambridge				UK
Ondreij Spacek	University of West Bohemia in Pilsen			X	Czechia
Patrick Coulter	Granta Design	X			UK
Paloma Fernández Sánchez	University Complutense		X		Spain
Pascal Salzbrenner	Ansys				UK
Peiyu Chen	University of Cambridge				UK
Penny Thomopoulou	Ansys		X		UK
Piers Ireland	Ansys	X		X	UK
Plinio Fernandes Borges Silva	Chalmers University of Technology		X		Sweden
Roald Lilletvedt	NTNU			X	Norway
Robert Thompson	University of Cambridge				UK
Rui A Goncalves	Nanyang Technological University		X		Singapore
Sergejs Gaidukovs	Riga Technical University			X	Latvia
Stephano Ferraresi	Politecnico di Milano		X		France
Susannah Cooke	Ansys			X	UK
Tatiana Vakhitova	Ansys	X		X	UK
Vit Jan	Brno University of Technology		X		Czechia
Wen Zhao	Ansys	X			UK
William Callister	University of Utah		X		United States
Yasmine El Gharoussi	Ansys, Polytech Clermont		X		France

Section 3: Presentation Abstracts

Unconstrained Learning from Books

Harry Bhadeshia
Queen Mary University of London

A university disseminates *and* creates knowledge. Creativity comes from deep understanding, which also is needed to deliver education in a palatable form to unpolluted and probing minds. Books help.

A course requires focus, so a hard copy is useful, more so than an ethereal version. A disadvantage of a tangible book is the inevitable and frequent changes in syllabus, style and emphasis (think that the unit cell in crystallography is set in stone?). Conventional books have editions to cope with this, but these are infrequent. I will demonstrate new techniques which mean that books can be modified, supplemented, corrected at will, with changes implemented literally overnight and available in print. There are features that make them essential to own, at little cost.

There is an explosion of knowledge that cannot and should not be included in undergraduate books, but in more substantial versions for curious minds. I shall explain why such books should exist in the context of undergraduate education and the poor quality of science journalism (....graphene....!).

A couple of questions for you to consider: (i) which is the best academic-quality control system in the world? (ii) Is there another book on materials that has sold > 500, 000 copies in eleven editions?

DoITPoMS- open access educational resource

Jessica Gwynne* & Robert Thompson
Department of Materials Science and Metallurgy, University of Cambridge

DoITPoMS (www.doitpoms.ac.uk) is an educational web-based resource developed over the last 25 years, designed to facilitate the teaching and learning of undergraduate level Materials Science. It is used by around half a million students and educators each year to support teaching and learning around the world.

DoITPoMS currently includes:

- A series of about 80 Teaching and Learning Packages (TLPs), which are self-contained interactive resources, each focusing on one area of Materials Science
- A micrograph library, containing around 900 micrographs and associated metadata.
- A series of Lecture Demonstration Packages (currently 5), which are designed as a resource for lecturers and contain information about short practical demonstrations that could be carried out within a lecture.
- A video library, containing over 150 videos, including experimental procedures, industrial processing methods and atomistic animations.

The resources are primarily created by undergraduate students during annual "summer schools", with the aid of a professional programmer and academic supervisors. The funding for the project mainly comes from small donations and grants and the project has no commercial sponsors or links. The resources are free of copyright constraints and can be used for any educational purpose, subject only to the acknowledgment of the origin.

This talk will introduce the DoITPoMS resources, discuss ways in which they can be used in Materials Science courses and consider the future direction of the project.

What could a Superhero do with EduPack?

Paloma Fernández Sánchez[1]*, Abby Cabrera Acles[2], Alberto Carvajal Diñeiro[2], Nahia Iraeta Sarasola[2], Francisco Javier Medel Arraiz[2], Adrián Jiménez Martínez[2]
[1]*Department of Materials Physics, University Complutense*
[2]*Students of the degree in Physics, University Complutense*

Materials play a central role in the world of fantasy. Innovation and completely disruptive technological approaches have captivated us on countless occasions. Fantastic powers that enable characters to fly, possess infinite strength, or heal instantly after severe injuries are often underpinned by extraordinary materials with unusual—and sometimes impossible—properties.

From the spider silk that allows Peter Parker to swing and climb across New York to the forging expertise of the dwarves in Tolkien's universe, these incredible inventions merge principles of materials science and physics with imaginative speculation, often beyond the limits of credible science.

Yet, in some cases, they have inspired new frameworks to explore real-world innovations in materials. In this work, a group of students has attempted to identify a real material with properties resembling those of Vibranium.

There are countless other examples. Would you like to explore some of them? Let your imagination take flight and break through the boundaries of what we currently know.

Day One, 11:20am

Bridging Disciplines: Developing a New Study Programme in Chemistry and Materials Engineering

Gerhard H. Olson
Norwegian University of Science and Technology (NTNU)

In 2025, NTNU will launch a new bachelor's programme in Chemistry and Materials Engineering, merging two existing programmes into one with a common first year and two specialisations. The programme has been designed in alignment with NTNU's 2021 strategy for engineering education, emphasising not only academic skills but also competencies such as critical thinking, communication, teamwork, and sustainable development. Our goal is to educate well-rounded candidates capable of tackling future challenges in both academia and industry. I will present an overview of the programme and how NTNU's strategy has guided us in the design process. Additionally, I seek to connect with others who have experience in developing similar engineering curricula.

Alloy Design – An authentic project in Materials Science

Robert Thompson* and Jessica Gwynne
Department of Materials Science and Metallurgy, University of Cambridge

Project based learning presents an opportunity to break out of a traditional teacher-as-transmitter and student-as-receiver model of learning. This style of learning provides an opportunity to develop skills-based learning outcomes by providing an authentic challenge that requires use of understanding of the problem as well as "softer" skills, including teamwork and professional skills, such as engaging with facility managers in order to undertake the necessary work.

The Materials Science course at Cambridge is biased heavily towards the theoretical areas of the subject, so the kinds of problems employed for engineering students may not be well suited to our students (or vice versa). Our solution is the Alloy Design Project, in which groups of students design a composition and processing route for an alloy against a design specification. Students then perform the processing and evaluate their alloy against the specification, finally presenting their results at a "mini-conference" day.

Some care must be taken with the specification to give enough scope to allow variation of approach and the possibility of failure, without becoming so broad as to either be impossible or result in student solutions following closely commercially available alloys.

We will discuss our experiences, what we think has (or not) worked, in particular:

- Student engagement and feedback
- Challenges in running the project
- How this affects our professional accreditation
- Past and future developments of the project

Day One, 12:00pm

Materials Science: The Textbook or The Lecture - Which Comes First? A Curiouser and Curiouser Journey Through Learning (for the Teacher)

Vit Jan
Brno University of Technology

Engaging students in large enrollment materials science courses is a unique challenge. The lecture theatre is packed with several hundred, to say the least, uninterested students, and there is limited time and space to either engage them or lose them to materials. The study aims to help transform traditionally dry and complex topics into engaging narratives by analysing the pedagogical approaches of well-known textbooks. We're looking at how to structure lectures and present content so that complex scientific concepts feel like an exciting story waiting to be unravelled, even though the presentation is being delivered to a crowd.

By studying how top textbooks structure content, introduce concepts and use visual and experimental demonstrations, the research aims to identify effective teaching strategies for making complex scientific concepts engaging. We want to build a course structure that helps students experience the satisfaction of seeing the big picture as soon as possible and emerge in its complexity as they master each new concept - where every page turned is a new step into material wonder.

The research recognises the challenge of large lecture halls and limited resources, but sees this as an opportunity to do the seemingly impossible: have a mass of students leaning in, eager to understand how the materials around them actually work - turning potential boredom into real curiosity.

Learning and teaching in an age of intelligent machines

Timo Hannay
AI/LLM/ML in Education, SchoolDash

Timo Hannay is the founder of SchoolDash (https://www.schooldash.com/), an education data analytics firm that works with the media, technology companies, charities, schools and governments. He is also a non-executive director of Sage Publishing (https://www.sagepub.com/), Arden University (https://arden.ac.uk/) and EDUCATE Ventures Research (https://www.educateventures.com/). In 2023 he convened the AI in Education Summit in London (https://www.edsummit.ai/). Timo was previously the founding managing director of Digital Science and before that ran the online business of Nature. He has also worked as a consultant at McKinsey & Company and written for The Economist. He holds a doctorate in neurophysiology from the University of Oxford and a degree in biochemistry from Imperial College London. Above all, he is fascinated by brains and computers, and by how they can complement each other.

In this session, he will outline learning and teaching in the age of intelligent machines.

Day One, 2:30pm

Professor LEODAR: Advancing Higher Education through Personalized RAG-based AI Tutoring

Leonard Ng Wei Tat
Nanyang Technological University

Large language models (LLMs) like OpenAI's GPT-3.5 and GPT-4 have made waves in education, but their application in materials science has been limited. While students in our Introduction to Data Science and Artificial Intelligence course at Nanyang Technological University experimented with ChatGPT, the results were underwhelming—responses were often verbose yet lacked depth, and there was little evidence of real learning. To bridge this gap, we developed Professor LEODAR, a custom-built chatbot powered by retrieval-augmented generation (RAG). Unlike generic LLMs, Professor LEODAR is specifically trained on course materials, including lecture slides, Jupyter Notebooks, past lecture videos, and key textbooks. Built with Amazon Web Services and deployed on a cloud-based LLM framework, the chatbot delivers personalized guidance tailored to the needs of materials science students. In this talk, I'll walk through the development process, highlighting the challenges and breakthroughs in building an AI tutor. I'll also share insights from student feedback—where Professor LEODAR has succeeded in enhancing engagement and understanding, and where there's still room for improvement. Finally, I'll discuss the broader landscape of AI-powered education, showcasing accessible technologies that educators can leverage to develop their own domain-specific LLM tools. As AI continues to reshape learning, Professor LEODAR represents a step towards more effective, personalized, and subject-aware tutoring in higher education.

Thoughts on AI and ML in Materials and Education

Penny Thomopoulou
Ansys

Artificial Intelligence (AI) and Machine Learning (ML) are rapidly transforming many fields, including engineering and materials education. We explore the role of AI-driven technologies, particularly large language models like GPT, in shaping students' learning and their development of problem-solving skills. Understanding key concepts of AI/ML can help students understand its potential and its limitations. A straightforward explanation of GPT-like language models will highlight how they analyze patterns and generate output text. We will then discuss how these models can be leveraged as powerful tools in both education and industry, through enhancing student learning experiences or speeding up the product development cycle. Beyond language models, the talk will touch on broader ML solutions, showcasing how data-driven methods can contribute to predictive modelling and wider engineering design. A brief historical perspective on AI's evolution will provide context for its current capabilities and limitations. Finally, we will reflect on the potential of AI/ML and ethical considerations in education and industry, opening the discussion of best practise in navigating and harnessing these novel technologies.

Sustainability with GenAI for an Inclusive Practice in Engineering Design

Daphiny Pottmaier* and Edward Causton
Department of Engineering, Nottingham Trent University

Sustainability in engineering design is a module for third-year students created to address the green skills job market and the urgency of the current global challenges. The content aims to equip future engineers with the knowledge and skills to integrate sustainability into their design process.

The first unit of the module focused on design thinking with the UN SDGs as the central theme. Systems thinking was introduced with ecological design audit in Ansys Granta by identifying critical stages in the product lifecycle. They were taught how to use a Morphological Matrix as input for GenAI prompts to create solutions. They engaged well with the Ansys Granta MI cards, which fostered teamwork and collaboration. The workshops included brainstorming sessions from greener materials to circular strategies within the Engineering for One Planet framework and Autodesk Sustainability material.

The second unit centred on designing the NTU SWIFT IoT node for circularity, following the total design approach combined with Cradle to Cradle. Students conducted market research, developed product design specifications, and went from concept to detail design supported by Ansys materials such as MI cards, Granta eco-audit and the Social Impact Audit Tool. These were employed to promote an engaging inclusive teaching environment. GenAI was utilized for text mining and design visualization. During detail design, students used the Pugh selection matrix with Granta datasets.

This module evidence group activities, such as ecological and social audits combined with material selection games, significantly enhanced student engagement and understanding of complex topics. The use of a diversity of resources provided different perspectives into the engineering design process for sustainability. This teaching strategy not only prepares students for future challenges but also fosters an inclusive culture for sustainability in engineering practices.

Day One, 4:00pm

From Classroom to Industry: Applying Data-Driven Science to Multiscale Materials Characterization in an EU Project at Ansys

Yasmine El Gharoussi[1]* and Davier Mercier[2]
[1]Polytech Clermont and [2]Ansys

As a student immersed in the rapidly evolving field of data-driven science, I have acquired essential skills in data analysis and machine learning during my academic journey at Polytech Clermont. My one-year apprenticeship contract at Ansys, as part of the NanoMECommons project funded by the European Union, provided a unique opportunity to alternate between the university and industrial environments. This dual exposure enriched my perspective and allowed me to bridge theoretical knowledge with practical application.

At Ansys, I focused primarily on leveraging machine learning to build and optimize a robust database for experimental nanoscale materials datasets. Collaborating with multidisciplinary teams, I contributed to developing multiscale workflows that bridged experimental nanoscale data and continuum-scale simulations. By employing advanced techniques in data preprocessing, feature extraction, and predictive modeling, I facilitated the creation of digital material twins. These twins seamlessly integrated nanoscale characterization results into computational workflows, enhancing the accuracy and efficiency of material behavior predictions.

This experience not only deepened my understanding of industrial-scale data management and machine learning integration but also underscored the transformative potential of data-driven methodologies in multiscale materials engineering. It highlighted the value of interdisciplinary collaboration and the broader applicability of these frameworks in advancing innovation within materials research and industrial applications. By sharing this experience, I aim to provide valuable feedback and insights to improve the understanding of knowledge transfer, and the essential skills required for success as a future data engineer.

Developing Interdisciplinary Professional Engineering Skills at University

Faith Nightingale
Skills for Science and Engineering Transnational Education, Queen Mary University of London

Engineers are required to have a number of hard and soft skills in order to be considered competent in their profession (Engineering Council, 2020). It is however widely reported that engineers lack soft skills which costs businesses money (The Institute of Engineering and Technology 2021; Winterbotham, et al. 2018). Therefore, it is a university's responsibility to ensure students develop the skills needed during their studies (Department of Education, 2017). However, there is a lack of consistency when teaching and developing soft skills which are usually taught sporadically and generically.

This talk will show how professional engineering skills are taught at Queen Mary Engineering School (QMES), Xi'an, China using a project-based, interdisciplinary approach. The poster will demonstrate activities that take place in all years in the Professional Engineering Skills modules to develop the skills that student engineers require such as through the Materials Library project, escape room challenges and the Engineering Logbook. By developing these activities that support students throughout their time at university, students develop professional skills that will support future academic or career applications. From research conducted, students recognise their development of these skills and acknowledge the importance of them.

By completing these activities, not only do students develop graduate attributes which aligns with the aims of QMUL and TEF (Department of Education, 2017), but they also learn through engineering themed projects which enables them to see the interdisciplinary relationship between engineering and soft skills. Developing activities that contain real-world engineering problems helps students see the relatability of professional skills in the workplace. Additionally, soft skills align with AHEP objectives for accreditation of a programme which has been achieved in QMES through these professional skills modules.

The aim of this poster is to show that supporting students to develop soft skills at university is not only worthwhile for the students, but also supports inclusivity. These activities can be developed and embedded into any programme using a project-based pedagogic approach. It is beneficial for a university to also develop interdisciplinary education and skills modules to aid in accreditation and diversifying the curriculum.

References:

Department of Education, 2017. Teaching Excellence and Student Outcomes Framework Specification. Department of Education.

Engineering Council, 2020. The UK Standard for Professional Engineering Competence and Commitment (UK-SPEC) Fourth edition. Engineering Council.

The Institute of Engineering and Technology, 2021. IET skills and demand in industry. The Institute of Engineering and Technology.

Winterbotham, M., et al., 2018. Employer Skills Survey 2017.

Day One, 4:40pm

Mechanical Element Design, Simulation and Manufacturing Laboratory as a support of bacharel subjects, final assignments and student skills

Guillermo R. Facal
University of Buenos Aires

During the 21st Century, technology in mechanical engineering has changed significantly. The complete digitisation of the design, simulation and manufacturing processes is a tangible reality within the industry and the research laboratories. Nowadays, the use of CAD, CAE and CAM systems for the project, design, simulation and manufacture in Mechanical Engineering courses is of vital importance for students to gain knowledge and experience to work in the current industry and laboratories. By late 2016, the Mechanical Element Design, Simulation and Manufacturing Laboratory was created to integrate the use of these software. The main purpose was to provide supplementary courses in CAD, CAE and CAM tools for students, professors and graduates. In 2019, the use of the Laboratory was extended to specialization subjects, such as "Proyecto de Máquinas" ("Machine Projects"), "Diseño de Máquinas Herramientas" ("Design of Tool Machines") and, in 2021, to "Elementos de Máquinas" ("Machine Elements"). Projects developed by students were fully digitised in the first subjects, and, for the last subject, teaching is performed via the traditional calculation method together with CAE and CAD systems. Final course assignments and thesis were also developed systematically with these software. The first final assignment was the design and simulation of an electrical bus for urban transportation performed by students with the SolidWorks Academy in 2017. The project and courses were so successful that around 80% of the Mechanical Engineering students started to enroll on said courses and performed the final assignments with the academic software offered by the Laboratory. Nowadays, we are also applying these software in the Formula SAE project. The premise is to develop projects with new and sustainable materials, designs and energy using SolidWorks, NX, SolidEdge, Autodesk Inventor, KISSsoft (CAE), FEMAP, ANSYS, NX CAM and Inventor CAM as preferred by students.

Concept-Based Learning and Understanding for Materials Courses

William Callister
University of Utah

Learning and understanding the fundamentals of materials science and engineering proves to be difficult and non-engaging for many students. Reasons for these issues include the following: (1) few opportunities for conceptual learning, and (2) lack of a sense of relevance for course topics. Many MSE topics are highly conceptual in nature, and for the typical course most assignments and tests concentrate on solving numerical problems.

This paper discusses an approach that incorporates features not found in traditional introductory courses. Concept learning is cultivated by requiring students to define, explain, and describe material concepts found in the course textbook and/or other reference materials. Creation of concept maps and explanations of concept associations lead to understanding of relationships between/among concepts.

Relevance of course topics involves the exploration of concept relationships on a more global scale. Using this approach, student assignments are based on a framework that utilizes the paradigm of materials science and engineering—viz. material performance depends on material properties, properties are based on the character of structural elements, and structure is determined by material processing. These assignments require students to elucidate concepts within these paradigm components and then discuss interrelationships among sets of concepts.

Day Two, 10:00am

Novel material trends for sustainability: analysis and systematisation of 95 case studies to map innovative options available to design students, design researchers and practitioners.

Stefano Ferraresi[1]* and Barbara Del Curto[2]
Department of Design[1] and Department of Chemistry, Materials and Chemical Engineering[2], Politecnico di Milano

Professional designers, technicians and especially design students – who will be employed as designers in the near future – are fundamental in the transition towards circular economy since their choices may drive towards more sustainable production and consumption patterns. Their choices can in fact decree a sustainable use of materials and define product architectures that allow materials valorization at product end-of-life. This research analyses, clusters in macro-trends, and systematizes a variety of innovative material proposals expressly formulated to ensure lower impact and/or improved circularity. The research aims to make these new materials more accessible to students and professionals, to improve the organization of sustainability-related parameters and to provide an overview of the potential of these innovative material proposals.

The research strategy involved an analysis of 95 case studies clustered into 8 macrotrends identified through a literature review and refined according to the characteristics of the identified case studies. For the systematization, 21 online material libraries were analyzed to define an improved framework.

The work resulted in a novel framework designed to describe and highlight the most relevant materials parameters related to sustainability and circularity (e.g. origin of raw materials, composition, end-of-life options, certifications, etc.). Afterwards, the 95 material case studies have been systematised based on the new framework, leading to the creation of a new database containing coherent and comparable information. Finally, the sample of 95 materials was analyzed to extract some quantitative data on prevailing trends, materials origin, materials end-of-life options and environmental certifications.

Analysis of the results showed a considerable prevalence of materials developed using circular (from by-products/recycling) and bio-based resources (78% are entirely or partially bio-based). Regarding end-of-life options, 56% of the materials are (claimed to be) recyclable but 72% of them require ad hoc processes. Another interesting aspect is that only 41% of the industrialised materials in the sample have at least one environmental certification. To improve the assessment of the environmental properties of these materials, it would be necessary to evaluate each case using methodologies such as LCA and to use each candidate in products consistent with the material characteristics (e.g. expected lifespan of the final product).

Day Two, 11:00am

Preparing the engineers of the future: teaching materials and manufacturing through degree apprenticeships

Kathryn Jackson* and Itai Vutabwarova
University of Sheffield

The landscape of higher education is changing. Higher education institutions are under increasing pressure to deliver value for money while preparing their students for future employment and meeting the quality scrutinies of various stakeholders. Conventional student funding models are not economically sustainable. Are degree apprenticeships the answer? The University of Sheffield diversified its provision to include degree apprenticeships in engineering and manufacturing over nine years ago. This alternative route through higher education is receiving increasing attention from employers due to the improved preparedness of graduates for employment by 'learning on the job'. Degree apprenticeships are the route of choice through higher education for many students due to the diversity of learning methods, accelerated professional development, and the opportunity to graduate with no student loan while earning a salary. Likewise, apprenticeships may be more economically viable than conventional routes through higher education as students start contributing to the economy sooner. However, programme design and delivery to maintain academic and professional standards while satisfying the needs of a diverse pool of employers and not overloading students is a challenge. This presentation explores the experiences of nine years of delivery of degree apprenticeships in engineering and manufacturing at the University of Sheffield's AMRC Training Centre, with reflections on the lessons learnt and outlook for the future.

Day Two, 11:20am

Empowering Future Designers: Evaluating the Role of the Social Impact Audit Tool in Developing Critical Thinking on Social Sustainability

Plinio Fernandes Borges Silva*, Giliam Dokter, Peter Hammersberg, and Jonas Tuveson
Chalmers Technical University

Introduction
The social dimension of sustainable development, vital for achieving the first five Sustainable Development Goals (SDGs), remains underexplored in product design. Current design tools often emphasize environmental over social sustainability, leaving a gap in engineering education and practice. Tools like the Social Impact Audit Tool (SIAT) by Ansys offer a promising solution by ranking social impacts across production chains using publicly available data. This study investigates the challenges faced by engineering students at Chalmers University of Technology when integrating social benchmarking into product development. It explores how tools like SIAT can enhance critical thinking about social impacts, empowering future designers to create socially sustainable solutions.

Methods
A half-day workshop introduced students to SIAT in a bachelor-level course. Students analyzed the social impact of electrical consumer products, optimizing production chains through thresholds and stakeholder prioritization. Data from Miro boards, surveys, and facilitator observations were analyzed to evaluate tool efficacy and student insights.

Findings
Students faced significant challenges using the social benchmarking tool, particularly in (1) setting thresholds for acceptable social impacts, (2) balancing sustainability trade-offs, and (3) ensuring data reliability and transparency. Half of the groups arbitrarily set a threshold of 50, struggling to define acceptable values and prioritize social impact categories. Workshop discussions revealed the importance of investigating data sources and aligning interpretations of social sustainability within groups. Many reported increased awareness of social impacts, leading to reconsiderations of material choices and production locations.

Conclusion
This study highlights the potential of the SIAT tool to promote systematic analysis of social impacts in product design while fostering critical understanding of social sustainability metrics. However, challenges in threshold-setting, trade-offs, and data interpretation underscore the need for further education and refinement of the tool.

Rethink Textile Production - Developing sustainable concepts for textile industry using production simulation

Kristin Müller*, Marie Gillian Guerne, Brit-Maren Block, and Jens Heger
Leuphana University

Current textile production is not ecologically sustainable. Experts estimate that textile industry is responsible for 5 - 8 % of global greenhouse gas emissions. The majority of these are produced at the production sites themselves, e.g. by using raw materials that are not ecologically sustainable. While further 10 % are caused by the supply chains of textile materials.

An innovative, interdisciplinary seminar was designed and implemented as part of the Leuphana complementary studies programme, which deals with rethinking the textile industry. Students from all disciplines can attend the seminar.

The first phase is to impart knowledge about textile materials, their properties, their production processes and their environmental impact using the 'flipped classroom' approach. A material quiz is used to deepen knowledge, raise awareness and physically feel the individual materials. In order to further address the environmental impact of textile materials, a climate puzzle is carried out to demonstrate the interrelationships involved in climate change. After an introduction to production simulation, the students develop innovative approaches to improve the sustainability of textile materials in group projects. The variety of developed approaches exceeded our expectations. Moreover, the teaching evaluation shows that the students are satisfied with the course and their increased knowledge. On a 5-point Likert scale (1= strongly disagree; 5= strongly agree), the students indicated that they were very satisfied with the course overall with a mean value of 4.1 (N=11). In addition, it was found that most students had very little knowledge about textile materials and their environmental impact or their influence on climate change. The innovative concepts illustrate the potential for sustainable textile materials and the need for sustainable developments in this area. The simulation models developed help to measure the sustainability of textile materials by focusing the production and supply chain. At least two further rounds of the seminar are planned in the future.

Day Two, 1:50pm

Effective Approaches for Teaching 4D Shape-Changing Textile Structures in Engineering: The Role of Design-Led Research and Design Thinking

Hannah Kelbel*, Danchen Zhang, and Thomas Gries
Institut für Textiltechnik of RWTH Aachen University

4D textiles are textiles that can change shape or function over time by the influence of a stimulus, mainly force and heat. They are mainly made by 3D-Printing on pre-stretched textile and part of the broader concept 4D printing. The complexity of the shape change combined with the functional and aesthetic possibilities arouses great interest. To design applications with these structures though practitioners and engineering students must first unlearn some thinking principles that are inherent in product design approaches such as Pahl&Beitz which mainly focus on static structures.

To address this challenge, we have posed two hypotheses: 1. The concept of shape change must be learned experimentally. 2. The problem to be solved in an application should be found by the students themselves to enhance the deep understanding (problem-based learning). To address these hypotheses, we designed Summer Schools including Design Thinking as well as Design Led Research principles. We tested and further developed the concept in five Summer Schools in which we accompanied over 70 students from different fields of study and nationalities between 2019 and 2024.

The variety of developed structures has extended our expectations and were highly influenced by the experience of the students. We have seen huge motivation as well as deep understanding to work with the structure when students had the problem in mind, for which they wanted to develop a structure. The overall understanding of shape changing behavior is highly influenced by the order of activities in the Summer Schools. In this talk we will present the evolved summer school structure, methods, tools and communication we used and best practices we derived.

We see great potential to extend this approach to the entire field of active materials.

Section 4: Poster Overview and Abstracts

Poster Overview

#	Poster Presenter, Affiliation, and Title
1	**Hannes Geist* & Frank Balle**, University of Freiburg *Circularity Engineering: An Urgent Challenge in Materials Education*
2	**Guillermo R. Facal* and Carlos J. Gérez,** University of Buenos Aires *The future of Mechanical Engineering in Design and Manufacturing 2025-2030.* *The Challenge of the University to Teach New Technologies.*
3	**Sergejs Gaidukovs**, Riga Technical University Material Science Teaching Perspectives for Chemistry Students at Riga Technical University
4	**Claudio Tosto**, Politecnico di Milano *Enhancing Materials Education Through Advanced Manufacturing and Multidisciplinary Projects*
5	**Niamh Willis-Fox,** University of Manchester *Armourers & Brasiers Ambassadors Programme – Encouraging Undergraduate Outreach*
6	**Gianluca Cicala,** University of Catania *Additive Manufacturing (AM) Case Studies in Materials Engineering Teaching: The experience at the University of Catania*
7	**Mouna Chetehouna* and Giuseppe Viola**, Queen Mary University of London *A Teaching-Learning Framework for Materials Characterization*
8	**Roald Lilletvedt**, NTNU *Go out and find materials in use and the misused ones!*
9	**Ivana Slamova*, Tomas Kalina, and Ondrej Spacek,** University of West Bohemia in Pilsen *Cross-sectional Shape Optimization Software Tool for Students*
10	**Matteo Seita,** University of Cambridge *Product Disassembly: A new extension activity for engineering students*
11	**Kaitlin Tyler and Elisabeth Huelse,** Ansys Academic Development Team *Bringing Craft Time Back to the College Classroom: Exploring Material Choices via Musical Instrument Creation*
12	**Lakshana Mohee and Juan Doval Roque,** Ansys Academic Development Team *Bridging the Gap in Simulation Education for Biomedical Engineering Students*
13	**Nicolas Martin,** Ansys Academic Development Team *Materials and design engineering evolution in teaching: using ML to explore the design space*
14	**Susannah Cooke and Kaitlin Tyler,** Ansys *Annealing, Scanning Electron Microscopy, and More: Enhanced Processing and Characterization Data in Ansys Granta EduPack 2025R1*
15	**Tatiana Vakhitova and Piers Ireland,** Ansys Academic Development Team *Ansys Academic Social Impact Audit Tool Application*

1

Circularity Engineering: An Urgent Challenge in Materials Education

Hannes Geista*[1] and Frank Balle[1,2,3]
[1]*University of Freiburg,* [2]*Freiburg Materials Research Center FMF, and* [3]*Ernst Mach Institute*

Economies are dominated by a linear model, where raw materials are extracted, transformed into products, used, and then discarded as waste. This model is reinforced by conventional engineering design practices, including materials selection. To prevent and mitigate the resulting increasingly negative and systemic impacts on the environment, society, and economy, concepts of circularity have been developed over the past decades. The circular model aims at designing product, component, and material flows in ways that retain, recover, and add to their value for as long as possible while minimizing adverse effects. Circularity engineering is introduced as the engineering of matter and the interplay of information, energy, and matter towards a circular economy as a necessary, but on its own not sufficient contribution to a regenerative and resilient sustainable development. It is a novel modus operandi across all conventional engineering disciplines. The poster discusses the role of material choice within circular engineering design, its implications on material selection methodology, and materials education. This includes novel perspectives on the interrelation of materials and recycling processes, materials and value-retention processes (= VRPs; e.g., remanufacturing, refurbishment), materials circularity, and the assessments of criticality and sustainability of circular engineering materials. Finally, the current gap in research and education on material selection is mapped out.

2

The future of Mechanical Engineering in Design and Manufacturing 2025-2030. The Challenge of the University to Teach New Technologies.

Guillermo R. Facal* and Carlos J. Gérez
University of Buenos Aires

In 2025, Professors must consider how our disciplines are going to change in the next five years 2025-2030. In the case of Mechanical Engineering and specifically in the area of design and manufacturing, we know that the next decade will lead us to the total digitalization of design and manufacturing processes, the use of AI in design and manufacturing, the impact of new sustainable materials, equipment that provides sustainable energy, mobility with green energy, the Internet of Things, etc. Given that the use of these tools is already common in the professional field, the great challenge for teachers of Engineering careers is to integrate them into teaching methodologies. In this sense, in the design area of the Mechanical Engineering career at the University of Buenos Aires, we have been preparing to teach according to the evolution of technology for several years now. We started the changes in 2017 but today in 2025 our goal is to teach according to the parameters of 4.0 that implies the total digitalization of design, manufacturing and control systems. Every day the software we use in CAD, CAE, CAM and 3D printing, such as NX, KISSsoft, SolidEdge, SolidWorks, Inventor, FEMAP, ANSYS are more integrated with each other and with the processes of Designs or, Manufacturing and Control. Processes such as virtual reality, digital twins, the Internet of Things and the application of AI and the selection of materials through software have to be integrated into the curriculum of our subjects in addition to traditional teaching methods. The challenge is to integrate in the design areas subjects such as Mechanism Design, Machine Elements and Continuum Mechanics, Material Selection, Finite Elements so that in this way students can make better sustainable designs of machine components and finally design machines and equipment that meet the parameters of the 21st century by applying virtual reality and digital twins to verify the designs.

3 Material Science Teaching Perspectives for Chemistry Students at Riga Technical University

Sergejs Gaidukovs
Riga Technical University

The Material Science study course for undergraduate chemistry students at Riga Technical University is designed to provide a comprehensive understanding of modern materials, including metals, inorganic substances, polymers, and composites. The course focuses on the preparation, chemical synthesis, structure, and properties of these materials, while also developing practical skills in key research methods. Students are expected to acquire the following competencies: i) Analyze the chemical composition, structure, surface, mechanical, thermal, rheological, diffusion, electrical, electrochemical, and optical properties of various material groups; ii) Select the most appropriate technologies for material preparation and the most suitable methods for structural and property analysis; iii) Evaluate quantitative and qualitative experimental data, perform analyses, and draw informed conclusions; iv) The course structure emphasizes independent study, including reviewing literature, solving practical problems, and preparing for tests and discussions. Students also engage in group work, particularly on case studies that assess the selection and environmental impact of materials and technologies. This presentation summarized the results of a student survey conducted between 2022 and 2024, which highlights levels of satisfaction, academic performance grades, and anticipated perspectives for 2025.

4 Enhancing Materials Education Through Advanced Manufacturing and Multidisciplinary Projects

Claudio Tosto
University of Catania

As part of the “Advanced Manufacturing of Plastics and Composites” course at the University of Catania (Italy), Mechanical Engineering students are required to develop a case study and deliver an oral presentation on the technical and economic feasibility of a component with real industrial relevance.

During laboratory sessions at the Polymers and Composites Laboratory, students explore multiple 3D printing technologies, including FFF/FDM, metal and ceramic FFF, SLS, DLP/LCD, as well as polymers and composites manufacturing processes such as filament fabrication, prepreg layup, and resin infusion. These hands-on experiences allow them to bridge theoretical knowledge with practical applications.

This year, a team of three Mechanical Engineering students developed a case study focused on the feasibility of a variable-geometry intake trumpet. The project involved evaluating different additive manufacturing techniques and material selection strategies using Ansys Granta EduPack to balance performance, weight, and manufacturability.

By integrating knowledge from other disciplines, the students enhanced their project using Ansys SpaceClaim and Ansys Fluent.

This project highlights the importance of learning by doing in materials education, preparing students to tackle real-world engineering challenges through innovative design, material selection, and advanced manufacturing techniques.

5

Armourers & Brasiers Ambassadors Programme – Encouraging Undergraduate Outreach

Niamh Willis-Fox
University of Manchester

For a long time, PhD students had been the backbone of our outreach activities at the Department of Materials at the University of Manchester. Following the COVID pandemic, we have noticed a downturn in PhD students participating in public engagement initiatives as they focus on their research and lab work. However, we realised our enthusiastic undergraduate students are keen to engage with their chosen topic and were an untapped resource in this area.

The Armourers & Brasiers Ambassadors Programme is designed to inspire the next generation of materials scientists by engaging undergraduate students in the development and delivery of innovative materials science outreach activities. Participants work in teams to design interactive workshops aimed at late primary and early secondary school students. Through a series of structured sessions, they have been receiving training, mentorship and support to develop these activities that make complex scientific concepts accessible and exciting. By the end of the programme, each team will have created an outreach activity, ready to be delivered in local schools. Topics include viscoelasticity, textile properties and sustainability and materials for bridge building.

The initiative not only enhances the science communication skills of the undergraduate ambassadors but will also inspire enthusiasm for materials science among school students. This programme is proudly supported by the Worshipful Company of Armourers and Brasiers, helping to promote material science education and outreach.

6

Additive Manufacturing (AM) Case Studies in Materials Engineering Teaching: The experience at the University of Catania

Gianluca Cicala
University of Catania

Materials selection is a fundamental component of an engineer's toolkit. At the same time, additive manufacturing technologies stem out from the prototyping realm to enter in the real manufacturing world. This fundamental step forward let engineering teachers to have an efficient tool to instruct future engineers how to run material selection with an open wide approach covering the issues from material's choice as well processing and cost selection. In one word, additive manufacturing is a powerful tool to empower the so called "learn by doing" approach.

This poster presents some of the additive manufacturing (AM) case studies developed at the University of Catania as an effective teaching and learning strategy for proper material selection.

The combination of Ansys Granta EduPack with AM case studies has proven to be a powerful tool for fostering active and creative learning methodologies in materials science and technology education.

7 A Teaching-Learning Framework for Materials Characterization

Mouna Chetehouna* and Giuseppe Viola
School of Engineering and Materials Science, Queen Mary University of London

"Materials Characterization" is a broad discipline that plays a pivotal role in various scientific sectors and requires diversified training to provide learners with the necessary tools and skills for the investigation of materials' structure, microstructure, and properties. This study puts forward a comprehensive framework aimed at providing undergraduate STEM students with a wide range of competencies for material characterization. These include acquiring the essential theoretical knowledge of key characterization methods, the ability to construct experimental plans, the skills needed for sample preparation, and the aptitude to generate, analyze, and interpret data. By combining various strategies and pedagogical tools, the framework aims to facilitate self-directed and self-determined learning, allowing students to shape their educational journey and explore areas of personal interest within the discipline. Furthermore, the framework incorporates diversified approaches aimed at developing research proficiency and the ability to communicate research outcomes, both within conference contexts and through report formats resembling publications. The findings demonstrate the promising prospect that undergraduate students have the capacity to acquire the methodologies of scientists and to produce work of comparable quality. This study testifies the considerable potential that lies in engaging enthusiastic and capable students in scientific research and fostering the early development of future researchers.

8 Go out and find materials in use and the misused ones!

Roald Lilletvedt
NTNU

Taskcards is a virtual interactive whiteboard where teachers and students can collaborate in real time to create, discuss and organize content. Taskcards have many possible uses, for example as a tool for joint writing and brainstorming, group work, or as a digital learning resource.

A board can be shared with a link and contributors do not need to log in to participate.
Taskcards are used in the browser either on a computer or mobile/tablet.

We have used it as an introduction to materials use, the task given was: The groups will go out four times and find and document metals, ceramics, polymers and composites is use. The groups should take pictures, comment on the type of material and why, or why not, this is a good choice, 15 minutes per material type.

In the second year the same technique is used in teaching corrosion. The task given was: Go out and find good or bad material choices and good or bad solutions regarding corrosion protection.

This has improved the student's ability to observe and discuss material's use and corrosion protection. Several examples of corrosion protection and material selection observed by the students will be given.

9

Cross-sectional Shape Optimization Software Tool for Students

Ivana Slamova*, Tomas Kalina, and Ondrej Spacek
University of West Bohemia in Pilsen, Department of Machine Design

Designing optimal cross-sections is a key aspect of mechanical design. This paper presents a new software tool developed for educational purposes that enables students to quickly and efficiently evaluate suitable cross-sections and optimize their shape for the most efficient use of material.

All the basic stiffness and strength calculation formulas are known for standard section shapes. However, approaches for assessing the stability of profiles are lacking in established practice.

The tool is based on a combination of classical calculation methods and Professor Ashby's theory of shape factors. It allows the stability of different section shapes to be analysed and their form factor to be evaluated, which is a key parameter for assessing material utilization efficiency.

The tool has been used by students of the Department of Mechanical Engineering in the course of Design. The aim was to verify its user-friendliness and effectiveness in solving practical problems. The students successfully used the tool to solve the assigned tasks and the results of their work confirmed the potential of the SW tool to support teaching.

Conclusion:

The developed software tool represents a significant contribution to the field of teaching mechanical design. It enables students to quickly and efficiently understand the principles of cross-section optimization and gain practical experience in structural design. Thanks to its analytical basis and flexibility, it has the potential for further development and use, e.g. for torsion loading.

10

Product Disassembly: A new extension activity for engineering students

Matteo Seita
University of Cambridge

This presentation focuses on a new extension activity which we are running for Engineering Tripos students at the University of Cambridge. In this activity, called "Product Disassembly", students work in pairs to take apart household products to understand their design and manufacturing. Product Disassembly provides a good hands-on opportunity to learn about choice of materials and processes and to think about life-cycle and environmental impact of consumer goods. During the activity, the students are invited to seek answer to a number of questions, including what materials are employed in the product, how they are manufactured and assembled, what are their design requirements, what is their embedded energy, and how important is this in the life-cycle energy of the product.

11

Bringing Craft Time Back to the College Classroom: Exploring Material Choices via Musical Instrument Creation

Kaitlin Tyler* and Elisabeth Huelse
Ansys Academic Development Team

Many materials educators would agree that students getting hands on experience working with materials increases their understanding of material behavior and performance while keeping them engaged with course content. But in university curriculum, lab time and space are limited. Many materials of interest are not easily (or safely!) explored in a typical classroom. So what can we do to increase engagement and get more materials in the hands of students?

Why not bring craft time back? As part of the Ansys Academic Development Team's STEM Resource Initiative, we have created an in-class activity to help students explore the material properties of interest in musical instruments. This involves using available materials (cardboard, rubber bands, milk cartons, and more) to create a musical instrument in class.

Wondering if this activity would be a fit for your class or wondering what else we have created? Come by our poster to test this activity yourself—all materials will be provided!

12

Bridging the Gap in Simulation Education for Biomedical Engineering Students

Lakshana Mohee and Juan Doval Roque
Ansys Academic Development Team

Our analysis of biomedical engineering curricula across various global universities reveals that students are introduced to simulation concepts significantly later in their studies compared to their counterparts in other fields of engineering such as aerospace or mechanical. This delay poses a challenge when these students enter the workforce, where proficiency in simulation for healthcare applications is often expected. To address this educational gap, we have developed an innovative healthcare web application designed to teach simulation concepts through interactive clinical applications. This tool is particularly suited for first-year students, providing an engaging introduction to simulation before they advance to more complex computational software.

13

Materials and design engineering evolution in teaching: using ML to explore the design space

Nicolas Martin
Ansys Academic Development Team

The integration of various engineering tools and the evolution of industry practices are paving the way for more comprehensive and interconnected methods in teaching design. Traditionally, the stages of the design process were often taught separately, either in a step-by-step sequence or through repetitive cycles. However, modern advancements allow us to address these stages simultaneously.
In this poster, we highlight a teaching case study that embodies this shift. The case study involves several key activities: selecting appropriate materials, modifying the shape and structure of a design, conducting Finite Element Analysis (FEA) to simulate and analyze the design's behavior under various conditions, and using optimization techniques to improve the design. Finally, we perform a trade-off analysis to evaluate different design scenarios, considering the environmental impact throughout the product's entire lifecycle. We will discuss the learning opportunities and challenges presented by these methods: (a) Exploring the Design Space, as the ability to consider multiple aspects of a design simultaneously (b) Using Machine Learning Tools to aid in the design process (c) Understanding "Black Box" Tools as, the difficulty of teaching tools whose internal workings are not fully transparent (d) The need for students to know methos to balance and prioritize multiple, often conflicting, design goals.

14

Annealing, Scanning Electron Microscopy, and More: Enhanced Processing and Characterization Data in Ansys Granta EduPack 2025R1

Susannah Cooke[1] and Kaitlin Tyler[2]
[1]Ansys Academic Product Manager and [2]Ansys Academic Development Team

Materials Science & Engineering students need a fundamental understanding of not only how material properties change through processing, but also the characterization techniques which can be used to assess these properties. Equipment for material characterization is often expensive, and can be in high demand for research activities, meaning that it can be difficult to integrate teaching of these techniques into the undergraduate curriculum.

The 2025R1 release of Ansys Granta EduPack aims to support education in this area by including a new ‘Characterization Techniques’ table in the introductory-level Materials Science & Engineering database. This new table aims to introduce students to core characterization techniques through images, schematics, descriptions and categorization of each technique. We have also increased the number of bulk material processing techniques have also been added to this database to enhance students’ understanding of bulk processes alongside primary or secondary manufacturing processes. We will explore the new characterization and processing data, and ways to use it in undergraduate Materials Science & Engineering curricula in this poster.

15

Ansys Academic Social Impact Audit Tool Application

Tatiana Vakhitova and Piers Ireland
Ansys Academic Development Team

Integration of social sustainability and methodologies, such as Social Life Cycle Assessment (S-LCA), in engineering curriculum are still being explored and unevenly applied in engineering curricula. At the same time, topics of engineering ethics and recognition of soft skills as critical or transversal skills, has been increasingly evident (e.g. talks at Engineering Education for Sustainable Development conference 2020, European Society for Engineering Education (SEFI) conferences 2023 and 2024).

The Ansys Social Impact Audit Tool App (SIAT) is based on originally developed by Mike Ashby and Granta's academic team excel-based Tool (2019) . The Tool was designed to help engineering students in understanding concepts of Social Life Cycle Assessment (SLCA).

The SIAT is now an interactive application which helps to explore social sustainability by evaluating potential social impact at a level of nations using a variety of data visualizations. The SIAT App helps to compare products' life cycle based on their social impact. The data in SIAT is consistent with Ansys Granta EduPack Sustainability database. The SIAT follows the UN Social-LCA guidelines 2009, 2020 as well as the ISO 14075 SLCA, aligning with the Social Life Cycle Performance assessment methodology.

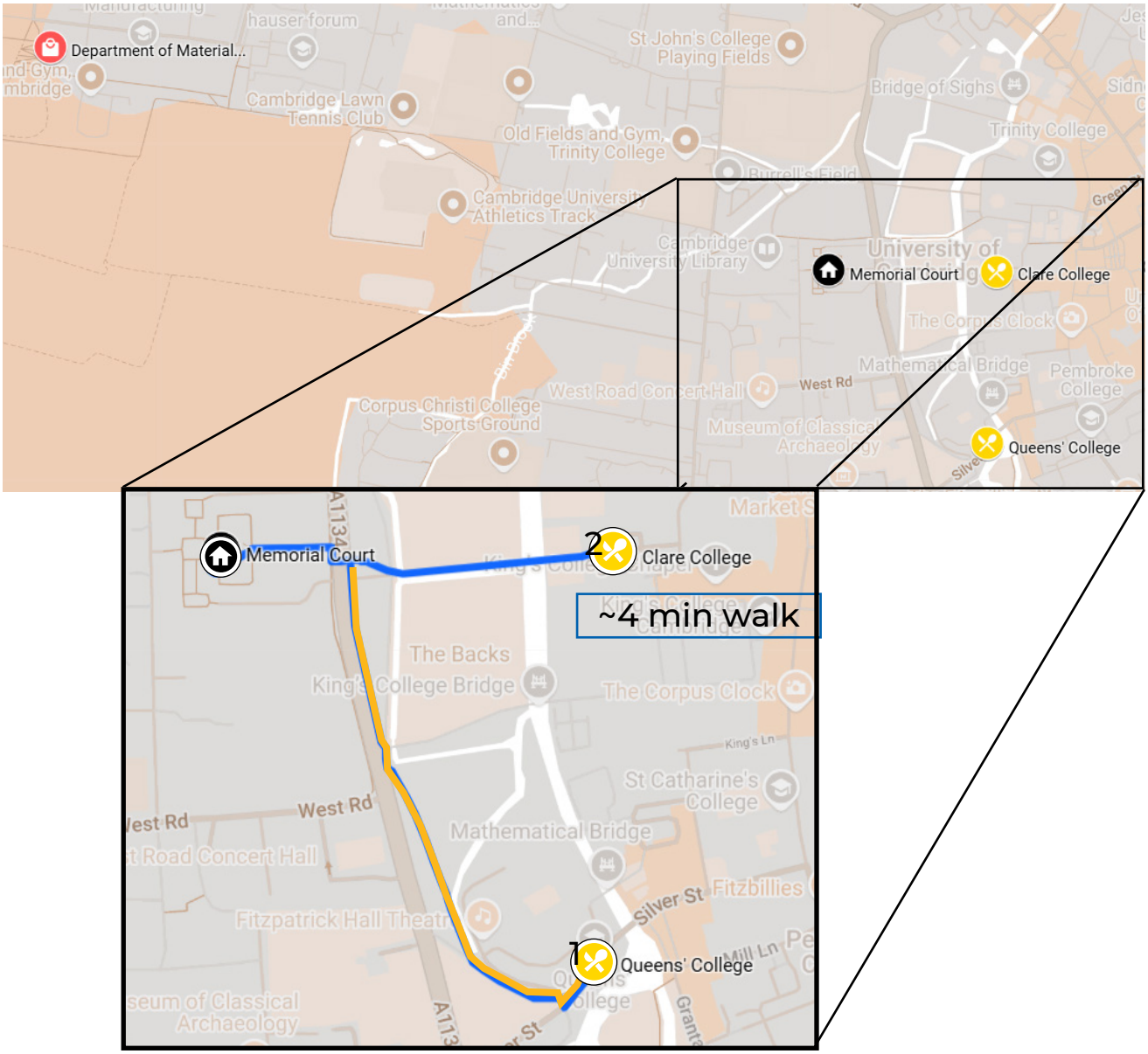
SIAT App helps students to:

1. Recognise fundamental concept of S-LCA (Social Life Cycle Assessment), aiding to a fully holistic assessment of a product life cycle.
2. Examine potential socio-economic impact of product-related decisions.
3. Evaluate socio-economic data visualisations and explore scenarios.

The SIAT App has now been tested by academics in several universities. The poster will provide an overview of the feedback from testing stage as well as explain its functionality. We are welcoming educators, users of Ansys Granta EduPack, to try this new Tool in their teaching.

Section 5: Maps, Contact Details, and Venue Information

Key Event Locations



Location	Address
	**Clare College Gillespie Conference Centre** (Symposium Venue and Accommodations) Memorial Court, Queens' Rd, Cambridge CB3 9AJ, UK
	**Queens' College** (Presenters' Dinner- Invitation only!) Silver St, Cambridge CB3 9ET, UK
	**Clare College** (Symposium Dinner Location) Trinity Ln, Cambridge CB2 1TL
	**Department of Materials Science and Metallurgy, University of Cambridge** (Workshop Location) 27 Charles Babbage Rd., Cambridge CB3 0FS

WiFi Access

To access WiFi while on the University of Cambridge campus, you can 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 Wednesday, April 3rd will be at the Department of Materials Science and Metallurgy in the University of Cambridge

Presenters' Dinner

The presenters' dinner will be hosted at Queens' College. Invitation only!

Address: Silver St, Cambridge CB3 9ET, UK

- Pre-dinner drinks will start at 7

- Dinner will be served in the Dining Hall

Symposium Dinner

The symposium dinner will be hosted at Clare College

Address: Trinity Ln, Cambridge CB2 1TL

- Pre-dinner drinks will start at 7

- Dinner will be served in the Dining Hall

Section 6: Workshop Details

Teaching Materials with Ansys Granta EduPack™ Level 1

Instructors: Kaitlin Tyler & Claes Fredriksson

From space shuttles to hip implants to toothbrushes, every physical product is made from materials. Engineering and design students need to understand how materials compare to one another and how best to choose the right material for the application. Ansys Granta EduPack™ is a teaching software for materials education. Designed to enhance student learning, Granta EduPack includes a database of materials and process information, materials selection tools and a range of supporting resources.

In this workshop, attendees will learn the basic functions of the Ansys Granta EduPack software, explore materials selection via the Ashby Selection Methodology, and develop their own short activity to implement in their courses right away.

Software Access:

Access to Granta EduPack will be provided in the workshop- no need to bring a personal computer. No previous experience with Granta EduPack is required.

Certification:

Free assessment and certification are available after completion of this workshop.

Workshop Learning Objectives:

By the end of this workshop, participants will be able to:

- Perform the basic functions of the Ansys Granta EduPack software
- Understand how the Ashby Selection Methodology can be implemented in the software
- Create and present a short class activity utilizing the Ansys Granta EduPack software

Proposed Agenda: (Full day workshop)

Time	Activity
9:00-9:15am	Arrival, Check-In, Coffee and Tea
9:15-9:30am	Intro to Ansys Granta EduPack software
9:30-10:15am	Basic Software Functions: Browse, Search, Chart/Select, and Eco Audit
10:15-10:45am	Coffee Break
10:45am-12:00pm	Basic Materials Selection
12:00-12:450pm	Lunch
12:45-1:00pm	Personal Break
1:00-2:00pm	Advanced Materials Selection
2:00-3:00pm	Course Activity Development Part 1
3:00-3:20pm	Coffee Break
3:20-4:15pm	Course Activity Development Part 2
4:15-4:45pm	Course Activity Presentation (required for certification)

Reference Materials:

Materials Selection White Paper | Ansys
Material Property Charts in Ansys Granta EduPack

Teaching Sustainable Product Design with Ansys Tools Level 1

Instructors: Wen Zhao & Harriet Parnell

In pursuit of realizing a responsible production (United Nations Sustainable Development Goal No.12) of goods, sustainability considerations are becoming indispensable in an engineer's decision-making process throughout the product development. Holistic product design must consider the functional, geometric, and material needs as well as environmental impact. This can be challenging to teach to students, especially when various degree programs often focus on specific portions of the design process more than others. To support this, we have developed a Sustainable Product Design (SPD) Methodology, which combines materials selection (building on the Ashby Selection Methodology), functional and geometric analysis via simulation, and a simplified LCA and trade-off analysis. In this workshop, attendees will implement the SPD methodology utilizing Ansys Granta EduPack™ (a teaching software for materials education) and Ansys Discovery™ (a 3D product simulation software) and explore how to implement this in their existing courses.

Software Access and Previous Experience:

Access to both softwares will be provided in the workshop- no need to bring a personal computer. Previous experience with the Ansys Granta EduPack software is recommended, but not required. No previous experience with Discovery is required.

Certification:

Free assessment and certification are available after completion of this workshop.

Workshop Learning Objectives:

By the end of this workshop, participants will be able to:

» Understand how materials selection, simulation, and product life cycle considerations can be used in the classroom for teaching sustainable product design

» Explore the connection between the Ansys Granta EduPack and Ansys Discovery softwares for teaching

» Create and present a short class activity utilizing the Sustainable Product Design Methodology

Proposed Agenda: (Full day workshop)

Time	Activity
9:00-9:15am	Arrival, Check-In, Coffee and Tea
9:15-9:30am	Introduction to the Sustainable Product Design Methodology
9:30-10:15am	Materials Selection of a Longboard
10:15-10:45am	Coffee Break
10:45am-12:00pm	Topology Optimization of a Longboard Deck
12:00-12:450pm	Lunch
12:45-1:00pm	Personal Break
1:00-2:00pm	Streamlined Life Cycle Assessment of a Longboard Deck
2:00-3:00pm	Course Activity Development Part 1
3:00-3:20pm	Coffee Break
3:20-4:15pm	Course Activity Development Part 2
4:15-4:45pm	Course Activity Presentation (required for certification)

Reference Materials:

Utilizing Materials Selection and Simulation in Design | Ansys

Case Study: Bike Crank Design Optimization – Towards Sustainable Product Design

The Social Dimensions of Sustainability

Instructors: Tatiana Vakhitova, Nicolas Martin, & Piers Ireland

Sustainability is a complex topic to teach, involving many aspects related to the Natural, Human & Social, and Manufacturing capitals. One area that can be overlooked is the social dimension of sustainability. In this workshop, we will provide tools and knowledge on how to support students being decision-makers with a holistic view on sustainability. The foundation of this workshop is Ashby's 5-Step Methodology for Sustainability Assessment, a well-established active-learning approach to introducing sustainable thinking in the classroom. Two tools will be used to aid in implementing this methodology. The first is the Eco Audit Tool in Ansys Granta EduPack™, a teaching software for materials education that is often used in this methodology for fact-finding and decision making. The second is the Ansys Academic Social Impact Audit Tool (SIAT), which helps to enhance students' understanding of social impact along a product's life cycle. First developed in 2019 as an excel-based tool, an app of the SIAT is scheduled to be released in 2025 and will be used in this workshop. The new app follows UN Social-LCA Guidelines (2009, 2020) and when combined with Granta EduPack saves time on data research, data visualization, and analytics. Details on practical curriculum enhancement recommendations and shared experiences from fellow academics will be included.

Software Access and Previous Experience:

To access the Ansys Granta EduPack software and the SIAT app for the workshop, please bring a personal computer that can run Windows (Mac running Windows via Bootcamp or Parallels will work). Previous experience with the Ansys Granta EduPack software is recommended, but not required.

Workshop Learning Objectives:

By the end of this workshop, participants will be able to:

- Examine sustainability impacts in conjunction with Ansys Granta EduPack Sustainability Database and Eco Audit Tool.
- Examine potential social and socio-economic impacts of product-related decisions
- Evaluate socio-economic data visualisations and explore different scenarios.

Proposed Agenda: (Half day workshop)

Time	Activity
12:00-12:450pm	Lunch
12:45-1:00pm	Check-In, License Setup *Please arrive by 12:30pm to avoid delays
1:00-1:40pm	Introductions, Agenda, and Background
1:40-2:20pm	Introduction to: • Ansys Granta EduPack & Sustainability Database L2 • Eco Audit Tool • Ansys Academic Social Impact Audit Tool (SIAT)
2:20-3:20pm	Case study introduction: group work with prompts Part I
3:00-3:20pm	Coffee Break
3:20-4:00pm	Group work with prompts Part II (SIAT)
4:00-4:30pm	Group discussion & Final Remarks

Reference Materials:

Paper: Social Life-Cycle Assessment and Social Impact Audit Tool | Ansys
Materials and Sustainable Development | ScienceDirect

Section 7: Journal Publication Opportunity

Journal of Chemical Education Special Issue:
Teaching Innovation in Materials Science and Engineering

Interested in publishing? Contact Leonard or Rui!

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Materials Education SYMPOSIA North America

August 4-6 2025

hosted by

Georgia Tech College of Engineering
School of Materials Science and Engineering

with support from Ansys

Schedule

Pre-Symposium Workshop:

Monday, August 4th

Symposium

Tuesday, August 5th to Wednesday, August 6th

Session Themes

- Innovation in Materials Science Education
- AI & Machine Learning for MSE Education and Industry
- High Impact Practices in MSE Education

Special Poster Call

- K-12 Outreach
- Transfer student programs & recruiment
- Engaging with the larger community

IMPORTANT DATES

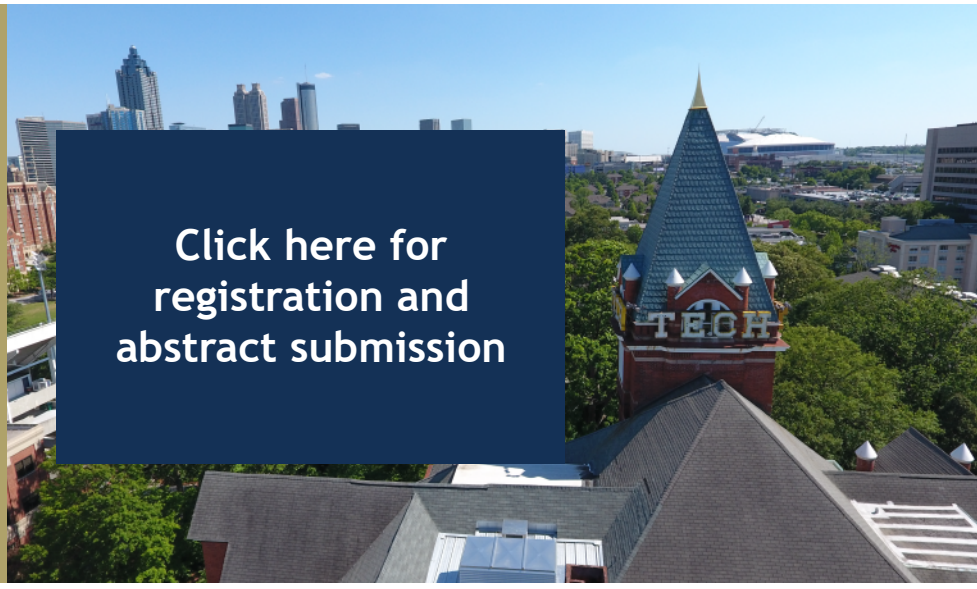
NOW

call for abstracts and registration

April 15th, 2025

deadline for:

- presentation abstracts
- poster abstracts
- early bird registration



Click here for registration and abstract submission

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