

The use of CES EduPack at all levels of Higher Education

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Synopsis

At the time of writing, CES EduPack is used in over 1000 colleges and universities worldwide, with the aim of supporting Materials Education across different departments and throughout all years of study. Divided into sections according to the level of education, this paper will explore how academics from across the world are using the software in their undergraduate or postgraduate teaching. Although it does not attempt to provide a fully comprehensive overview of how the CES EduPack is being used, it does hope to showcase some interesting stories which could be used to give you some fresh ideas.



Figure 1. Where in the world CES EduPack is being used.

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Introduction

The CES EduPack is a unique set of teaching resources that is designed for Materials Education from pre-university up to post-graduate study. Originally developed at the Engineering Department of Cambridge University (UK), the CES EduPack is now used across the world. It is used in approximately 70 % of all UK Mechanical Engineering programs, so can be considered part of the ‘current practice’. Providing an interactive opportunity to engage students with various aspects of materials engineering, the visual software can also be used to teach transferable skills, such as a systematic rational materials selection. With access to over 350 teaching resources, educators can also find ideas for industrial case studies and self-learning exercises. CES EduPack supports teaching in subjects across Engineering, Design, and Science through several different Editions such as *Bioengineering*, *Aerospace*, *Polymer and Sustainability*. This gives the educator the ability to tailor the content to both their own experiences and that of their students.

Quick links

Quick links to relevant topics can be seen in Figure 2; numbers indicate which page a particular contributed topic can be found on.

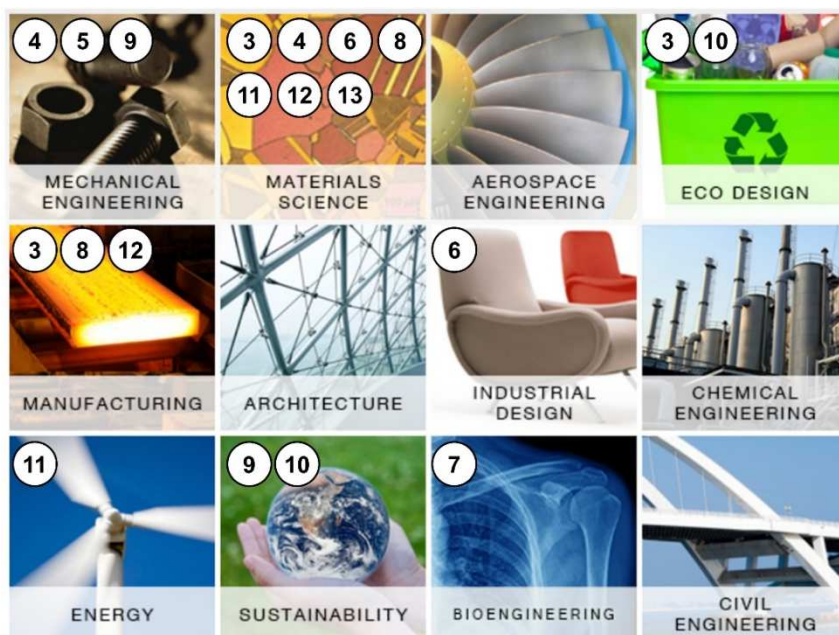


Figure 2: Topics supported by CES EduPack.

CES EduPack at undergraduate level



Ir. Erik Thomassen
Delft University of Technology, The Netherlands

Subject: Industrial Manufacturing
Student cohort: 300 students

Since 2007, the Delft University of Technology, has been using a campus wide license of CES EduPack to supplement the teaching of several bachelor courses. After recently taking over from Dr. Erik Tempelman, **Ir. Erik Thomassen** now coordinates the *Industrial Manufacturing* course as part of Industrial Design Engineering (IDE) program. This course has previously received three awards for Best BSc course from all students over a five-year period, supported by the CES EduPack which acts as a background tool for data and information on manufacturing processes. As well as the primary textbook *Manufacturing and Design*¹, “having a copy of the EduPack is mandatory” as students are encouraged to select materials based on its property records. It is often that case, that later in their undergraduate programs, students will naturally return to CES EduPack when asked to support design decisions. Ir. Erik Thomassen believes that “it is a great tool and very well suited for university learning”. The different levels allow early-stage users to access simplified databases with ease whilst, also allowing experienced users to access more advanced features. Knowledge gained through using CES EduPack “improves the quality of their work and reasoning”. Furthermore, even though a large portion of the students have MacBooks, “running the software *via* BootCamp or similar, appears to give little difficulty”.

“it is a great tool and very well suited for university learning”

— Ir. Erik Thomassen



Prof. Elza Bontempi
University of Brescia, Italy

Subject: Laboratory of spectroscopies for materials characterization
Student cohort: 100 students

The department of Mechanical and Industrial Engineering (DIMI) is one of the oldest engineering areas at the University of Brescia and offers seven Programs, including three at Bachelor level. **Prof. Elza Bontempi** is a full professor of fundamental Chemistry and teaches on the undergraduate course ‘*Laboratory of Spectroscopies for materials characterization*’. Lecturing to an audience of 100 students, Prof. Elza Bontempi started using CES EduPack so that her class could have access to “a database of materials characteristics and performances”. Allocating specific lessons and exercises to CES EduPack, Prof. Bontempi feels that the teaching package has helped her to “introduce materials evaluation, in terms of sustainability. Not only with eco-design strategies, but [also] with attention to raw materials scarcity”. Although not discussed in detail here, the software has also been able to supplement her own research with information from “Embodied Energy and Carbon Footprint properties”, which has led to several publications².



Dr. Richard W. Neu
Georgia Institute of Technology, USA

Subject: Materials Selection and Design
Student cohort: 50 students

The Georgia Institute of Technology have been using CES EduPack since 2005, and as a campus wide resource from 2010. Based in the George W. Woodruff School of Mechanical Engineering, **Dr. Richard W. Neu** teaches on the undergraduate course *Materials Selection and Design*. Supported by the primary textbook '*Materials Selection in Mechanical Design*' (Ashby, 4th Edition), the elective module also requires students to have access to the CES EduPack which can be freely downloaded onto personal computers. At a glance, the course has four primary outcomes: 1) to provide students with a systematic approach for the selection of materials for mechanical design; 2) to familiarize the students with material properties and fabrication processes, including those capable of producing a component with specific size, shape, properties and cost; 3) to teach students how to deal with realistic multiple constraints and conflicting objectives; and 4) to introduce the students to the methodologies for designing new materials and conceiving hybrid materials. Through homework and projects, such as an energy and CO₂ eco-audit for the propane patio heater, Dr Richard Neu feels that the CES EduPack "provides an easy to use database for students to understand the properties of materials of all types...the graphical presentations are [also] quite useful".

"provides an easy to use database for students ..."

— Dr. Richard W. Neu



Dr.-Ing. Kerstin Kern
Hochschule für Technik Buchs, Switzerland

Subject: Materials Science Basics
Student cohort: 50 students

As part of the Bachelor in Systems Engineering program, at the Hochschule für Technik Buchs, **Dr.-Ing. Kerstin Kern** teaches *Materials Science Basics* to a class of 50 undergraduate students. Following on from the work of her supervisor, Dr.-Ing. Kerstin Kern began using CES EduPack for access to the databases. Students are encouraged to complete small, self-study tasks at home, to prepare for subsequent lectures. Using CES EduPack helps "students to get a feel for the materials properties in general, which is the aim of the course". It also gives them an opportunity to become familiar with a modern database and assists them in finding solutions to simplified materials selection problems.

"students get a feel for the materials properties..."

— Dr. -Ing. Kerstin Kern

Markus Dumschat
University of Applied Sciences Ravensburg-Weingarten Germany

Subject: Product Development

Student cohort: between 50-80 students

The University of Applied Sciences Ravensburg- Weingarten, have been using CES EduPack since 2017. Within the Faculty of Mechanical Engineering, **Markus Dumschat** has been teaching 50-80 students, on the undergraduate *Product Development* course. Markus started using the CES EduPack as he noticed “that the students only know a few different construction materials at the beginning of their studies (2nd semester). This was especially evident in open tasks, when students had to develop and construct under marginal conditions such as lightweight construction, cost reduction or sustainability”. In many cases, students would only provide information on the family of materials *e.g.* steel, aluminum and plastics, without naming specific alloys (besides S235 or Al7075). Markus believes that this can be changed with the use of the CES EduPack and that the “current first run looks very promising”. He explains that the CES EduPack has been incorporated into the teaching *via*

**“In times of digitization...
the software gives a good
opportunity to offer
students alternative
access to a world of
materials...”**

— Markus Dumschat

**“real tasks developed
in cooperation with an
industrial partner”**

— Markus Dumschat

“real tasks developed in cooperation with an industrial partner”. Students are expected to optimize a subsystem of the product guide example ‘the chainsaw’, which they discuss during a subsequent lecture. Divided into separate tasks, students must 1) come up with a creative solution using preliminary calculations; 2) choose materials for the final design (possibly with a prototype) whilst; 3) also attempting to “map a complete construction process in the best possible way”. By the end of the project, students will have shown “at least 3 suitable material types for 3 components developed by them and [must have] proved their suitability with material characteristics”, all with the help of CES EduPack. “In times of digitization and decline in the use of classical literature for the acquisition of knowledge...the software gives a good opportunity to offer students alternative access to a world of materials and corresponding processing/ manufacturing processes”. In the long run, Markus and his colleagues want to give students “the possibility to use the software outside the engineering project, *e.g.* final theses, as well as to use [it] at the annual in-house bridge construction competition for materials selection in the ‘Natural Materials’ area”. Since using CES EduPack in the Product Development course, Markus has seen that students have more to say when initially defining materials properties and the main characteristics of the respective applications, as prior knowledge is required to set appropriate boundary conditions during the CES EduPack selection process. As well as an improvement in technical knowledge, students also show improved interdisciplinary competences such as communication skills during group discussion.



Marian Kozlowski
RWTH Aachen, Germany

Subject: Engineering Design courses
Student cohort: 100 to 250 students

The Mechanical Engineering BSc program offered at RWTH Aachen combines a challenging core curriculum with future-oriented and interdisciplinary projects. Using current themes, as well as grounding from the fundamental and theoretical underlying concepts, **Marian Kozlowski** leads the teaching on several engineering design courses. Tasked with engaging 100 to 250 students, Marian started using CES EduPack as he believes “it’s the best software for materials selection available”. Dedicating one learning unit to its use, the software has been incorporated into the teaching “as a

“teaching with state-of-the-art software also used in industrial practice is very valuable...”

— Marian Kozlowski

practical application to teach Ashby’s approach to materials selection”. Systematic material selections, as well as an understanding of correlations and trade-offs, are just some of the benefits Marian believes is offered by CES EduPack. “Teaching with the state-of-the-art software, also used in industrial practice, is very valuable for engineering courses”.



Dr. Adrian Lowe
Australian National University, Australia

Subject: Engineering science and Engineering materials
Student cohort: 200 and 90 students

Since 2017, the Australian National University have been using CES EduPack as a campus wide resource for various engineering programs, including two courses taught by **Dr. Adrian Lowe**, a senior lecturer from the College of Engineering. Dr. Adrian Lowe began using CES EduPack in his teaching as it “seemed to be a very visually informative materials selection and investigative tool”. His *Engineering Science* first-year undergraduate module, aims to teach students how a knowledge of materials *e.g.* properties, processing and performance, is key to all engineering activities. Using “basic investigative and material selection exercises” the CES EduPack has been able to support him with this. During the third-year *Engineering Materials* module, Dr. Lowe has also been able to use CES EduPack to deliver “more advanced, case study-type exercises”. Regardless of the level of study, he feels it allows students “to visually explore the materials universe and see how structure, property, processing and performance all interrelate”.

“...a very visually informative materials selection and investigative tool”

— Dr. Adrian Lowe



Dr. Kareen Coulombe
Brown University, USA

Subject: Biomaterials
Student cohort: 35-60 students

The *Biomaterials* course, primarily taught to Engineering students and some master's and PhD attendees, is delivered by **Dr. Kareen Coulombe** during the fall semester. Covering several topics which include metals, ceramics, tissue-biomaterial interactions, smart materials and tissue engineering (non-exhaustive), Dr Kareen Coulombe started using CES EduPack in her teaching as she “needed students to apply their knowledge in a quantitative way that would engage them in problem solving, related to medical applications”. Students are set one homework question per assignment (10 in total for the class) during which they will use CES EduPack to look up quantitative information and assemble tables of data. They will also plot various properties, so they can examine different classes of materials and generate new material records with data from the primary scientific literature. Students will then complete a final project where they must individually complete a materials selection, for a specific medical problem of their choice. This requires students to identify the design space, research and assign quantitative limits with justification (*i.e.* in reference to the literature), refine the materials space and then finally make recommendations for future materials in the relevant application. On completion of this project, a written report is submitted. This year members of Granta's Education Team, had the pleasure of deciding which projects would be placed 1st, 2nd and 3rd from the selected final year reports. Amongst many high-quality submissions, gold was given to a project which examined ‘Bioresorbable Vascular Scaffolds’ (Figure 3)³, silver went to a project which looked at ‘Materials Selection for an Intrauterine Device’ and bronze went to project which examined ‘Tissue Engineered Conduit for the Fontan Procedure’. Dr Kareen Coulombe values how CES EduPack provides instructors with “quantitative values and easy-to-find definitions to which we can direct students through homework sets, lecture material and the final project. It puts a lot of data in one place and at our fingertips”. She says that students “report liking this software, as a way to apply their knowledge”.

“...It puts a lot of data in one place and at our fingertips”

— Dr. Kareen Coulombe

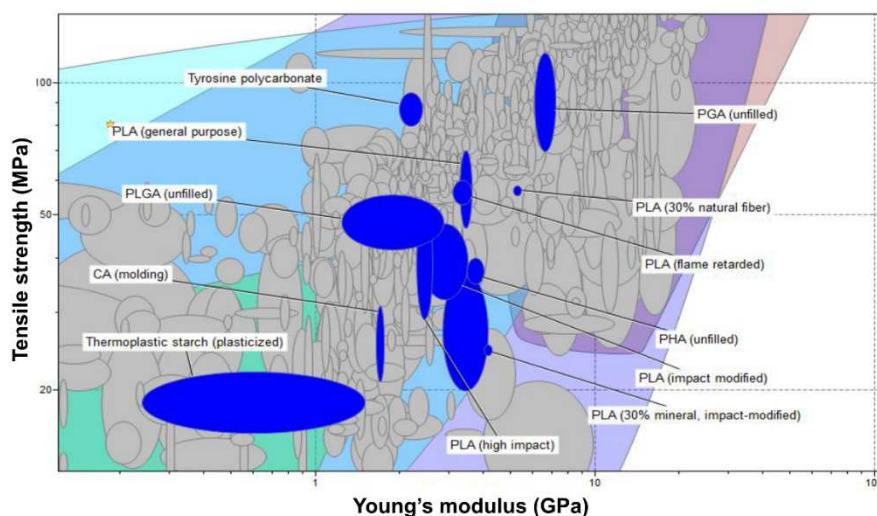


Figure 3: Young's modulus vs. Tensile strength chart for bioresorbable vascular scaffolds³.



Dr. Conrado Rosales Torres
ITESM, Campus Puebla, Mexico

Subject: Materials Technology, Manufacturing Technology, Advanced Manufacturing
Student cohort: 72 students

The Instituto Tecnológico de Estudios Superiores de Monterrey (ITESM) is a multi-campus university based in Monterrey, Mexico. With over 30 campuses in 25 different Mexican cities, the Puebla Campus has been using a campus-wide CES EduPack license since 2013. **Dr. Conrado Rosales Torres**, from the department of Mechanical Engineering, leads the teaching on three undergraduate courses: *Materials Technology*, *Manufacturing Technology* and *Advanced Manufacturing*. After hearing about CES EduPack from another colleague, Dr. Rosales began incorporating the resource into his teaching, making use of the “large quantity of well documented information” which can be found all in one place. Through CES EduPack exercises, he has been able to teach students about materials selection and how to effectively use performance indices, Eco-Audits and part cost estimator. Dr. Rosales values the “support from a company...who understand our needs”. He believes the benefits of CES EduPack allow connections to be made between various undergraduate programs and that the database is continually updated, so that the records are reliable and “do not become obsolete”.

“...support from a company...who understand our needs”

— Dr. Conrado Rosales Torres

Prof. Alejandro Muñoz Zapata
Universidad Pedagógica y Tecnológica de Colombia (UPTC), Colombia

Subject: Materials Selection and Engineering Materials
Student cohort: 60 students

The Universidad Pedagógica y Tecnológica de Colombia (UPTC) are a multi-campus institution who have been using CES EduPack since 2014. **Prof. Alejandro Muñoz Zapata**, from the Faculty of Engineering, teaches *Materials Selection and Engineering Materials*, to an audience of 60 students. After UPTC acquired the license, Prof. Muñoz introduced the software into his course as it offered versatility and a tool through which students can “understand properties as well as process characteristics”. Implemented using case studies and webinars, Prof. Muñoz values CES EduPack as it contains continually updated material records.

“...[students] understand properties as well as process characteristics”

— Prof. Alejandro Muñoz Zapata

CES EduPack at master's level



Prof. Stéphane Gorsse

**Institut Polytechnique de Bordeaux (Bordeaux INP),
France**

Subject: Advanced Materials and Processing, Materials Engineering and Composites and Mechanical Engineering

Student cohort: 100 students

As one of five schools at the Institut Polytechnique de Bordeaux, the Ecole Nationale Supérieure de Chimie, Biologie et Physique (ENSCBP) and the Ecole nationale supérieure d'électronique, informatique, télécommunications, mathématiques et mécanique de Bordeaux (INSEIRB-MATMECA) have been using the CES EduPack in their teaching since 2006. More recently, **Prof. Stéphane Gorsse** has been using CES EduPack during three master's programs: *Advanced Materials and Processing*, *Materials Engineering and Composites and Mechanical Engineering*. Prior to starting the course, students already have a good background in chemistry, physics and materials science however, they "still find it hard to compile their fundamental

"CES EduPack enables... project-based learning, flipped classes and ongoing assessment which favor action learning and collaborative working..."

— Prof. Stéphane Gorsse

knowledge and to draw [it] into effective knowledge-guided decisions, taking into account performance, cost and environment". The students all search for meaning and want to have an active role within the classrooms. Prof. Stéphane Gorsse says that "CES EduPack enables [him] to carry out project-based learning, flipped classes and ongoing assessment which favor action learning and collaborative working (groups of 4-5 students) on practical problems". Two case studies used by Prof. Stéphane Gorsse include 1) materials and process selection for a wood stove (Figure 4) and 2) materials selection for a harmonica (Figure 5). The first of these case studies encourages students to design a smokeless, autarkic and cheap wood stove exploiting thermoelectricity to harvest the energy for running a fan. This project encourages students to consider materials as a system including multi-functionality, cost, processability, supply chain, sustainability and social responsibility. Students resolve this complex problem from the design and selection to the manufacturing by using the Sustainability database (materials and processes universes) and the Functional materials database of the Materials Science and Engineering package. The second case study focuses on an "innovative design for strong value-added" harmonica cover. "Emphasis is placed on aesthetic and sensorial properties (e.g. touch, tactile warmth...) that gives the product its personality". Students use the Products, Materials and Processes database.



Figure 4. Materials for a wood stove.



Figure 5. Materials selection project work based on a harmonica cover.



Dr. Markus Berger
TU Berlin, Germany

Subject: Eco design
Student cohort: 30-35 students

Since 2016, the CES EduPack has been used to support teaching at TU Berlin, including on the *Eco design* course taught by **Dr. Markus Berger**. As part of the Sustainable Engineering department, the course aims to convey basic concepts that can be used to analyze and reduce the environmental impact

“it allows students to consider environmental aspects in design decisions ...”

— Dr. Markus Berger

of a product during its development. Covering topics such as legislation, life cycle assessment & footprints and implementation & supply chain management, Dr. Markus Berger began using CES EduPack to supplement his teaching as “it allows students to consider environmental aspects in design decisions”. Incorporated into the schedule *via* seminar tasks, students can “learn about material selection considering design constraints/ objectives and the mechanical properties of materials”.

Dr. -Ing. Sebastian Kilchert
Fraunhofer-Institut für Kurzzeitdynamik, Germany

Subject: Materials Life Cycle
Student cohort: 60 students

The Institute for Sustainable Systems Engineering, within the *Fraunhofer-Institut für Kurzzeitdynamik*, have been using a campus-wide license of CES EduPack since 2015. **Dr. -Ing. Sebastian Kilchert**, from the department of Composite Design, teaches *Materials Life Cycles* to a class of 60 students studying for a master’s. He began incorporating the CES EduPack into his syllabus as it “has a lot of well prepared material ([particularly] materials & sustainability) available for teaching”. As well as exercises and small projects which are centered around the CES EduPack software, Dr. Kilchert also uses several slides, from the teaching resources on Granta’s Education Hub, to supplement his own lectures. He finds that students are able to gather and prepare information with ease and that the teaching resource makes it “possible for them to experiment and play, which provides a lot of motivation”.

“[CES EduPack] makes it possible for them to experiment and play, which provides a lot of motivation ...”

— Dr. -Ing. Sebastian Kilchert

CES EduPack across all higher education levels



Prof. Dr. Vladimir Martínez
Universidad Pontificia Bolivariana- Medellín,
Colombia

Subject: Material Science (Bachelor) and Nanotechnology & Energy (Master & PhD)

Student cohort: 60 students

The Universidad Pontificia Bolivariana (Medellín) have been using CES EduPack as a teaching resource since 2017. Capable of supporting courses at different levels of higher education, **Prof. Dr. Vladimir Martínez** has incorporated the software into his undergraduate *Materials Science* class and his postgraduate *Nanotechnology & Energy* class. Prof. Dr. Vladimir Martínez explains that “it is difficult to teach the functional attributes, the mechanical, physical, chemical and environmental challenges, as well as the relationship between structure-properties-process, without a theoretical understanding”. He also highlighted the need for “learning tools which really emphasize the importance of material science in engineering”. Prior to using CES EduPack, Prof. Dr. Vladimir Martínez was unable to find any teaching tools which could help shorten the time taken to explain relevant topics whilst also conveying “an integral understanding of material selection for the education of engineering professionals”. When he started using the software he found it was an “excellent tool which started to really complement [his] interests as a professor”.

“excellent tool which started to really complement my interests as a professor ...”

— Prof. Dr. Vladimir Martínez

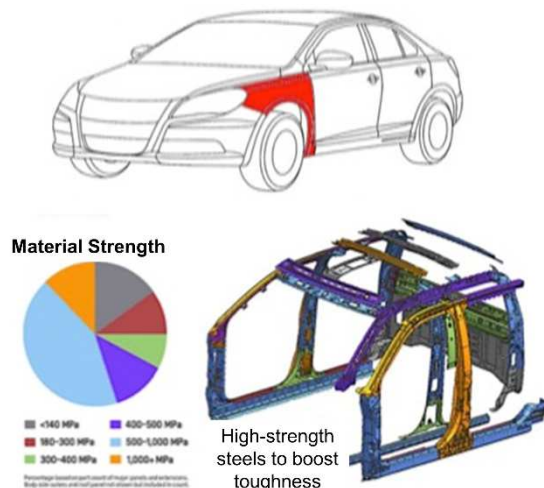


Figure 6: Materials selection process for the reduction in vehicle mass.

bending stiffness and buckling ($E^{1/3}/\rho$) and for tension-compression loading (σ_y/ρ). At the bachelor level, the software has been used to “introduce new concepts” and at the master’s level, it has been used to “compare behaviors between materials (or material classes)”. Prof. Martínez values the CES EduPack resource as it supports his teaching during *materials science*, which is “the biggest mandatory course in engineering with an important connection to later courses in mechanical, aerospace and automotive engineering (among others)”.



Dr. Christophe Le Bourlot
Institut National des Sciences Appliquées de Lyon (INSA
de Lyon), France

Subject: Introduction to Materials Sciences

Student cohort: 300 students

INSA de Lyon, is one of the Grandes Écoles of France, and has been using CES EduPack to support undergraduate and postgraduate teaching since 2007. **Dr. Christophe Le Bourlot** is an Associate Professor in the Metal team of MATEIS and teaches on the *Introduction to Materials Sciences* course. When he was hired, CES EduPack was already being used by the institution however, he continued to incorporate the software into his classes as he felt it was a strong reference for materials records and properties. Dr. Christophe Le Bourlot also explains, that more and more CES EduPack is being used as a tool to “introduce new notions”. For example, students start by selecting materials for a given problem and then as they work through the task associated properties can be discussed. Dr. Christophe Le Bourlot also values the teaching resource for its illustrations and interactivity. Acting as a materials wiki for the student, he says that “it is easy to ask [them] to prepare exercises with CES EduPack” and that the “property maps are used a lot”.

“...more and more it is used as a way to introduce new notions”

— Dr. Christophe Le Bourlot

Dr. John Metcalf
Sheffield Hallam University, United Kingdom

Subjects (inc.): Engineering Ceramics and Polymers, Manufacturing Processes, Failure Investigation with Materials and Process Selection

Student cohort: 200+ students

Since 2005, **Dr. John Metcalf** has been using CES EduPack to support his teaching during several BEng, MEng and MSc programs: Materials Engineering, Manufacturing Engineering, Aerospace Engineering and Mechanical Engineering. Following on from the work of his predecessor, Dr. Metcalf continued using the software during several of his courses, *e.g. Level 4 Manufacturing Processes* and *Level 7 Competitive Materials Technology*, as he believes it helps him “teach to a deep level of learning”. Implemented through several assignments, students begin with some basic CES EduPack functions like browsing and searching, before moving on to more complex assignments, such as design limiting properties, interpretation and formulation of objectives and constraints and finally Eco Audits. More advanced projects are also explored, based around a diverse range of topics including materials for a knife blade and materials for engine blocks. Although a little time is required, when planning how the information will be conveyed, he finds the CES EduPack a very powerful tool for selecting materials and processes. The students appreciate the approach and feel they would be much more confident having it in their real-life jobs. They can understand the relevance of materials and process selection and acknowledge the privilege of having access to a massive database without having to disperse on books and on-line searches, which is potentially unreliable.

“...students acknowledge the privilege of having access to a massive database ...”

— Dr. John Metcalf

Dr. Jone Muñoz Ugartemendia
Universidad del Pais Vasco, Spain

Subjects (inc.): Fundamentals of Materials Science, Structural Materials and Metrology

Student cohort: 350 students

Since 2010, the Universidad del Pais Vasco has been using CES EduPack to support both undergraduate and postgraduate teaching. **Dr. Jone Muñoz Ugartemendia**, from the department of Mining and Metallurgical Engineering, Materials Science, teaches on a number of programs including: *Fundamentals of Materials Science*, *Structural Materials*, *Material Selection and Utilization* and *Metrology*. Dr. Muñoz began using CES EduPack to support these courses as it offered her “new resources for teaching” and was approved by the students. Supporting several years of study, she uses the software to “start discussions and consolidate previous knowledge” based on the Ashby charts (Bachelor 2nd year); highlight “the importance of microstructure and composition for materials properties” (Bachelor 4th year) and with use of the entire software, “make a materials selection based on a proposed problem”. From an academic point of view, Dr. Muñoz feels that the CES EduPack “is well adapted to the [modern] student profile”. Not only does it help her with the visual resources (“which are excellent”), it also gives her an alternative way to teach the fundamental science. Students tell her that they like using it, particularly on the master’s course, as it serves as both a materials selection software and “a reliable source of information”. This year’s best student comment has been “...since I [started] using CES EduPack, my life has changed...” Dr. Muñoz thinks this says it all!

“is well adapted to the [modern] student profile ...”

— Dr. Jone Muñoz Ugartemendia

Prof. Antonio Julio López Galisteo
Universidad Rey Juan Carlos, Spain

Subjects (inc.): Selection and Application of Materials and Advanced Fabrication Processes for Metals and Ceramics

Student cohort: 60 students

Since 2005, the Universidad Rey Juan Carlos have been using the CES EduPack during several undergraduate and postgraduate courses. **Prof. Antonio Julio López Galisteo**, from the department of Materials Science and Engineering, has incorporated the software into some of his courses including: *Selection and Application of Materials*, *Technology of Fabrication Processes* and *Advanced Fabrication Processes for Metals and Ceramics*. He believes that the CES EduPack is “the ideal complement for teaching materials selection and fabrication techniques”. Through a flipped classroom method, where students get the opportunity to use the software (supported by his own video tutorials⁴), subsequent lectures are spent putting their skills to practice, with a specific material selection case study. The finally, students work in groups of 3 to create a materials selection case study of their own choosing. Prof. Antonio Julio López Galisteo values the CES EduPack as it has “permitted him to reach students in a more efficient way” and that it helps the students “understand the systematic process that’s used to select a material and the importance of the fabrication technique in the final cost of the product”. Since they are part of the digital generation, students “find it

“...the ideal complement for teaching materials selection and fabrication techniques”

— Prof. Antonio Julio López Galisteo

much more attractive to study with realistic material selection case studies than with books”. In addition, the “Materials Selection Challenge” motivates them to create interesting projects in class.

CES EduPack and the global state of Engineering Education

The subject of materials is arguably one of the oldest academic disciplines, with a history that can be traced back for at least 4000 years. Primarily emerging from metallurgy studies, materials education now exists as a vibrant interface between the applied and pure science. For materials-focused departments, the teaching of materials science and engineering is well established. However, for materials-related departments, such as *mechanical*, *biomedical*, *sustainable* and *design engineering*, competition for curricula space is fierce⁵ and as such, the teaching of materials has had to continually adapt.

Furthermore, the challenges faced by engineers have also dramatically evolved. Initially driven by technological advancements, *e.g.* electrification, the automobile, the radio or space exploration, engineers today are increasingly expected to consider the social and ecologically sustainable impacts of their decisions⁶.

During a 2015 interview⁷, Richard Miller commented that “the new challenge is educating engineers, not for greater technical depth, but for being able to see the whole picture...”. As founder and President of Olin College of Engineering, the institution was also recently recognized, by an MIT report⁸, as the current top leader in engineering education. Richard Miller emphasized that creativity should be nurtured throughout the student’s education, so that when they enter the professional world, they are already “a force of innovation”. A thought which is echoed by many leading academic and industrial professionals⁹.

In accordance with these important pedagogical trends, the CES EduPack has been developed into an effective teaching resource for engineering educators at all levels of higher education. This paper showcased how the implementation of CES EduPack, has helped educators balance both the breadth of materials-related topics, with depth of the fundamental science.

Contact information

To find out more about CES EduPack, email us on education.team@grantadesign.com. An online meeting is the best way to explore if it might be helpful for your students.

We continue to develop CES EduPack to support the teaching of the future. If you have feedback or ideas, please also contact us via email.



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