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The quarterly publication of the Industrial Designers Society of America (IDSA), INNOVATION provides in-depth coverage of design issues and long-term trends while communicating the value of design to business and society at large.
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For the past 20 years I have been promoting the value of materials and processes education within the industrial design community as well as working to improve collaboration between the industrial design, business, engineering and manufacturing communities. As designers of product experiences that often manifest themselves in tangible manufactured artifacts, it is incumbent upon industrial designers to understand the nature of materials, their manufacturing processes and their relationship to a product’s design.
During my tenure as the chair of the IDSA Materials and Processes Section, I was often contacted by professors and graduate teaching assistants tasked with teaching materials and manufacturing in their industrial design programs. They were seeking guidance on how to deliver this content to their students. What textbooks should they use? How should this information be presented? What are the most important concepts or ideas that need to be conveyed? These questions were a challenge to answer since the subject of materials and manufacturing is so broad and, for many institutions, time is limited in an increasingly crowded curriculum.

While I have been delivering workshops and presentations to students for years, only recently (Fall 2011) have I been involved in the teaching of a materials and processes class within an industrial design curriculum (NC State University, my alma mater). Despite my expertise in materials and manufacturing, teaching the subject to students proved much more challenging than I expected. This eye-opening experience has changed the way I think about this subject and how it might be taught. As I enter my fourth year teaching, I try to keep the following observations and insights in mind.

**Make the argument.** As a champion for materials and processes education, educators should make the argument to their students: explain why materials and processes education is important to them as designers. As industrial designers, we should be constantly looking for ways to leverage our creativity and value within our organizations to serve as the product’s advocate through the entire design process. That empathy extends to all stakeholders in addition to the user experience, including marketing, research, engineering, manufacturing and beyond. Good design strives to keep all these needs satisfied.

By understanding how a product is manufactured and the implications of each decision made along the way, a designer can ensure that everyone’s objectives are met while the design intent is preserved (or at least while the appropriate compromises are made). If the designer doesn’t remain engaged to address these issues and be a part of that process, someone else will end up doing it.

**Remember when you didn’t know.** The technical and complex nature of materials and manufacturing can be quite challenging for some design students to learn and even more so to apply. Remembering what it was like when you first learned this subject can help you to identify with the struggles of your students. In his recognition of the shortcomings of lecture-based teaching, Harvard physics professor Eric Mazur points out that the better you know something, the more difficult it becomes to teach. We forget what it was like not to know something and learn it for the first time. This lack of empathy for those we are teaching creates a disconnect between the educator and student—making learning more difficult. Mazur’s solution is to engage the students in the process of teaching as well as learning by encouraging peer-based instruction in which the students who understand the material teach the students who are still struggling to learn it.
Distinguish between Internet knowledge and internal knowledge. Educators and students should differentiate between Internet knowledge and internal knowledge. With ubiquitous access to the Internet, one might argue that simply having access to this information is as effective as knowing it. Unfortunately, there is no substitute for reading, understanding and internalizing the basic concepts of materials and manufacturing. This subject requires specific fundamental knowledge that includes a mastery of the language of materials and manufacturing. This understanding allows designers to communicate more effectively with engineers, materials suppliers and manufacturers.

It is also important to distinguish between what designers should know and what they should be able to look up. Of course, there are considerable resources (like material databases and design guides) that designers can access online. But while these references are useful in developing specific design solutions (how thick does this nominal wall need to be?), they are no substitute for understanding the basics of a manufacturing process or the general properties of a particular material. When sitting across the table from your client or a manufacturing engineer, stopping to look up the definition of “thermoforming” on your phone may not make the best impression.

Teach the language of manufacturing. I liken materials and processes education, with its specific technical jargon and terminology, to teaching a foreign language. There is a basic vocabulary (terms like “draft,” “nominal wall” and “undercut”) as well as conversational manufacturing (how you might discuss your product concepts with an engineer or manufacturer). Using these terms and expressions in class as well as in studio can help students become accustomed to using these terms correctly and understanding what they mean to them as designers.

Field trips are also extremely effective in exposing students to the manufacturing community and the language used. For programs located in areas where field trips to local manufacturers aren’t possible, consider inviting manufactur-
ing reps and engineers as guest speakers to discuss how
they work with industrial designers. They, too, will expose
the students to this new language.

**Connect materials to products.** Associating specific
materials and processes with specific types of products can
be an effective method of understanding and remembering
different material properties. One example might be to
associate products that require chemical resistance and
durability at a low cost with materials like polyethylene and
polypropylene. Another example might be to associate
commodity consumer electronics with ABS, but higher-end
and more ruggedized electronics with ABS/PC. If a student
understands why these products are associated with these
materials, they can transfer those properties to new product
concepts (leading to such a deduction as, “if polypropylene
is used for this product, maybe it will make sense for this
new project because it shares many of the same properties
and performance characteristics”).

**Understand where 3D printing and rapid prototyping fit.** Like other rapid prototyping and molding processes,
3D printing should be taught as another viable manufactur-
ing process. However, while the array of 3D printing tech-
nologies offer unique opportunities and specific advantages
for certain applications, they’re not a panacea or universal
replacement for all other processes. Every manufacturing
process has its advantages and disadvantages, and 3D
printing is no different. Students should understand where
these technologies fit in their tool belts.

**Create forensic designers.** One measure of success
for materials and processes education is the creation of
life-long forensic designers. When designers are out in
the world, every object they interact with should be an
opportunity to ask, “How is this made and why?” and
more importantly, “How could I make this product bet-
ter?” By figuring out these answers for themselves, they
learn from the experience and file that new knowledge away
for future use.

I frequently do this myself (much to the exasperation
of my wife), and hardware stores like Home Depot are my
favorites. I hold my final materials and processes class at a
Home Depot where the students and I tour the store pulling
products off the shelf and discussing how they’re manufac-
tured and why.

In addition, product autopsies or dissections are one
of the most effective hands-on experiences where design-
ers (young and old) can discover for themselves how
products are manufactured. We all have products that are
unused or broken that can be used as valuable learning
opportunities, and the resulting parts can be contributed
to your materials library.

**Extend the reach of materials and processes education.** With limited resources and an overburdened
undergraduate curriculum, many industrial design pro-
grams are forced to require only one three-hour materi-
als and processes class. However, courses in sketching,
CAD, design research, entrepreneurship and professional
practices as well as the industrial design studios all pres-
cent opportunities to build on the concepts learned in the
materials and processes class. By collaborating with other
faculty members to interconnect these other core courses,
this important content can be extended and reinforced
throughout the program.

**Make a connection.** Every student is different and
brings their own unique perspective, interests and method
of learning to the classroom. Some students will be very
enthusiastic about materials and processes, while others
may require more support to make the subject relevant and
compelling. Learning how to read the class and adjust to
the students has taken some time, but teaching has taught
me to be more reflective of my own work and approach to
design and how to share my knowledge and experience with
my students more effectively.

Recently a student sent me this email: “So tonight I
went to Bed Bath and Beyond and found myself picking
up random products and flipping them over, trying to guess
what they were made out of. Haha, thanks for that.” Perhaps
I’m starting to make a difference.
‘So intuitive I got right into it, started creating like I was using my hands.’
Erica Nwankwo,
MFA Candidate, Industrial Design

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