The Materialism podcast: Exploring new avenues for materials science education

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The digital revolution ushered in an unprecedented period of information storage, dissemination, and acquisition. If you were born in the mid to late 90s then you are likely part of the digital generation. Members of the digital generation grew up with constant internet-enabled connectivity in ways that no previous generation ever knew. It is estimated that by 2020 there will be 40 zettabytes (10^{21}) of data stored on the internet.[1] Initially, this information was primarily relegated to personal and commercial domains. The spirit of the internet in its early days was much akin to the American Wild West, where there were few restrictions on activity and the type of information that could be shared. This led to the internet being used as a platform for the free dissemination of data of all types. In some cases, this data sharing violated copyright law and resulted in legal restrictions on data sharing, eventually resulting in an infrastructure where data monetization is prevalent. This can be seen in the evolution of Napster to modern-day Spotify.[2] Nevertheless, the spirit of information democratization has persisted.

Academic institutions generate new knowledge. However, apart from their educational mission of training new professionals, their communications are largely directed to others in academia. This has led to a highly specific jargon associated with each field. Who hasn't looked at a research article at one point and wondered if it wasn't written in Greek? A recent study showed that in the medical field, published articles between 1881 and 2015 increased substantially in jargon while decreasing in readability, causing negative impacts on reproducibility and accessibility.[3]

Compare this with the broader trends occurring online. An increasingly specialized economy has created a large demand for technical skills and knowledge while academic research is becoming increasingly inaccessible to the public. In response to this demand, there has been an emergence of scientific content that is cheap and accessible. This accessibility has also created a modern trend of "pop-science," in which scientific news and information are disseminated and discussed in much the same way as pop-culture subjects.

Concurrent with this development has been an explosion in the amount of time we all spend online. Adults have gone from spending 9.4 hours a week online in 2000 to 23.6 hours a week in 2018.[4] Publishers of online scientific content have realized that people are spending increasing amounts of time on social media platforms. Targeting this trend, these publishers are integrating their content into new online mediums to capture large audiences. Science magazine recently surveyed researchers asking how they stay abreast of current research and found that many tuned in to unconventional outlets like Twitter, Reddit AMA's, or other sites.[5]

One particularly successful approach in this vein has been the emergence of scientific podcasts that seek to provide easily digestible content in an audio format. Today, there are over 700,000 active podcasts and 26% of Americans listen to at least one podcast per month; and this fraction is rapidly growing.[6] Many *Matter* readers likely have several favorite podcasts that they regularly listen to. Indeed, niche podcasts have been developed to target a wide variety of specific scientific fields. As podcasts continue to grow in popularity it was surprising to us that no active Materials Science podcasts were available although some inactive podcasts in the field existed.

Figure 1. Co-hosts Andrew Falkowski and Taylor Sparks.

Why a podcast?

With so much Materials Science information available, why is a Materials Science podcast a useful addition? Content already ranges from the in-depth and hyper-focused literature of research articles, to broad overarching review articles, general introductory as well as specialized textbooks, popular science news articles, university press releases, and social media posts. What does a podcast format of learning offer that these others do not?

One thing that the other media formats have in common is that they all rely on reading text or visually inspecting figures and images for learning. However, research in education has shown that individuals can learn in numerous different modalities[7] including visual (spatial), aural (auditory-musical), verbal (linguistic), physical (kinesthetic), logical (mathematical), social (interpersonal), and solitary (intrapersonal). A podcast format has the potential to expand the learning modality from visual and verbal (written) to include aural and verbal (spoken).

Moreover, many science and engineering podcasts rely on an interview format where a host directs questions to an author of a recent or high impact publication. In many instances, the conversation is highly technical with extensive jargon. This approach provides high quality, detailed information but at the expense of limiting the potential audience since the prerequisite knowledge to comprehend such formats can be high.

The Materialism podcast is unique in its audience, approach, and scope. The target audience for the Materialism podcast is practicing Materials Science engineers as well as undergraduate students who are interested in the field. The podcast goes to great lengths to provide content that is accessible to listeners from a broad range of backgrounds, including non-technical. We achieve this by relying on simple analogies and straight-forward explanations rather than specific jargon and detailed descriptions. Each episode typically begins with the hosts explaining key terminology and basic principles of a topic to orient and familiarize listeners with the main ideas or fundamentals before diving into the episode content.

Materials Science is a broad field and encompasses many facets. As such, a single emphasis for a Materials Science podcast would neglect the breadth of available information. Instead, the Materialism podcast rotates between five recurring episode topics: history of known materials, commercialization, processing, new materials, and characterization.

Topic	Subject
History	Steel (Episode 1) Hemodialysis and artificial organs (Episode 6) Roman Concrete (Episode 11)
Commercialization	Green surfactants (Episode 2) Gore-Tex (Episode 7) EDX Magnetics recycling (Episode 12)
Processing	Microwave synthesis (Episode 3) Chocolate tempering (Episode 8)
New Materials	Thermoelectrics (Episode 4) Shape memory alloys (Episode 9)
Characterization	X-ray diffraction (Episode 5) Scanning electron microscopy (Episode10)

Guest co-hosts are regular contributors to bring in expertise in specific subject matter such as diffraction, Roman concrete, commercialization, and microwave synthesis. However, rather than simply interviewing guests, the episodes are carefully crafted around narratives. Telling the backstory to materials, processing, or characterization techniques opens up a more interesting and engaging listening experience than simply reciting facts and trivia.

For example, consider Episode 6 which covers hemodialysis and the birth of artificial organs. Rather than simply explaining how these devices work, we begin by setting the stage for the discovery. The year was 1945 in Nazi-occupied Netherlands. A Dutch doctor, rather than cooperating with Nazis, leaves to a small town to continue practicing medicine. There, he is confronted with a patient who is a Nazi sympathizer whose kidneys are failing. He decides to treat her anyway but has to develop a machine from spare parts including an old washing machine, beverage cans, and sausage casings. The woman had been in a coma, but after receiving treatment, she recovered and lived an additional seven years. Similar, interesting backstories are presented for most episodes as a way to contextualize the material covered.

Finally, the Materialism podcast differs in its community engagement. The podcast was born out of our desire to share Materials Science with everyone. Part of that is listening to the community as they share feedback, suggestions, questions, and more. One particularly good avenue has been the r/materials subreddit on Reddit, where subreddit members can find links to shows on different platforms, discuss recent episodes, suggest future episodes, and provide feedback. This format also serves social learners who learn best in groups by creating an online virtual learning community. The podcast recently incorporated a Question and Answer segment at the end of the episodes to give listeners a chance to ask specific questions and get to know the hosts better.

Changing trends in scientific knowledge have ushered in new and innovative ways of sharing and disseminating scientific information. The Materialism podcast contributes by making materials science accessible and engaging audio format. If you have ever wondered why Roman concrete lasts so long, or how steel led to the creation of the first joint-venture corporation, or how shape memory alloys work, then consider giving the Materialism podcast a listen.

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Declaration of Interests

The authors declare financial interests associated with the production of the Materialism Podcast through their company Materialism Podcast LLC.

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