Purdue University

Purdue e-Pubs

Charleston Library Conference

Science Education Gone Wilde: Creating Science References That Work

John Rennie
McGraw-Hill Professional

Science Education Gone Wilde: Creating Science References That Work

John Rennie, Editorial Director, Science, McGraw-Hill Professional

The following is a lightly edited transcript of a live presentation at the 2014 Charleston Conference. Slides and videos are available at http://2014charlestonconference.sched.org/.

John Rennie: Okay. Well thank you very much, I appreciate that very much, and I, first of all, am hugely honored to say that you recognize how important a figure I am here in the United States, although that puts you in a very specialized company. I assure you. But thank you very much.

I am John Rennie. I am the Editorial Director of McGraw-Hill Education's general science reference AccessScience. For 15 years I was also the Editor-In-Chief of *Scientific American*, and I've been involved in science journalism, and so forth, for gosh now thirty years. Yikes. I have to say that this is first time coming to a Charleston Conference and looking at the program and seeing a dizzying number of choices, and problems confronting modern librarians and the modern scholars, and the students that depend on them is very impressive. I'm very honored to have been selected to come and speak to you today, but I have to say that when I look at all those matters I could not begin to claim expertise in many of them or any of them. So, I will happily entrust your attention to a lot of the other speakers on a lot of those matters. What I would like to discuss though, in this time, is a little more specific to the creation, selection, and acquisition of good science references and texts; ones that truly do serve the needs of today's scholars. And I am going to, maybe idiosyncratically, look at this on the basis of my own experience.

I think if I were to make a distinction between a lot of what we've already heard about today, there's been a lot of discussion of platforms, and metrics, and of business models, and new ways of approaching it, and they're all very relevant to your concerns. I, though, may look at this a little more from a content creation standpoint, and sort of the question of what should we be looking for in these science texts and science references.

What would help us distinguish the good ones from the bad ones? So, I am partly going to be speaking about science in education, but I'm also going to speaking about the way we speak about science in education. I'm hoping that, if nothing else, some of what I have to say will have some sort of value to you, value to you in maybe helping you to select certain kinds of works in a new way, or evaluating them in a different light. And, for those of you who are in the publishing side of things, maybe to help to reinforce the most sound intuitions you have on this subject so far. Of course, in the spirit of the Charleston Conference, the theme it has thrown down, I am indeed going to try to discuss all of this by, by using Wilde's play, *The Importance of Being Earnest* as a jumping off point. I am picking up the gauntlet as it was thrown down.

Now, the choice of the *Importance of Being Earnest* might seem rather an unpromising starting point on all of this. I'm sure, as you all know, this is widely considered to be Wilde's masterpiece. It's also famously like a Victorian-era version of Seinfeld. It is a play about nothing. It is a comedy of manners. It is filled with false and mistaken identities and the pose of seriousness being more important than reality. It all builds up to the word play which we see in the last lines. In which, Lady Bracknell says, "My nephew, you seem to be displaying signs of triviality." To which Jack, one of the protagonists says, "Well, on the contrary Aunt Augusta, I've now realized, for the first time in my life, the vital importance of being earnest." By the way, Anthony, I apologize now for venturing anything that resembled a British accent.

To my mind, science education suffers from more than a little bit of its own problem with earnestness and triviality. As politicians and education reformers, and social critics are constantly pointing out, STEM literacy is crucial to the nation's well-being. Not simply as an economic driver, but because average citizens must increasingly grapple with the practical and

ethical impacts of new science and technologies in their lives. So there's a lot of effort given to all this, but quite frankly, as you know, US students lag embarrassingly in international assessments of math and science achievement and this problem is likely to have serious repercussions for our national competitiveness and well-being. When we look at the state of the public discussion on climate change, and GMOs, and so many other sorts of topics, it's clear that the grasp of science by the public is not all that we might hope. I mean, for example, we can just take as one example of a failure of public science communication, the current Ebola crisis. There is this monstrous confusion, not just among the public, but also politicians, and news commentators, and others about the dangers of the disease, and the advisability of quarantines, and so much of this confusion is really very largely attributable, to my mind, to the failures of the news media to have adequately explain the difference between infectiousness, the efficiency with which viruses will spread throughout the body, and contagiousness, the effectiveness with which disease is actually transmitted from one person to the next. Two rather different things.

As Oscar Wilde joked in *The Importance of Being Earnest*, "The whole theory of modern education is radically unsound. Fortunately, in England, at any rate, education produces no effect whatsoever." But in the 21st-century America, we are not laughing about that. I think a contributing cause to this is that most conversations about science education and indeed most educational science works themselves come wrapped in this mantle of earnest gravitas and weighty importance. Which is a shame because I think it only reinforces this joyless, eat your vegetables, they're good for you, with which many people in the public and particularly students regard science. It makes students approach their science with this sort of dutiful, doomed resignation. This is not a formula for success. I think there's value in breathing more vitality and fun into science lessons, and doing more to help students connect with the natural curiosities, and enthusiasms that they have about the world around them. That's an approach to science that can inspire and entertain us, as well as illuminate. Now many science

communicators, particularly those in the general popular media have read about this problem and they do try this, this sort of lighter approach to explain science, often with good results.

In the world of television, I don't know if you think about this, but what is one of the most commercially successful of all science related brands on television? MythBusters. Because they blow stuff up. And people are interested in watching that kind of thing. Now the danger, of course, in a lot of these situations is that this sort of approach can flirt with a kind of triviality. They may succeed in making science seem appealing, but the risk of portraying science then is that it may come across as a kind of carnival of fun, but disjointed facts. But I'm not recommending that science texts need to change into some kind of nonstop laugh riot, nor even that in the name of popular outreach we should give in to some sort of fanciful sensationalistic nonsense like the cable TV shows that are claiming, with a straight face, that there are mermaids and pyramids built by aliens. Rather what I'm trying to suggest is that a bit of fresh air and sunlight might end the gloom, might help inspire students with their science studies, and there are ways for us to do this very responsibly by availing ourselves of communication techniques that work well in lots of other situations outside of science. My hope is, in talking about some of my views about science communication, and why it succeeds and fails, I'm hoping that can be of some value to you in making some of the kinds of choices that you will be making, and also helping to inspire publishers to do better as well.

If we're going to try to understand this deadly earnestness with which we've often approached traditional scientific references, let's consider what have traditionally been prized as core virtues in those kinds of works. Now, I am . . . by the way, everything I'm about to say, I will be speaking in gross generalities and probably unintentionally defamatory statements, so please forgive me for all of that. But the excellence in science communications often involved correctness, obviously, and accuracy, credibility, and authority, and thoroughness; a notion of completeness. The precision or exactness of the presentation of data;

timeliness, or currency, things being up to date, and, of course, clarity. Though, if we're honest with ourselves, we'd have to say that we've sometimes tolerated some great lapses in clarity in service to conveying the rest of those. We have counted on science texts and reference works to fully and accurately capture the expertise of their authors because this is what the students or scholars turning to them would want or expect. The experts were the final authorities themselves; the librarians and publishers were the gatekeepers to a lot of this information. And, although great and sincere efforts were made to help students find text references that were appropriate to them, the bottom line has typically been that students had to meet those texts on the ground that the authors and the publishers selected for them. Not every work was for everyone. Basically, it was expected that scholars approaching a particular work would rise to the occasion of being able to read and use it, and if they couldn't . . . well too bad; look again. This makes for an intimidatingly formal and intellectually unforgiving system, and if it were a person, I dare say it might be one who would embrace the description in Wilde's witticism, "If I am occasionally a little over-dressed, I make up for it by being always immensely over-educated."

It should probably, of course, go without question that there is nothing wrong with upholding the importance of accuracy and the rest of those kinds of scholarly virtues, but today I would submit they are not enough. They define a certain kind of excellence in, in scientific information, but they don't guard against what makes for the worst kind of reference. Because make no mistake, the worst reference isn't one that's wrong. It isn't one that's incomplete. The worst reference is one that people won't use even if they know, in theory, it could help them. The untouched text is our greatest failure. So, we also need to take very seriously this sort of danger that here, in the era of the internet, that there are dangers associated that simply didn't exist when reference libraries were more closed curated collections. Exclusively, the risk on the internet is that the people could start to consult allegedly scientific works that are in fact misleading or misinforming, but which might actually be more accessible and more

appealing than the better informed ones that we would like them to consult. This great trifecta of challenges that presents itself to all science communication, popular and scholarly alike, is this: the three problems are boredom, confusion, and other priorities. Now boredom, we often blame people for being bored, but it's not just a matter of short attention spans, or some kind of innate dullness in the material. Readers get bored when they fail to see the relevance or significance of a subject, and why it matters to them. Confusion; there's always a central issue for something as, as potentially taxing as a lot of scientific subjects to become confusing, but assuming that readers want to really try to learn about a subject, they may still have trouble digesting the sense of it as it is presented. And, of course, other priorities.

Those other challenges don't play out in a vacuum. Readers can't help but constantly question whether their time might not be profitably invested by attending to other needs that they have. Now these have been problems in all kinds of media, not just scholarly ones, and indeed a lot of popular media have had to come to terms with these early because of course we've heard of about the sort of disasters that have been setting the popular media on their ear. It has always been easy for audiences to try to go to something else and particularly, outside of scholarly needs, where there isn't even a compulsion for them to attend to any one thing in particular, but it's something now that scholarly publications are also very sorely challenged by.

Let me show you something. This, which you can't see very well, but this is a paper that was published in *Nature* back in 1992; it's the growing inaccessibility of science. It's kind of a remarkable paper because it takes a look at the state of the difficulty of reading various scientific journals over the decades. And it makes a rather interesting, a rather interesting point, which I hope you'll be able to see with this. It uses measurements of lexical difficulty in a variety of them, and so, for example, this graph shows how it is the journals *Nature* and *Science*, but also *Scientific American*, how they became harder to read over that period of 1930 up through 1990. And, as you can see,

they've all been rising for quite some time, but that particularly once you started to get into the 60s and 70s you really started to see more of a rapid rise in all of that. That represents a real challenge for helping people to be engaged with this kind of content, and it's something that's not just restricted to those journals. It's something that we would see actually, well, across a number of other blurry journals [referring to slides], but I assure you it makes a very similar point about the level, the constant increase, largely because of the increasingly specialized terminology that would be used in the scientific works themselves. It's a great problem with all of that. Now the scholarship in these published papers, it may be revealing all sorts of important truths about how the universe works, but as Oscar Wilde reminds us: "The truth is rarely pure, and never simple." And, it's too bad that our journals and other works have so often not done anything or not done enough to push back against that.

I have a unique perspective, an introduction to a lot of these sorts of problems, during that time, as Editor-in-Chief of *Scientific American*. If you'll indulge me, let me give you a sense of a kind of thing that happened with *Scientific American* over time. We have to jump way back in time to understand just how that's the case. *Scientific American*, established back in 1845, the oldest continuously published magazine in the United States; curiously enough, it started off, as you can see, as this broad sheet of new patents and philosophical reflections, the occasional poem, news of technical and scientific advances. And it followed actually a variety of different sorts of formats and looks up through the balance of the 19th century. Then halfway through the 20th century, it was reinvented back in 1947 and 1948, and that's when it actually became the magazine that most of us think of as *Scientific American* now. That's when it because this magazine which educated readers could find descriptions of science in the words of the scientists who were responsible for that. This turned out to be brilliantly successful; far more so than the reinventors of the magazine had ever intended for it to be. In retrospect, it's not hard to see just why that is; part of it came from the fact that, that they did a great job of making the magazine look

and sound like it was the embodiment of the attitudes that people had toward science. It was cool and austerely white like some sort of Grecian temple. It was a place for contemplation of pure ideas and objective truths, unsullied by merely human opinions and personalities. Science at that time was obviously regarded as this kind of ideal, better than humans. Now, this is what so many of us grew up with and came to love about *Scientific American*.

We all can understand sticking with a good thing, but sometimes sticking with a good thing too much can be a bad idea, and to understand that let's take a look at *The Atlantic* magazine during the same stretch of time: from 1950 through the 1990s. What you could, in theory, see from that is during this time, *The Atlantic* actually experimented with a number of different logos and looks. These are just the covers, but you get the sense that this was a magazine that was constantly reexamining itself, constantly checking whether or not its methods of trying to reach out to its audience worked appropriately. Take a look at *Scientific American* during that same stretch of time. *Scientific American* changed almost not at all for really the better part of 40 to 50 years. It was astonishingly static, partly because readers loved it, they loved it exactly that way and, and people were afraid to tamper with that. But, the problem is that is a formula that when you think about that problem of the rising lexical difficulty, it increasingly became a formula that worked for a certain number of die-hard people who loved the magazine exactly that way, but it did not work for new generations of people who were coming along. And so the mission for *Scientific American*, as glorious as it was and as well-loved as it was by many of us, in that form it still was something that was not working for new generations of students. And, so, that meant that then starting in the 90s we had to start to reexamine this, and we had to make a number of different sorts of, of changes looking back at it, and we did start to open up to new different kinds of formats, and new approaches to articles. We had to do things like make some of them shorter and use different, more contemporary designs, and visuals. We started to open up to different kinds of voices within the narrative of the magazine, and a more

prominent presence of personalities as such. What we came to discover was that it was possible to uphold a proud intellectual tradition without slavishly repeating the exact same content formulas all the time, and the audience agreed with this. Which paved the way not only for an improvement in the original magazine's critical and financial fortunes, but also the expansion of the brand into another magazine, *Scientific American Mind*, and a strong online presence. So, it's possible to make these sorts of changes and to rethink how we do, in a reasonable and sober way, still approach science well, but not let the soberness of the subject overwhelm the fun that can possibly connect to it.

If we go back again to that notion of some of those underlying great virtues: correctness, accuracy, and the rest, they all still apply. We all still want those in text and science references, but real excellence now isn't just a matter of trying to make sure that those are there. You can't just tick those off and expect that you actually still have, in effect, an excellent science work that people will relate to anymore. Instead, the emphasis needs to be on successful learning by the user rather than on the successful capture and display of accumulated knowledge by the author. Learning is this sort of dynamic process; there's always more to learn. So, it can't be measured in just how much has been told, but in how much has been absorbed, and so we should use any and all tools available to us. To that end, including a spirit of joy and wonder that might help inspire the readers of this material to engage with it. The absolute imperative is we need to understand one's actual audience; not just the intended audience, but who are the people who we are actually reaching with these sorts of works, and it's not just the vital importance of being earnest about who they are, it's, it's even more. It's about anticipating that audience's needs and expectations.

Publishers, smart publishers, realize that they can't just know what their users expect; they have to anticipate it, especially with digital products, because when it comes to digital a satisfying experience makes all the difference in the world. When they have a question about the information

they've been provided, or they want to improve a set of return search results, or whatever else, users don't want to have to try to remember at that point how an interface works, or have to consult a help option to try to do it. The appropriate options for further information or for linked resources, or facets for filtering, or whatever else, they need to be prominent and self-explanatory in the moment and ideally they should sink back to a less prominent position when they're not needed in the same way. Anticipating users' needs and their questions is, at every point, an interactive process, and is highly important in crafting a successful online experience. Now, some of the questions that they're going to have will have a lot to do with the context and relevance of the subjects that they're looking at. Context, of course, refers to how that information fits within a field or multiple fields, and relevance is going to point out how that information may therefore have direct or indirect bearing on that person's life or interests. Yes, it can sometimes get sort of wearisome to constantly be bringing things back down to individuals in this way, but remember that problem of the other priorities. Users need to be reminded and ultimately they want to know why it is that they should be making time to learn this information.

Speaking of priorities, I will throw this out, potentially as a controversial point: accuracy, completeness, and clarity of meaning are all very important, but of those ensuring the clarity of the presented information trumps the others. Within a reasonable margin, the user is better off with a confident understanding of a scientific message that is slightly off or incomplete in its details than with only a foggy grasp of extensive, painstakingly precise data. It's a function of human psychology. Human psychology is also what prompts me to make this other point: although we don't often talk about it in discussions of science references, the vast experience of the human race, and, in fact at this point a not insignificant body of psychological literature, teaches us that good stories and strong narratives have always been the best way to convey meaningful information to people. There are studies that suggest that people can remember facts embedded in narratives and

retain that more than 20 times as well as they can just isolated sets of facts. So, not only do such narratives automatically hook into issues of relevance and context for the users, but these kind of stories also evoke faculties in their audience. Readers and listeners, they start to learn and they learn about it in a way that, again, there's nothing else that just a flat presentation of information can possibly hope to match. There's actually, while I was putting this talk together, this paper in *Science* actually just came out a couple of weeks ago and it made an interesting point. It showed that narrative fiction, people reading that, that it spurred the readers, their theory of mind capabilities. It, basically it allowed them to understand character's motivations at a much richer, more visceral level than they could with just a simple outside presentation of facts. That is a phenomenon that we in the world of science communication need to try to take advantage of.

Now most of my examples, I'm sure it's not lost on you, have come from the more popular world, but I can absolutely assure you that these more congenial editorial presentations are very much an issue among the editors of journals themselves. They recognize these problems of ensuring the professionals will want to be sufficiently prioritizing their journal engagement as a way of staying current. That rise of lexical difficulty is still always a problem even within fields, and remember that is mostly a barrier to lay people and people who are coming from the outside of a field, but a lot of the most exciting, most important science that's happening these days is exactly at these areas of interdisciplinary collaboration where it's the biologists working with the physicists, or the material scientist working with the biologist. That's the sort of thing that we want to most enable. We need to get past the problems the rising terminology itself.

These are certainly the kinds of things that I and my colleagues working at AccessScience have been very involved with. I'm not going to try to spend a lot of time about the details of what we've been doing in that area, but we definitely, you know, the roots of AccessScience may lie back in the, the encyclopedias of science and technology that McGraw-Hill published in the

past, but we've been working to try to make sure that AccessScience is itself a new product; one that is appropriate to this kind of digital sphere. So, it still has that encyclopedic view of science, but it is richly connected to the underlying resources, and that we are trying to make sure that it is something that students and others who will be using it will get the most possible out of it. One of the things that we do when we move in to this area of digital products and what's so exciting about it is, is that it does allow us to do things that we could never adequately do in print. As you all know, this is a higher area of, of adaptive learning, you know, my colleagues over on the McGraw-Hill higher education side, they have been developing their smartbook program and these kinds of instructionals are really very fascinating because they can develop different sorts of probes that don't just look at what students know on the basis of the presentation of the material, but they can also test the confidence with which they know that and how well they can use that information, how they can turn that over into some sort of skills. Those are exactly the kinds of insights that can be used to individualize the review of material and so that it helps students concentrate on what it is that they most need to study and move more briskly through anything else. That means that students are going to be less bored, they learn more and retain more of what they learn, and those kinds of improvements can actually be documented. Which is something that can then be useful in trying to justify the sorts of investments that would then be made about them.

The other kind of thing I'm very excited by is the uses of these kinds of adaptive heat maps which are based on being able to watch users' eyes as they are reading on screen. We can see precisely where it is that they are running into passages that they are having problems with because that is a guide to those of us on the publishing side of where we can go back and can improve that. It's a great, new, highly detailed granular way to look at updating and revising and improving text, moving on in the future.

We're all familiar, obviously, with the great resources that Cross-Ref and so many others here have been developing. I mean I think that kind of

digital innovation is something that needs to be there. It's something we're all looking for, that much more in this case, just the fact that it does so much to help make clear the kind of underlying linkages in subject matter, and authorship, and funding, and that they become more visible and measurable to those of us that are involved with this sort of work. It's why I'm so excited to be here and to be learning more about the kinds of opportunities for that.

But I'd also like to note, at least in passing, that there is at least one other way in which a lot of us can be doing things to try to improve products that has nothing to do with technology and everything to do with humanity. We in the publishing side of things, in service to including only top authorities as authors, it's very, very easy to default back to featuring an overabundance of old, white, straight men. And it's very easy to justify that kind of choice because they are the ones who do have most of the honors and the seniority and the fame at this point, but we, particularly in the content creation side of this, we need to be aware of the fact that there are tremendous numbers of accomplishments being done by other kinds of people, and that this is not being well enough represented in the scientific works we are presenting. We are in a position to take those extra steps to include a wider diversity of different sorts of people, and you know, the outreach scientist Danielle N. Lee has said, "Perception paves progress and one way to broaden the audience for STEM works is to broaden the image of who does STEM." And that's something that we do by just including a greater diversity. It's true to the facts, it's not something we should feel we're being pushed to do, but I will tell you audiences increasingly want to see that, and that more and more science-savvy audiences of students and others, when they look at works and they're aware of a deficit of women or people of color or others then that starts to turn them off those works and they look for other things.

All of us here today want to create and make available better science texts and references. Ones that don't just inform, but also truly engage and inspire. We want students to appreciate how the universe of scientific information is unified by our curiosity, and that directly or indirectly everything really is connected. We want serious scholars to be able to traverse this cosmos of knowledge as effortlessly as their own questions will occur to them. Making that happen is going to involve an enormous amount of work, and collaboration, and active partnership by the scientists themselves, by the publishers, by the librarians, and by the end users, but we have the tools now for being able to bring everyone into that discussion far better than we did in the past. It is a lot of work, but it's work best pursued with a sense of its own fun and reward and not the gravitas of science being so important. If we're going to be earnest about anything, let's be earnest about that. That, thank you very much, and I'll happy you take your questions.