Chapter 24

Beyond Teaching and Learning: Bringing Together Science and Society with and through Movies

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Science and movies seem to be getting along very well lately. Old complaints about unrealistic and derogatory depictions of science and scientists have given way to an apparent honeymoon between filmmakers and scientists which includes more and better science on the big screen and on TV. So much so that the main goals and motivations for science communication can be mapped to the ways science is depicted in fictional film. This scenario may not always be the consequence of a targeted effort by the scientific community, but is certainly welcomed in any case. What scientists can undoubtedly do now is to contribute to making it last by helping filmmakers achieve their ultimate goal of entertaining.

Introduction

When we think of science education one of the ideas that first comes to mind is inspiration. If we are looking back at our own experience of classroom science we invariably remember those teachers who were able to enthuse us with their passion for the topics they taught and who made memorable and life-changing events out of otherwise routine-laden lessons. We might or might not recall any specific piece of knowledge of those classes, but they certainly inspired us to look at science with different eyes, and in some cases set us off on the path of a career in science. If we look forward along the current trend and need to bring much needed new students into scientific disciplines, we all agree that the way to go is to inspire young students in that same way.

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But the world has changed substantially, and there are now many more and different ways the message can reach these young students. Effective teaching in the classroom certainly is still a major factor, but present-day children, youths and adults are exposed to science in various different contexts and education is acknowledged to occur not only at early ages but throughout life. Let us thus understand here the term education in its broadest sense, which encompasses both formal and informal education, for people of all backgrounds, ages and professions. Under this perspective let me first review different aims and motivations behind the pursuit of science education of students and the public.

- One major aim is, of course, education in the strict sense of **teaching and learning**. This takes place in the classroom and is complemented by a wide range of informal education initiatives, from open day visits to labs to purpose built interactive science centers, planetariums, aquariums, and zoological and botanical gardens.
- As mentioned above, inspiring teaching and learning has always helped to **motivate students towards scientific careers**. But the current alarming decrease in the numbers of students of fundamental scientific disciplines turns this into an explicit and urgent need, in order to ensure the continuity of basic research in several important research fields.
- Scientific institutions also feel the need to inform the public about the research they undertake as a duty towards the taxpayer as its funder. This results in an approach to science communication as a **showcase of current and anticipated research**, presenting it as important for society, and highlighting those aspects relevant to citizens.
- There is also the concern to promote **scientific literacy** in order to build a society of informed citizens and voters. These will need to have educated views on the various areas where science intersects with democracy, from deciding whether a line of research is worth funding from a merely economic point of view, to morally and ethically controversial issues. This scientific literacy approach also includes a concern about the increasingly worrying lack of critical thinking in certain population segments and their defenseless exposure to the pseudosciences.

Communication and Emotions

Science in movies can and does contribute to each of these general aims of science education and communication. At the heart of its potential to do so is the importance of the emotional aspect of any attempt to communicate. If we remember those inspirational teachers of our childhood it is certainly not because of the particular interest or relevance of the contents of their lessons at a given time. It is rather related to their ability to spur in their pupils strong emotions that irreversibly reinforce a positive attitude towards the subject, regardless of what contents were covered during a certain class. The pleasurable emotions of discovery by being able to ask the right questions; of understanding thanks to a well prepared and explained lesson; of joining the adventure of humankind's quest

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to know thanks to knowledge being presented in a relevant wider context; these are all examples of emotions that make for a lasting impact that goes a long way towards achieving the aims of science education considered above.

Documentary filmmaking has gradually realized the need to appeal to viewers' emotions to reach a broad audience. A good example is the BBC's recent series *The Great British Countryside* (*1*). This show is not even presented as a science documentary. It appeals to viewers' emotional connections to certain landscapes through the relationship between their geology and their population´s everyday life, from economy sustaining activities to pure leisure, encompassing trade, hiking, sports, traditions, gastronomy and much more. Science is embedded in a relatable manner. Another emerging trend that responds to the need to stir viewers' emotions are "live" documentaries like Planet Earth Live (*2*) and Volcano Live (*3*), where viewers are drawn in to share the presenters' live experience on site, in jungles and near active volcanic sites, respectively. Nevertheless this kind of factual show demands that viewers place themselves in a learning attitude in one way or another. The Oxford English Dictionary reflects this perception of documentary features defining "documentary" as "*Factual, realistic; applied esp. to a film or literary work, etc., based on real events or circumstances, and intended primarily for instruction or record purposes*" (*4*). This is often hardly compatible with a context of leisure time in which audiences primarily seek entertainment. Viewers seek entertaining shows irrespective of whether their subject matter is interesting to them or not.

It does therefore not come as a surprise that, in addition to the immense wealth of high quality documentaries being available and increasingly striving to appeal to viewers' emotional engagement, a trend is emerging and consolidating, of scientists and science communicators concerning themselves with the educational value of fiction movies, where emotions are a central way of communicating with the audience. Emotional involvement scaffolds engagement and thus provides unique educational opportunities. Hopefully, this trend will be underpinned by research on its effectiveness. Such research is still scarce and fragmented as excellently reviewed by Orthia *et al* (*5*), and opens a whole new field for science educators and communicators.

Movies and Science Education and Communication

Science in Movies as an Educational Resource

The use of science in movies as an educational resource considers the way scientific principles are taken into account (or ignored) in this or that sequence of a film, such as Special Relativity in *The Planet of the Apes* (*6*) or Evolution in *The Time Machine* (*7*), or the didactic value of historically accurate accounts of the lives and feats of scientists, from Marie Curie (*8*) to Charles Darwin (*9*). These are important ways to utilize movies as teaching tools or illustrations in popular talks, which I frequently undertake and enjoy. This approach has become the subject matter of educational resources in the form of websites such as Teachwithmovies.com (*10*) or Film Education (*11*) and books (*12–16*). Also among works aimed at the general public there are numerous titles that directly

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address the science of TV shows and movies with the title or subtitle *The Science of...* (*17–23*). A specific way that has proven to be particularly effective along these lines is to structure a session entirely around five or six brief video clips from different movies about a certain topic, ordered in a way that they help move the lesson forward, while at the same time "recover" those students lost due to their short attention span. Even the most reluctant ones end up engaging with the lesson if they can relate to the clip shown, because they went to see that movie and therefore can speak out knowingly in front of their peers. Luckily, there are sufficient movie clips to choose from so that the science they address fits different stages of the development of a particular subject.

But there is a deeper and farther reaching way in which movies map to the other goals, motivations and messages that the scientific community tries to address through science education and communication.

Science in Movies for the Promotion of Scientific Careers

As mentioned above, one major and common aim of educating young students in science is to promote scientific disciplines as professional options, especially in recent years, when there is an alarmingly decline in the uptake of scientific careers, and less qualified professionals are becoming available to replace retiring investigators/researchers. As there is a strong emphasis on motivation in this approach to science education, it usually focuses on the benefits, both personal and professional, such a career can provide in life. Scientists tend to be presented as explorers in a quest, as solution providers for many important issues of modern life, as citizens who are recognized for their achievements…

This endeavor has certainly been both mirrored and supported by the way science and scientists have been portrayed in movies. We have had mad, selfish and sometimes even evil scientists in movies as recent as *Spiderman 2* (*24*), but gradually this distorted view has given way to more neutral representations, in which the villain is not the scientist but a 'regular' wrongdoer who lures and forces the scientist into his service for a misuse of his scientific discovery, as seen recently in *The Dark Knight Rises* (*25*), or where there are scientists on both sides, as in *Coma* (1978) (*26*).

It is increasingly frequent, too, that the scientists play a pivotal role to counteract or fight the villain as seen in the three strands of *CSI* (*27–29*), *Bones* (*30*) or *Numb3rs* (*31*), or even become the heroes themselves, often unwillingly, as it is expected from the corresponding archetype (*32*), as seen for example in *The Andromeda Strain* (*33*) or *Sphere* (*34*). A typical case of this is the ubiquitous natural disaster movie, in which the tension between the scientist-hero and the politician/military-antagonist is revisited again and again as the latter usually does not want to lose decision-taking power nor risk losing authority by raising the alarm too early. The methodological and even philosophical question of scientific certainty is then often addressed as the wider debate in which the argument is contextualized, as for example in *Dante's Peak* (*35*).

Science in Movies and Scientific Literacy

Issues like the latter, as well as ethical and legal implications of scientific research, need to be made accessible to the wider public in the effort to keep society informed and even involve the public in decision-making. This falls within the area of the promotion of scientific literacy, whose aim is to foster well-informed voters and users of technology. In this regard, movies are again a powerful channel to raise awareness of these far reaching questions. Numerous films have addressed such issues in more or less depth. Some deal with them directly, as in *Godsend* (*36*), others just as a backdrop of the actual story, like *Jurassic Park* (*37*).

Noteworthy in this context is the evolution of the scientific questions attached to superheroes: Ang Lee´s vision of *The Incredible Hulk* (*38*) includes nanotechnology; both Batman in Christoper Nolan´s version (*25*) and *Spiderman 2* (*24*) are involved in the development of unlimited clean energy through fusion, and Spiderman´s powers have their origin in genetically modified spiders, both in Sam Raimi´s version (*39*) and in the latest reboot by Mark Webb (*40*). All of these movies reflect the controversial aspects of leading edge research of the moment and contribute to the public awareness about them. A further notch in this direction is offered by science fiction dystopias, in which the controversial science is addressed through its extrapolation to an imagined future in which its effects are taken to extremes. This is the way in which the issues related to artificial intelligence have been addressed most often, with cinematographic landmarks such as *Blade Runner* (*41*), *A.I.* (*42*) or *The Matrix* (*43*), and so many more.

Science in Movies as a Showcase of Research

But current research does not need to be controversial. The scientific community is eager to make known to the public any research that is being carried out with taxpayers' funds. This showcases science communication as a duty towards the public (which provides funds through taxes) and has a clear reflection and support in filmmaking. *Contact* (*44*), *Mission to Mars* (*45*), and *Red Planet* (*46*) depict imaginary scenarios that lay within the horizon of research carried out at the time the movies were made (although real life science went into different directions thereafter). We could also include in this category accounts of fairly recent science history like *The Dish* (*47*) or *Apollo 13* (*48*), or certain disaster movies as they show how science helps to face such disasters with ever more refined and effective warning techniques, such as *Twister* (*49*), defense mechanisms, as in *Deep Impact* (*50*), or solutions, as in *The Andromeda Strain* (*33*).

Storytelling and the Scientific Message(s)

However, it may be considered by some to be an unduly interference with filmmaking to proactively try to influence how science is portrayed in movies with any of the abovementioned purposes in mind, as if it were a kind of subliminal advertising or education. In this regard, let me argue that fictional film is a modern way of storytelling, a deeply human activity of emotional communication that goes

back to the beginning of mankind. From cave paintings and the stories told around a fire, to theatre plays, movies and computer generated audiovisuals projected onto the domes of digital theatres, humans have devised so many different ways to carry out the one and same activity of storytelling. Storytelling is so embedded in human nature that it has been found in serious psychology to have therapeutic value in interventions with emotionally damaged children (*51*, *52*) and even with patients with Alzheimer´s disease (*53*).

Movies would not even be the most modern form of storytelling any more. Computer games could be viewed as an even more sophisticated and immersive way to tell a story, and it is becoming more and more frequent that a game version of a film is released while it is still being shown in cinemas. The computer game of *The Matrix* (*54*) should not be viewed as just an entertaining merchandise of the fictional world, but rather yet another way of immersing the audience in an experience that has numerous and deep philosophical layers (*55*). More recently the fictional world of *Defiance* (*56*) is expanded into a game (*57*) simultaneously to the TV series to provide a uniquely immersive, and therefore engaging opportunity.

And storytelling has always had an educational angle, sometimes even in a very explicit manner, as was the case in Haesop´s fables or Jesus´s parables. In its cinematographic version, nobody will be surprised at, let alone object to, movies being a channel to spread values like generosity, self-sacrifice, patriotism, the joy of living, the power of love, etc… Like anything in life, this can certainly be taken too far. When the educational intention is simply juxtaposed to a story and it hinders or even spoils the entertainment value, a movie can certainly come across as patronizing or worse. Movies can even be used as sheer propaganda and even a tool for indoctrination. But within a reasonable and universally acceptable parameter space, stories always use their entertaining value to convey a message through emotions, which is the most effective way to make an impact in people´s minds and hearts. A recent clear example is the message of environmental concern of *The Lorax* (*58*). If this is considered acceptable and even positive in other subjects, why should science be excluded from the educational potential of storytelling through movies?

The Scientific Community and the Movie industry

In fact, in view of the apparently successful marriage between science and film one might be tempted to conclude that this is due to a deliberate collaboration with all those purposes of science communication in mind. But reality tells us otherwise: there are still relatively few instances in which a proactive approach by scientists to filmmakers has had an effect on a successful movie. The trend towards a perhaps more realistic and fairer depiction of science and scientists in movies has resulted primarily because filmmakers have considered in recent years that it might add some value in their works. Features like plausibility, realism, relatability come immediately to mind.

Plausible and coherent scientific explanations increase the credibility of a story, particularly among educated audiences. Realistic depiction of scientists makes the audiences' identification with them as story characters easier. The

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inclusion of real life hot topics, an increasing number of which are scientific and technological, makes a movie more relatable to the viewers, who will more easily be drawn into the argument. The fact that this way of using science in film is also convenient from an educative point of view is only a collateral effect which is not sought directly by filmmakers. It should not be forgotten that if it would hinder, rather than help, their primordial aim of entertaining, they would as easily revert to a more caricaturesque, inaccurate and derogatory portrayal of science and technology.

What the scientific community needs to do now, is to make the most of the current trend, and contribute to make it last as long as possible. The only way to go is to reinforce the added value this kind of scientific garnish provides to movies, and to make an effort to come up with new ways it can keep doing that.

As extensively argued by David Kirby (*59*), a successful and lasting relationship between a scientific consultant and the director of a movie has to be based on the former being convinced that the latter's only goal is to make a movie that will attract and entertain big audiences. The filmmakers have the power to ignore and to disregard any suggestion by the scientific consultant or even to get rid of him altogether. The scientific consultant, if hired at all, is very low in the hierarchy of professionals that contribute to the success of a movie. No director will even think of not having a soundtrack of some sort, or allow the actors to act without make-up, or work without a lighting expert. But a scientific consultant will be easily let go in case of financial constraints, or even in view of severe disagreement with the senior members of the creative team.

It is not realistic to dream of a future scenario where things are much different in this regard. The scientific community needs to be realistically humble in the approach to science in the movies and just play the game to their own interest while trying to make it last. But within these terms and boundaries, the prospect is very promising. Science and technology are providing topics and developments at increasing rates, and there is always more to pick from by filmmakers. There is a growing awareness of potentially controversial issues with science and technology in society, and filmmakers will naturally draw from them to build the essential ingredient of conflict into their stories.

So, let the conflict stay in the realm of fiction and let us procure a harmonious collaboration between science and fictional film for the benefit and enjoyment of everyone.

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