

Physics in the Media – Opportunities for Training Scientific Thinking

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The goal of many efforts in public lectures, science centers, students' laboratories and similar institutions is to enhance the public understanding of physics. People show different interests in physics. Accordingly physics does not only explicitly occur in media but also implicitly e.g. in artistic interpretation: exhibitions on physics and art are staged, views of physics occur in novels, poems or movies and physical devices are presented and discussed. All these activities reflect the importance of physics as part of human culture. Perhaps (unwanted) interferences between the physical and artistic perspectives lead people to think of possible, sometimes mysterious influences on their life and well being. Insight into the scientific method, learning about doing physics, shortly: conveyance of scientific literacy, should be the appropriate way to prevent severe misunderstandings. Science education hence may not only comprise facts and laws but also has to clarify the scientific background of physics terms and laws viewed from philosophy of science. The possibilities of introducing this kind of reflection and corresponding scientific analyses in physics lessons with aid of concrete examples from the media are discussed.

Introduction

There are many bridges to physics. People learn about physical laws or technological achievements not only in school but also in media. However, physics is seen as inaccessible for “normal” people. Nevertheless many popular presentations are used but sometimes may lead to misunderstandings or mystification of physics. People may think for instance that the moon phases, energy from planets, radiation from the soil, electric and magnetic fields have direct influence on their well- or ill-being. The connected (mis)conceptions of the nature of science and their statements do not appear from nowhere. Without having the (cognitive) tools for deciding on the adequateness of the assertions most people have to believe in the statements of science and scientists. For science, especially physics, the strong reliance on physics statements for “everyday use” can be interpreted in several ways:

1. Science is of relevance for people. Science can – and shall – explain the processes in the environment, in technology and in daily life.
2. Technological devices can – and most probably do - harm people.
3. Scientists tend to neglect the natural needs of human beings.
4. Science can and should help people.

One mirror of the public understanding of physics can be the occurrence of physics e.g. in novels. Some authors transform their thoughts, their interpretations or misinterpretations of physics in stories or novels. Hence their implicit views are transported in media of the most different kinds, in movies, comics, stories, features and nonetheless books for the youth, not designed for instruction. Often in journals reports on scientific subjects are given, sometimes with a somewhat esoteric touch, sometimes with valuable information and explanations. One of the most attractive subjects is astronomy or astrophysics. Questions with relation to technology used in everyday life are mostly found in TV or newspaper.

Which influence on children can those media exert? In general, the children would pick up terms and learn some facts, not always the correct ones. Furthermore, views on science most probably develop in children even long before their first lessons in science education. They early develop a view on physics and what physicists do. But as the children do not have broad experiences with physical phenomena or the scientific method they would not know which statements e.g. in books are true and which are not. From this natural uncertainty of children there is only a small step to some of the above mentioned esoteric views.

Experiences from teaching practise show that students ask about subjects published in media. Often they want to know which statements are true and try to understand their meaning. Some students read stories with certain physical content, come across new terms or descriptions and ask about the physical core of science fiction novels. All these open-mindedness and curiosity should be used for conveyance of scientific literacy. Students can gain insight into the scientific method and learn about doing physics. Science education has not only to include facts and laws but also to clarify the scientific background of physics viewed from philosophy of science. Thinking about the role of experiments, the foundation of scientific terms and their limits will students help in judging the quality of statements referring to physics phenomena.

Physics in Books - Examples

Every media has its specific aims and audience: there are different types ranging from specialised books to novels, criminal stories and science fiction. Besides science journals there are books for youth and adults that embed physics into stories. Generally, the books (novels) are written by adults with their view of physics that informs their writings. As there are only relatively few novels with an explicit treatment of fascinating results of physics, most will transport an implicit view on physics. Very seldom physics is really integrated into the strand and plays a dramaturgically important role. Those few authors deliberately use physics in order to make the young people think about the – mostly philosophical - implications physical insight may have for their further life.

But generally pupils will not notice physics related content or - if at all - will think about it only exceptionally. In the following I will concentrate on novels for the youth which might influence them in an unconscious way.

View on Physicists and Physics

Scanning the books (or movies) with respect to the role of physics it can be observed that physics phenomena often underline strange, mysterious or dangerous situations. The acting person is confronted with natural phenomena or technical processes he or she cannot understand or only master with great difficulties so that she is subject to bad feelings.

Often improbable physics tools or devices are used in a superficial way in order to increase the tension, to create a strangely looking environment. The described devices are extremely powerful, of course especially in science fiction novels. But looking back, some of the once incredible visions seem to become true. I only mention the famous science fiction novel “The hitchhiker to the Galaxy”, a satirical account of space flights, where the electronic guide nowadays seems realistic. But admittedly only a small part of the conceived technology becomes (nearly) true.

In general astonishing results of modern physics incite the phantasy of authors. Topics are chosen mainly from quantum theory, teleportation, travel in time (connected to relativity theory) or visions of use of nuclear fusion. [Schlichting 2000]

Besides the physics, the physicists play typical roles:

- There are the good – but somewhat strange – guys, who are not always aware of their surroundings, have strange ideas, make inventions and are nearly esoteric. Einstein is the mythos of this species: gifted with incredible talents, difficult to understand, a genius, almost not from this world.
- There are the experts who can explain all things and know everything; this is connected to the view that physics tells the truth.
- On the other hand there is the scientist trying to control mankind, governments and things by misusing his knowledge, sometimes even cruel without human feelings. The prototype of this species may be “Frankenstein”.

These characteristics may represent extreme facets. But they mirror at least part of the general view and promote it further or even enforce it. Accordingly, already children have a quite dichotomic look on the work and character of scientists. The scientists might likewise help or destroy. This view on scientists seems to perpetuate itself: it influences the young, remains stable or is even underlined by experiences in the adult age, manifests itself in books, and is thereby transported to the children, and so on.

If a goal of education amongst others consists in conveying an adequate view of science and the nature of science then the education has to take these views into account. Hence it might be a way to contribute to a more balanced view to make students aware of the hidden topoi in media by addressing them directly.

Goals connected with literature approach

A successful learning process requires active engagement of the students. However, as students are all individuals each one of them has different preferences. Physics education research has the task to identify topics that interest most students best and to offer different pathways to appreciating physics. There are many reasons why people could like physics. The cultural aspect is perhaps one of the most enduring ones. The examination of the role of physics in literature displays the influence physics has on world view. It shows that physics is connected to the thoughts of people and their perception of reality. Besides there can be identified several reasons for using – surely not always – stories or novels in physics lessons.[Schlichting 1999]

Emotional aspect

Mostly physics is viewed as an objective, neutral, “cold” science. However, many physicists stress that the best theories have to be beautiful or elegant as a possible criterion on correctness. The term beauty might be ambiguous in this connection. But its use displays a somewhat emotional aspect of physics.

During the physics lessons the students might feel boringness, complicatedness, fear or other adverse emotions. As human beings tend to remember agreeable things better, positive emotions may play an important role in learning physics. Physics examples from literature represent a totally different approach compared to most other teaching learning environments. It stirs the creativity of students and their awareness of the occurrence of physics.

If scenes from a novel are thrilling, funny or exciting the connected physical questions could contribute to the goal of positive feelings towards science.

Gender aspect

Studies on media use show that girls in general have better reading experience. They read more than many boys, so they should have a lead in an approach strongly related to language and reading. Treating novels requires abilities that normally are not used in a physics course,

but that could also be used in physics: analysing complex relations, drawing connections, noticing similarities and interpreting (data). Physics can then be seen as part of culture and be integrated in the intellectual or even spiritual aspects of world. Perhaps this view might be more important for girls than for boys.

It has to be tested whether a novel approach actually could interest girls more than the standard approach.

Training scientific thinking / Furthering knowledge of scientific methodology

Students might become aware of appearance of physics in unexpected contexts far from the physics laboratory if they encounter physics related events e.g. in a novel.

In novels the physics often appears alienated; the author has the freedom to play with physics, to interpret results, to extrapolate developments, on the whole: he can give space to his visions. So students will be led to ask which is the physics core of the story and where the pure phantasy of the author begins. They are animated to explore the border between phantasy in novels and the real world. So the treatment of novels might train critical reading and critical analysis. Students have to identify texts which do not contain reliable information on physics. So they are led to explore the frontiers of physics and to think about the physics content.

Depending on the subject occurring in the novel there can be several possibilities:

- In relativity theory or quantum theory thought experiments might be an important means to help students with the analysis. This type of experiments requires extraordinary abilities in scientific thinking.
- Concerning phenomena with connection to everyday life students could do real experiments. This may help them in gaining an appropriate view on physics. They apply the scientific method and learn to appreciate its worth: stating hypotheses, planning and performing an experiment and interpreting the outcomes.

If trained in the scientific procedure students should be more able to recognize pseudo scientific statements or the multiple facets of physical modelling, an important aspect of scientific literacy.

Relevance of physics for everyday life and promoting scientific literacy

It is an important goal of physics lessons that students get aware of physics in their daily life. Often students do not see a connection between the abstract topics of physics lessons and the concrete experiences in their environment. They need many examples and hints to see any relations. The occupation with physics in literature can then contribute to scientific literacy: Students learn to apply their knowledge and judge facts. This might facilitate to apply knowledge from physics lessons in everyday life, outside the classroom and hence stress the impact of physics for life.

All these reasons should convince to try different media in physics lessons; there are quite a lot different possibilities.

Examples

Movies and dramas

There can be distinguished several basic types of movies or dramas:

- The science fiction genre with famous examples as “Odyssee 2001”, the “Star Trek” series or similar movies.
- Movies or dramas that illustrate the role of physicists as inventors or as people far from everyday life, as ingenious, sometimes bound in their knowledge and the

power that this gives to them: “The Physicists” by Dürrenmatt, “Galileo Galilei” by Bert Brecht or “Copenhagen” by Michael Frayn.

- Action movies that use sometimes tricky devices, without caring too much about the feasibility, as e.g. scenes from James Bond movies.

Analysing scenes with physics content (movements, weapons, technical devices) in the movies can train the physics view on the world. As video analysis becomes a common tool in physics lessons the application to a „real“ movie could effect some motivation and inspire for doing real experiments.

Novels

Although there is a vast number of novels it is not easy to find examples with possible substantial contributions to physics lessons. The first guess would be science fiction, but glimpses onto physics can be found in every kind of novels. The choice of examples hence is strongly dependent on the teacher. From longer novels only significant scenes can be chosen for reading and thinking.

A very singular example – especially suitable for younger pupils - is the story of „Jim Button“ by Michael Ende. Here phenomena from everyday physics as a swimming steam engine, the appearance of Fata Morgana and similarly bewildering wonders play crucial roles in the strand. Although Ende himself thinks quite critical about the impact of sciences and the „cool“ scientific thinking his leading characters act very rationally and meet with strange phenomena very open mindedly.

Some scenes can be found in the trilogy „His dark materials“ by Philip Pullman, designed for older children or young adults. He plays with devices as the radiometer, the mysteries of elementary particles, the many universes interpretation of quantum theory and different occult forms of energy.

These two examples are taken from youth novels. A general list cannot be given since it will depend on the teacher's preferences.

Writing own stories

From the viewpoint of a constructivistic learning environment it is crucial to engage pupils in the active elaboration of physics contents and methods. In the context of physics and literature they could be encouraged to write own stories, embedding physics in an interesting story, might be kind of science fiction or a fairy-tale [Horn 2005, Wallace 2004]. This will also be a good way for learning about the preconceptions of pupils.

Conclusion

The use of different media in physics lessons seems to be promising in so far as pupils get a different view on physics. In order to evaluate the realisability of the different opportunities appropriate materials have to be developed. Problem solving connected to reports in newspapers or scenes in novels can increase the interest of pupils. This could be a step towards convincing more teachers to try such an approach and in such way enriching the physics lessons.

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