Making physics more realistic with fiction

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One of the many questions that students who takes any major or minor subject, particularly physics, either in elementary or in college that actually makes sense is “ When am I going to use what I have just learned in the real life?” But in reality, physics is found everywhere, from our cars and cell phones, the way we walk and interact with things, throwing stuff, to some of the not so familiar topics like in subatomic particles and in comic books. Some teachers and professors are looking into ways on how to present these ideas and concepts without making the student sit through hours of leaden and tedious technical discussions. From fictional examples and situation, to extraordinary cases like lifting a star and preventing falls with a single hand, students slowly realize that physics is just as important as breathing and clothing. And one good example of fictional, but true, example of the application of the concepts learned in physics is found in comic book superheroes. Now, the thought of superheroes is logically impossible, but their actions and their “ super incredible powers” presented in comic books and in movies are actually governed by the laws of physics and nature (Trusted, 1991). From electricity, to lifting heavy objects, to shooting lasers out of nowhere, their power is also present in the real world, but in a less amazing and rather simple manner. In theory and in practice, the concepts of physics found in the stories of comic book superheroes helps in developing the logic of students to understand physics. As more and more teachers resort to more exciting and easy-to-understand examples which the students can relate, more and more students who have the same question above are now finding light in comic book superheroes.

As any student who have gone through the first day of physics class, it is clear that physics is essentially the study of matter and energy; physics is an experimental science which deals with the basic elements of the universe and their interactions. (Young & Freedman, 2012). There are a lot of theories and laws which govern the interaction of one matter to the other, and one of them is Newton's laws of motion. There are 3 laws in it, which are the laws of inertia (an object in motion will remain in motion unless acted upon by an external force), acceleration (force is equal to mass times acceleration), and action and reaction (for every action, there is an equal and opposite reaction). Physics also deals with electromagnetism, which is mainly concerned with particles having an electric charge, which is just either a positive or a negative charge property of a particle (Jones & Childers, 1993). There are also discussions about momentum (which is the product of the object's mass and its velocity or speed), impulse (the change in momentum), and collision between two objects, whose examples are fairly simple, but not as exciting to learn. But, in order to do physics, one must have energy, either potential (energy at rest) or kinetic (energy in motion). With all these examples of the concepts in physics, their examples are just as technical as their discussion. One can deal with the laws of motion by observing the movement of a ball in a vacuum and applying external force, throwing a ball out of a cliff, pushing a wall, and a big winded wire induced by electricity to produce a massive electromagnet. These examples may seem simple enough to comprehend, but the physics in them is what makes them dreary to understand. One can simply put off the explanation by stating that the velocity, time, and height by which a ball drops from the cliff to the ground can be computed using the kinematic equation and the students just

substitute values and solve. But one can make things a little more challenging by putting childhood favorite superheroes as examples. By replacing the ball with Gwen Stacy falling and Spider-Man catching her, students will get an essence of just how important these values are in the comics and in the real world.

Comic book superheroes didn’t just exist out of nowhere, it also had a history. According to Wandtke (2012), from the early comic strips in England whose purpose varied from entertainment to revolutionary movements, a lot of today’s superheroes came from snippets of these strips. *Amazing Stories* and *Astounding Stories* were one of the early comic book novels, which were mass produced in newspapers and in print, and one of the earliest superheroes was Superman, who was a creation of Siegel and Shuster, which came from the idea of a bizarre visitor from another world with powers greater than any man known on earth who came to save humans from evil (Gifford, 1984). Superman first came known to print in the *Action Comics #1* in 1938. After Superman, a lot of heroes joined in, like Flash (who had powers of incredible speed), Hawk-Man (power of flight), Captain America (Amazing strength from a “ super soldier” serum, now called steroids), and Batman (with the occasional appearance of his sidekick Robin). In 1962, a boy named Peter Parker was bitten by a radioactive spider, who surprisingly lived, and became Spider-Man. Most of the beginnings of superheroes reflected their time, from the Great Depression to the World War, and discoveries in science like radioactivity and quantum mechanics (Daniels, 1995). With the rise of heroes came along with their enemies, like the Joker, the Green Goblin, Electro, Magneto, and many others. The addition of these

villains added suspense and action to the stories. Several ages came into play, with heroes ranging from the Silver Age to the Golden Age, with one example of a Silver Age Flash meeting his Golden Age counterpart through an alternate universe (Duncan & Smith, 2009). Movie adaptations of these comic books were released, which closely resembles the comic book counterpart with an addition of unexpected scenes.

Now, what do comic book superheroes have to do with physics? A professor named James Kakalios of the University of Minnesota, who is an avid fan of comic books, started to use these heroes to conceptualize physics, as most us are unaware that most of the time, comic books gets their science right. While one may think that this is a silly idea, the fact that students can learn such a complicated subject like physics in such a sophisticated and animated way like in comic books is a great way to capitalize on an innovative way to teach something without hurting. Let’s take into consideration the case of the death of Gwen Stacy, Spider-Man’s girlfriend. The story goes as the Green Goblin kidnaps Gwen Stacy, bringing her to the top of Washington Bridge, luring ‘ Spidey’ into battle, then dropping off Gwen to her apparent doom, but Spidey manages to catch her, by which to his surprise that she is dead. Supposing that Gwen weighs 50 kg, fell for half a second (0. 5s) and fell from 300 ft., she would have fallen with a speed of about 95 miles an hour, and the force needed by Spider-Man’s web to stop her would have to be 10 times the acceleration due to gravity (Kakalios, 2005). This explains the “ SNAP” sound located next to her on the comic strip of her fall. This shows that it was the webbing of Spider-Man that killed Gwen and the concept of physics involved here were the definition of velocity and

acceleration, momentum and impulse, and force. The same discussion also explains the physics behind airbags and how they prolong the time from the impact to rest (Jacobson, 2012). Compared to the earlier examples, this is easier to understand and visualize because most of the students are interested with Spider-Man and the discovery of something new. An example of when they get it right is in an issue of Super Boy (young Superman) where he coils a locomotive with metal wires, induces a current, and gets a big electromagnet. This demonstrates simple electric induction where some may find it difficult to understand due to the terminologies like induction and repulsion and conductors and charges, but with Super Boy's example, it all becomes clearer and easier(Weiner, 2008) (Kittel & Knight, 1973).

But sometimes, comic books get it wrong too. Another way to represent physics, particularly electromagnetism, is through Spider-Man's villains, Electro and Magneto (whose names obviously represent the concept of physics they embody). In a scene where Electro faces Spider-Man, Spidey throws a metal chair to Electro and Spider-Man says that any metal can act like a metal rod, neglecting the fact that it has to be grounded for it to become a lightning rod (Jones & Childers, 1993). But an episode in Superman actually gets it right when he drags someone, whom he tries to get information from, and runs along telephone cable wires, to the man's panic, but Superman reassures him that they would be electrocuted unless the wires is grounded or when he steps on a telephone wire pole (Daniels, 1995). Students can easily learn electricity through this: wires or any conductor has to be grounded for it to become effective. But one shouldn't be assured that the concepts presented are true all the time. But then again, Cyclops (a

single eyed hero who shoots lasers from his eye band) got Newton’s Third Law of Motion wrong when he blasts a hole through the ceiling of Grand Central. If Newton’s Third Law of Motion holds, then he should have experienced an opposite reaction equal to his action of blasting a hole, unless he has a super neck strength (Booker, 2010).

Present day objects are also works of the science that powers superheroes. An example is the MRI (Magnetic Resonance Imaging) where one’s body can be examined live using magnetic repulsion from a user generated magnetic field, polarizing (splitting and dividing) the water molecules, and pinging the target level for examination (Young & Freedman, 2012). The same technology is used by Magneto, Spider-Man’s enemy, where he levitates himself using magnetic repulsion. This has not been done by, and to, a human being, but a group of researchers has managed to levitate a frog (Simon & Geim, 2000). Another one is through Iron Man. His suit can be comprehended today part by part. The jet boots is something which many have tried doing, but only few have successfully flown 10 feet or higher. The exoskeleton suit is being worked up by the military for defense purposes and also it is being developed for those who have paralysis and body defects. The science behind the helmet, which controls the suit according to the comics, is technologically feasible. Some technologies in Japan and America have done prototypes which allow mouse pointer manipulation through the signals sent by the mind to the helmet ([Distinctive Voices], 2010). And one perfect example for that is Stephen Hawking and how he is able to communicate through signal waves converted to audio through a machine on his wheelchair. But the Arc Reactor is an exemption to the rule, being

purely fictional for now, for no technology today, which could explain how something on earth could how such enormous power in a small, confined space ([Russell Scott], 2014).

A very complicated topic in physics, which is hard to understand from a simple person’s point of view is quantum mechanics. Quantum physics or mechanics deals with the behavior of a particle, particularly on a molecular, atomic, or in the nuclear scale (Young & Freedman, 2012). It has to do with wave functions with the inclusion of Schrodinger’s equation which just simply states that force is equal to mass times acceleration for electrons, much like Newton’s second law of motion. This governs the existence of parallel and alternative universes, which up to now, has not yet been proven to exist. Using Schrodinger’s equation, given the force, there is a huge probability of locating the position of a certain electron in space (Beiser, 1967). Given a radioactive isotope (same element, different mass number) and the equation will give the probability of it having a half-life (reducing the original amount of substance by half through a time interval). Something on a subatomic particle scale is hard to comprehend and represent, but comic books may provide some light in the teacher’s burden in teaching this topic. On the issue of the Flash # 123, four years after Everitt formulated a theory which states that there is a parallel and alternate universe and using quantum mechanics, one can go from one universe to another on a subatomic level (Booker, 2010). In the Flash issue, the Silver Age Flash meets up with his Golden Age counterpart, through which scientific explanation of Everitt’s theory was presented. The concept of time warp or time travel, which is synonymous to parallel and alternate universe theories, is not new to

comics. A lot of science fiction movies have shown the movement of one person to another world through a machine of abduction of aliens. And in another comic book called *The Atom,* which talks about a physics professor who was trying to develop a shrinking ray, but was missing one key ingredient: a piece of a white dwarf star (because of the dwarf in the name) (Gifford, 1984). Quantum mechanics tells us that dwarf star weighs almost 50, 000 tons, thus making it very dense. But the professor was seen huffing and puffing every line that he said in the speech balloon, which adds to the fact that that star was really dense. But essentially, with the white dwarf star, The Atom could exploit quantum mechanics and go beyond the atomic level, shrinking himself proportional to this atomic structure. While quantum mechanics does not disapprove of this, the ability to shrink someone has not yet been done or proven as of today (Wandtke, 2012).

With all the given examples, of course not every concept of physics is present in comic books, so one should not rely on comic books to learn physics. One concept that has little instances of comic books is the concept of flight. With many superheroes with capes are seen flying, like in the case of Superman, physics cannot explain this phenomenon since there is no action from nature that could cause a cape to fly a 150 kg man (presumably) over the clouds. The concept of flight of airplanes doesn’t work on capes, and less likely on magic carpets. Another one would be how a normal human being could grow to as huge as hulk in a matter of seconds. Even with a huge amount of radioactive material, there is little chance that someone could be as strong as hulk, save for the bigger probability that a person could die due to radioactive contamination. Another is the explanation of

Thor’s hammer. No one on earth could lift up Thor’s hammer, and science doesn’t have the knowledge to tell us what is inside Thor’s hammer (Kakalios, 2014).

With an increasingly complicated world, people begin to overlook even the simplest of things in order to go directly to the big picture. With so many technicalities around, people are finding it harder to follow the trend of technology and the science behind them. But if one can present the idea to their audience in a manner which they could effortlessly grasp the main idea, then more people could be educated about a certain topic. Studies have shown that there is a declining rate of the student’s performance due to their teacher’s beliefs and methods of teaching (Caprara et al., 2005). Cases like this should not be overlooked and should be solved within the classroom. There are a lot of fun and meaningful ways to present concepts without the jargons. But when it comes to physics, there is no harm done in presenting it, superhero style. As long as the topic is relevant and correct, comic books can be seen, not just as a nuisance, but as an educational material worth giving attention to.

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