Weaving values and ethics into science and allied courses: an indispensable approach in the age of technological innovations

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Innovation is the mantra in this age of technology. While many innovations have served humanity well, others developed devoid of ethical concerns, have turned out not only to be a nuisance to the society, but also dangerous. Such haphazard innovations and their indiscriminate use are also unfavourable for sustainable development. Hence there is an urgent need to prepare our students with ingenuity by innovating our courses and classroom discourses to encompass the aspects of ethics and values, especially in science and allied courses, the breeding and brooding ground for inventions and innovations, to prepare them to become responsible innovators and consumers.

Technology could be defined in several ways. Here, we will broadly define it as a 'product' (such as devices and appliances) and as a 'knowledge' (such as technical know-how, processes, designs, software). The world is booming with technological innovations in every sphere – electronics, machines and tools, engines, software, healthcare, food processing, genetic engineering and so on. Innovation is the *mantra* in this age of technology. Newer updated versions of the existing products or new products are being floated in the market so frequently that we find it difficult to keep track of the latest technologies or models.

Given the fast-changing world that our students are experiencing all around them, are we simultaneously preparing them to assimilate and reflect on these changes taking place around them? In this situation, it has become necessary for us to make innovations in our curricula and teaching strategies, starting from primary to university level, so as to incorporate such aspects in our science classroom discourses which could be biology, physics or chemistry, including the allied fields such as technology, engineering and medicine. Though research institutions are increasingly making attempts to incorporate ethics component as they undertake their projects, a more effective approach will be to sufficiently tune classroom discourses to integrate the aspects of ethics and values in their science classrooms so that students are nurtured to naturally engage in responsible research and innovations. All students may not be innovators, though our efforts are to make them so. But they will be definitely users of innovations. Given this, discourses on responsible innovations and responsible consumerism will go a long way in our attempt towards sustainable development.

Technology for 'superiority'

Even as technology invades every aspect of our lives, there is increasing inclination towards the transhumanist approach which is aimed at enhancing the lives and living conditions of humans by applying advancements in technology. To what extent should we exploit this approach? Our craze to use technology is growing so fast that it has become necessary to ask 'to what extent should we exploit this transhumanists approach?' Eradicating diseases, removal of pain, improving living conditions making use of the technology are all fine. But should we be playing or toying around with the human intellectual or emotional capacity as envisaged by the transhumanists? Or simply put, aiming to 'improve' the present 'unexplored' humans into superior humans that will eventually result in posthuman, the 'super human'. Such possibilities are being explored by present-day science which is worrisome since human relations, or biological diversity for that matter, find hardly any space in such transhumanist approach. Most likely, this approach will ultimately produce technological optimists who think that technology can solve all problems of the world, emotional included. What remains then of the attributes of human nature? Will we now solely depend on the number of chromosomes to decide whether we are actually human beings? But we are manipulating that as well! If we think that there is uniqueness to humankind which we want to retain and preserve, then it will be for our own benefit to set ourselves some limits or draw for ourselves some boundaries in our innovation, exploration, manipulation and application of technology.

Disconnect between classrooms and reality

In today's science classroom, the discourses on ethics and values, i.e. 'what is good' do not find place. Our focus seems to be on raising curious minds that could develop new technology. If science is considered to be a mechanism to satisfy our curiosity alone, then we might be reminded that there is no end to human curiosity. No wonder, 'one-way ticket to Mars' offer generated so much euphoria and stiff competition when it was announced a couple of years ago. Whether such ambitious plan to establish a colony in the red planet will actually happen or not, the enthusiasm amongst people tells so much about the curiosity of human mind at the cost of risking life itself. We may have divergent ways of defining what ethics or value is – whether it is absolute or relative in nature. Whatsoever, we can agree that there are good, or at least, better ways of addressing issues or solving problems. However, some sort of taboo is still being attached to the idea of taking ethics and values into the classrooms. This could be because ethics and values are most often associated with religion[1]. Hence in order to avoid controversies or to project oneself as secular, or because of the blinkered disciplinary vision a teacher has about science, such integrations are avoided. Thus, we end up teaching only hard scientific knowledge, principles and procedures, which

by nature is 'exploitative in its orientation'[2], without empowering students on how to use such knowledge.

However, with increasing complex issues facing the world as a result of advancements in technology, it has become inevitable to include ethics and values as an important component in our educational courses, especially in science classrooms which are the breeding and brooding ground for inventions and innovations. Such classrooms need to be oriented in such a way that the innovations, inventions and ideas that are developed will be for the common good of human as well as non-human entities. Ethics and values should be the basis for learning, doing and applying science. We cannot expect our students to learn to apply ethics and values by themselves through their life experiences, since the society is already biased and corrupt.

Ethics and values in different fields

Keeping in view the importance of incorporating ethics and values in science classrooms, the following sections will delve into some issues where discussions on ethics and values cannot be avoided.

Inventions and innovations

A typical science and technology classroom teaches and guides students on how to apply the knowledge of science so that they can develop ideas that could be transformed into new technologies and thereby into new products. The catchword in such classrooms is 'new' or 'innovative' idea. However, a discussion on whether such new and innovative ideas are directed towards alleviating basic human pains or considering environmental impacts, hardly finds any place in such classrooms. Whether such innovations will solve any of the umpteen problems that humans are facing does not figure anywhere as the teacher transmits the idea, or when the student develops an idea about the innovation. Our teaching strategies do not in any way reflect the aspects of responsible research and innovation. This could one of the reasons for the haphazard production of electronic devices and softwares that are mushrooming. The world has seen too many innovations which are doing more harm than good to us and the environment. Yet again, only innovations can come to our rescue in such situations. For example, we had come up with plates, cups, bowls, etc. made of styrofoam or plastic, but now we need to innovate for an alternative which is safer to health, environment-friendly, sustainable and at a competitive or affordable price. Such is the need of innovation that the Government of India declared 2010–20 as the Decade of Innovations. However, our concern should now be not just innovation, but a responsible innovation which will cater to the masses, both rich and poor, is considerate on nature and the environment, and one which is sustainable. The concept of 'servitude,' 'compassion,' 'equity' and 'equality' needs to find a place in our consideration as we develop new technologies. As of now, the more the sophistication, the greater is the divide between the rich and the poor. Innovations should also be such that they are durable, tested for endurance, less resource-intensive and environment-friendly.

Food production

The time that we are living in is also the age of sophisticated manipulation of organisms. Genetically modified organisms, hybrids of different plants and animals, *in vitro* cultures of various kinds, multiple ovulation and embryo transfer (MOET) technique and crossing or hybridization of different animals are prevalent today. We have educated our children enough to know about how science can change the world, including human beings, but we have not simultaneously educated them about science that is humane. Genetic engineering (GE), tissue culture (TC) and other technologies are looked up to as the ultimate saviour of humanity. Hunger and poverty that are rampant in all underdeveloped and developing countries, are thought to be overcome only with the intervention of GE, TC and other *in vitro* technologies. There is no denying that these technologies will definitely come to the rescue of many of our food scarcity-related problems, but how far should we be exploiting all such possibilities of technology is the question. Ethical concerns related to food safety and food security need to receive adequate attention in science classrooms. We have not been openly talking about the issues that farmers are facing related to procurement of genetically modified (GM) seeds, weedicides and herbicides, current debates on the possible negative impacts on health, pollination, existence of wild varieties, biodiversity or even the monopoly of companies which are spearheading the application of GE or other technologies. If such issues are not discussed in the science classes, we will be depriving our students and future researchers, scientists and engineers from viewing issues holistically.

In case of animal husbandry, MOET is a popular technique to produce offspring with genetic traits that are desirable to humans, such as increased milk production, meat production, etc. There is scarcity of food in one hemisphere, while in the other hemisphere food grains and other produces are being fed to animals in farm houses. Crossing of different animals is another procedure followed to produce hybrids which will be beneficial to humans, as in the case of mules. Possibilities of successful cloning of animals are also being continually experimented and exploited to satiate our curiosity. To what extent humans should be exploiting animals and what should be called ethical are areas that need to be integrated in science classroom discourses.

Environment

Ethics and values are at the core of environment and environmental issues since lives, of humans and other organisms, are involved. However, apart from pampering our own kind as we exploit the available resources, we care little about the value of nonhuman nature. Nature, or our environment for that matter, appears to be the worst affected because of technological innovations. This is reflected in the haphazard manner in which we treat our resources. We have exploited nature and natural resources using such technologies to such an extent that it has brought danger to our very own existence. Today, it does not take much time to clear a dense forest or siphon underground water. Mining has become much more sophisticated. Agricultural lands have been converted into residential complexes in the name of development. We have found convenient ways to spray pesticides in vast agricultural lands spanning hundreds of acres using airplanes, which will ultimately pollute our air,

water and soil to the maximum. Forests have been cleared to construct roads and rails using huge machines and tools. Flow of rivers has been controlled through dams and barrages, flooding stretches of agricultural lands and forests which also results in habitat loss for different species thereby threatening sustainability. These are possible because of the availability of technology. Today, vehicles that we have manufactured for transportation are too many and they occupy much of our space in the cities, which is done at the expense of cutting trees and clearing the vegetation. We do need forest produce for timber, firewood or paper. We also need water for drinking and other purposes. We need coal to generate energy, and dams for irrigation and energy production. We need roads and other means of transportation to transport food and other items. But the issue lies in our total lack of concern for such nonhuman nature and therefore the resultant indiscriminate exploitation in all such ventures. Our sole target is maximum output or profit and minimum consideration for the environment. The intrinsic and extrinsic values of such nonhuman entity need to find more focus in our science classrooms. As of now, schools seem to be thriving towards producing students who are transhumanists. We seem to have infused a belief in the minds of students that science and technology is the solution to all the problems. But the fact is, though science and technology provides some solution, it is also the cause of many other problems[1]. The most sustainable solution seems to lie in minimizing our dependency on technology. The lesser the intervention of technology, the better it is for the environment.

We have exploited our earth so much and we are also aware that it will not be able to sustain humanity a few centuries from now. Hence we have started exploring other celestial bodies such as the Moon or the planet Mars where we could live, manipulate and exploit the resources. We cannot even imagine how much resources, material, finance and human resource, are being invested to develop suitable technology to succeed in such efforts. We also look for any possible place in space where we can dump our wastes. Our science classrooms proudly talk about humanity's achievements as it succeeds to find some clue on the possibilities of existence of life outside of the planet Earth. One can only wonder how many celestial bodies we will eventually exploit to meet our selfish ends. Will there be an end to our craving to prove our technological prowess over other living and nonliving entities? If we could simply mend our ways on earth, then we would not be required to look beyond this planet to find solutions for our insensitivities here.

Healthcare

It is no different even when it comes to an all-important area of healthcare. We can hardly see researchers and healthcare industries according any importance to ethics and value aspects. Over the years and decades we have seen so much advancement in the area of healthcare. Medicines – analgesics, sedatives, vaccines, steroids, etc. have been developed which are now easily accessible to most, if not all. These have helped humanity reduce sufferings tremendously. Coupled with this, advancements in techniques, equipment and technologies have also helped in diagnosis, prophylaxis, prognosis or treatment of diseases saving innumerable lives thereby drastically increasing the life expectancy to a great deal. However, there are more complex aspects where application of science and technology is not so simple. For example, topics that relate to medical termination of pregnancy, *in vitro* fertilization (IVF), surrogacy, gene therapy, euthanasia, etc. need wider, deeper and humane discussions. Such topics need to be discussed in the classrooms in the context of ethics and values by going beyond scientific viewpoint.

The introduction of IVF or the practice of surrogacy has brought smiles in the lives of many couples who otherwise would have been deprived of having children who inherit their specific identity, their DNA. But there are concerns on 'how far we can go?' in our search and application of technology to solve our problems related to healthcare. Are these options sustainable? We are already aware of how the poor, especially women, succumb to such 'opportunities' to keep their lives going. A case in point is that of surrogate mothers. Selective elimination of foetus is also not new. Similarly, gene therapy, even before it is tapped extensively, talks are already on about a 'designer baby'. Hence, there are questions we need to answer as we innovate or use the innovations. Do we have the right to end a person's life though our intentions may be genuine? Do we agree to a suffering patient's request to end his/her life? How different would that be from a suicide or a murder? Can we afford to leave it to individual choice for such sensitive issues as surrogacy, gene therapy, abortion, euthanasia, and so on? These topics need to be discussed with utmost ingenuity, and students have to be made aware of the use and abuse of such technologies. Besides, we also observe that much of these advances best benefits the rich and the powerful. Though technologies are available they are still not affordable to majority thus bringing about automatic social divide which also contributes to conflicts in a society. Do we really want to develop technologies that will benefit only the privileged section of the society and the powerful? Such issues related to equity are always delicate and they need to be dealt with sensitivity. Science, per se, is not responsible for this divide. It is more of an issue of governance. Nevertheless, scientists and engineers can actually take into consideration the aspect of equity when they conceive ideas and processes.

Conclusion

Science, as it is, is neither good nor bad. Science, by itself, will not tell whether what is being done with it is good or bad. It becomes good or bad on how we put scientific knowledge to use, and how it impacts us and our environment. Yet, we can agree that, which brings about equality, equity and sustainability is an indication of good science. Ironically, obsession to come out with something new still remains the only thing that is driving us in our endeavour to apply science and scientific knowledge. It is, therefore, essential that ethics and values should be at the core of our innovations. Fixing some sort of accountability on the part of scientists and engineers for their 'contributions' in the society has also been a topic of discussion in the academic arena as well as outside of it. However, there is lack of consensus on what those responsibilities would be[3].

Students are exposed to technologies of various kinds which are beyond anybody's control and they are enticed by it.

However, we have not educated our students on the use and abuse of such technologies, or how to be responsible consumers. The only way we can educate our students about 'good' innovations and their appropriate use is to establish connections between the innovative ideas and the issues facing human society in our classrooms. Education that focuses on such areas is also vital if we consider sustainability as a concern, which we definitely do.

1. Kibert, C. J., Monroe, M. C., Peterson, A. L., Plate, R. R. and Thiele, L. P., *Working Toward Sustainability – Ethical Decision Making in a Technological World*, John Wiley, New Jersey, 2012.
2. Lucas, A. M., *Studies Sci. Edu*., 1980, **7**(1), 1–26.
3. Frankel, M. S., *J. Responsible Innov.*, 2015, **2**(3), 301–310.

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