**Science & Technology**

*“The world is very different now. For man holds in his mortal hands the power to abolish all forms of human poverty, and all forms of human life.” – John F. Kennedy*

*“We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology.” –* [*Carl Sagan*](http://www.brainyquote.com/quotes/authors/c/carl_sagan.html)

**1. What is Science and Technology?**

**i. Science**

* Systematic knowledge of the physical or natural world gained through observation and experimentation.
* systematic and organized pursuit of knowledge
* **Purpose of science**: explain and manipulate the physical world (for better or for worse?)
* The first automobile, dating from the 1880s, made use of many advances in physics and engineering, including reliable ways of generating high-voltage sparks.
* Many of these innovations come about as a response to society’s changing needs, providing solutions to the problems faced in modern society, improving our standard of living and increasing our efficiency
* **Local context**: Singapore’s government has repositioned our economy to be a more science-based biotechnology, in order to create more jobs in this highly skilled and valuable industry.

**ii. Technology**

* The use of scientific knowledge to solve practical problems, especially in industry and commerce.
* The specific methods, materials, and devices used to solve practical problems.
* The first computers emerged in the 1940s from simultaneous advances in electronics and mathematics.
* Technology is always being improved by scientists and researchers to ensure that humans will be able to solve the problems of the world.

**2. Impact of scientific and technological development**

1. **Ethical implications**

Winston (2003) provides an excellent summary of the ethical implications of technological development and deployment. He states four major ones:

* + 1. **Challenges traditional ethical norms.**

Technology challenges how individuals deal with each other, even in ethical ways. The definition of “human life” debate has been ongoing ever since the development of the technology that perpetuated these acts such as abortion, euthanasia and capital punishment.

* + 1. **Changes the distribution of justice**

Those with technology tend to have higher access to justice systems. Justice is never equally distributed among those with technology versus those without.

(social media – public journalism – public vigilance / scrutiny (prevent social wrongdoings) – prevent social injustice – distribution of justice)

* + 1. **Provides great power (empowerment of the individuals – opportunities, rights, knowledge)**

Not only does technology amplify the ability and hence strength of humans, it also provides a great strategic advantage to those who hold the greatest amount of technology. Consider the strategic advantage gained by having greater technological innovations in the military, pharmaceuticals, computers etc. For example, Bill Gates has considerable influence, even outside the computer industry, in the course of human affairs due to his successful implementation of computer technology.

(*Winston, Morton (2003). "Children of invention". in in Morton Winston and Ralph Edelbach (eds.),. Society, Ethics, and Technology (2nd ed. ed.).)*

* 1. **Impact on society**

In many ways, technology has simplified life. Yet in other ways, it has complicated life.

* + 1. **Leisure and entertainment**

It has led to the rise of a leisure class, placing emphasis on the need for leisure and entertainment. People can now easily find leisure and entertainment in their homes, without the need to step out of their house to relax and have fun.

* **Positive impact – Creates wider variety of entertainment and leisure and improves the quality of life**
* Technological advancements facilitated the creation of alternative forms of entertainment and leisure that would raise the quality of life.
* For example, individuals can partake in leisure activities at home through the Smart TVs or tablet PCs. Also, there has been an increasing trend of users participating in online shopping.
* As a result, technology has brought about tremendous convenience in the lives of many.
* **Counterargument – Hinders personal development due to the widespread and frequent distractions**
* However, these new forms of distractions that are accessible anytime and anywhere could lead to undesirable consequences, such as the deterioration of educational development.
* For example, computer addiction is one common obstacle that parents and educators have struggled to overcome. Children can access games on many platforms, especially smartphones, which will distract them from their studies.
* social conflicts due to migration made possible by technology in the areas of technological advancements in transportation
  + 1. **Mass media**
* **Positive impact – Facilitates ease of access to up-to-date information**
* Technological improvement enabled individuals to consume latest information at a rapid pace, which raised awareness of the various issues around the world
* For example, people can stay updated through the television on the proceedings of a political election conducted in another country without having to be physically present there.
* **Counterargument – Distortion of truths**
* However, press owners can exploit mass media to distort truths and shape the mindsets of audiences, so as to advance political or personal agendas. For example, owners can cherry pick favourable news reports while concealing the rest.
* Without the ability to conduct self-censorship, audiences are vulnerable to these manipulative methods.
* ‘ the proliferation of fake news in the US media industry’ – undermine public confidence in the state authority and press
  + 1. **Communication technology**
* **Positive impact – Foster greater social interaction that transcends physical boundaries**
* Advancements in the communication technology enabled individuals to interact with one another without being hindered by geographical boundaries and time zone differences.
* For example, Information Communication Technology (ICT), communication between individuals within a family, company, or country can be made with ease.
* Also, the Internet was recognized as one of the greatest innovations that created an interconnected world. It allowed people to find, foster and develop relationships through online social networks like Facebook.
* **Counterargument – Privacy concerns**
* However, improvements in communication technology gave rise to privacy concerns.
* For example, the digital footprints and personal information we leave behind in the virtual world may be used for malicious purposes.
* As such, the interconnection has left us more vulnerable to virtual threats that would undermine our social lives.
  + 1. **Transport**
* **Positive impact:** made the world smaller by shortening travelling time. they are also more comfortable and safer than before.
* **Negative impact:** Increase in transportation technology has brought about congestion and even pollution problems in some countries.
* **Negative impact:** transport promotes social mobility – exchange of ideas and trade – create social differences and inequality – social differences and competition – social conflicts and war
  + 1. **Surveillance technology**
* **Positive impact – Ensured peace and security in countries as surveillance enhanced peacekeeping efforts**
* Surveillance technology enabled governments to expand their scope of reach in maintaining vigilance against potential threats to national security, thus achieving peace and security.
* For example, closed circuit television (CCTV) cameras can track the movements of any individual in the country, which allow the police to trace and apprehend the criminals and suspects swiftly.
* **Counterargument – Enabled the invasion of privacy due to the emergence of numerous and more intrusive surveillance methods**
* However, surveillance technology can lead to the invasion of privacy as the discovery of new monitoring methods allow surveillance owners to access personal and sensitive information of people, which is an infringement of individual rights.
* For example, PRISM is a clandestine surveillance program under which the United States National Security Agency (NSA) collects internet communications from at least nine major US internet companies. PRISM sparked public outrage and diminished the credibility of the American government.
  1. **Individual impact**
* **Positive impact – Technology empowers individuals as it provides them with many modes of communication to voice their opinions**
* Technology provides individuals multiple platforms to voice their opinions and protect rights of specific groups, such as the minorities.
* **Counterargument – Creates a disenfranchised society**
* However, technology creates a disenfranchised society as the ease of access to interaction platforms promotes the excessive desire for anyone to voice their opinions that may cause social conflicts
  1. **Educational impact**
* **Positive impact: Technology as a powerful learning tool**
* Technology has equipped every human being with greater knowledge of international issues, values and cultures. With the aid of mass media, people are able to obtain information at one click, whether it’s the television, the mobile phone or the internet. Development of transport technology has also allowed people to gain new knowledge of different cultures all over the world.
* Technology is an increasingly influential factor in education. Computers and mobile phones are being widely used in developed countries to complement established education practices and develop new ways of learning such as online education or distance learning education. It allows students more choice and control over what they are learning. The proliferation of computers also means that more new methods of teaching and learning are increasingly being developed.
* Technology offers powerful learning tools, including multimedia, to engage students in a virtual learning environment, to capture their attention in classrooms through technologies such as PowerPoint and interactive whiteboards. Technology is also being used in administrative duties in education, instructions for students as well as assessment of students. One example is the Audience Response System which allows immediate feedback tests and classroom discussions.
* **Negative impact: unequal access to education**
* However, the use of computers and the Internet is still at its teething stage in developing countries due to limited infrastructure, high startup costs and high access costs. These countries are limited to the use of print or in some cases radio and television as the delivery mechanism for education.
  1. **Environmental impact**
* **Positive impact: creation of environmentally friendly products**
* Some technologies may have been designed specifically with the environment in mind, but most are designed first for economic or ergonomic effects. People only start to focus on intangibles like a clean environment and more effective productive processes when they have fulfilled their basic needs and are generally richer.
* **Negative impact: pollution**
* Most modern technological processes produce unwanted byproducts in addition to the desired products, known as industrial waste and pollution. While most material wasted is reused in the industrial process, there are some which are released into the environment, thereby producing negative environmental side effects such as pollution.
* The effects of technology on the environment are both obvious and subtle. The more obvious effects include the depletion of non-renewable natural resources such as petroleum, coal and ores, and the added pollution of air, water and land. The subtler effects include long term effects such as global warming, deforestation, natural habitat destruction, and coastal wetland loss.
* One of the main problems is the lack of an effective way to remove these wastes on a large scale expediently. In nature, organisms “recycle” the wastes of other organisms. For example, plants produce oxygen as a by-product, which oxygen-breathing organisms take in to metabolize food. They in turn give out carbon dioxide, which plants use during photosynthesis to make food for themselves. No such mechanism exists for the removal of technological wastes.
  1. **Impact on medical research and development**
* **Positive impact – Ensures the survivability of Mankind**
* Discovery of cures and vaccines can not only alleviate pain and suffering but also facilitate artificial immunity towards diseases
* In addition, medical improvements prolonged the lives of many, particularly the disabled and those with special needs
* For example, the kidney dialysis machines have enabled many people to survive kidney diseases that would once have proved fatal, and artificial valves allow sufferers of coronary heart disease to return to active living.
* As a result, medical advancements and breakthroughs prevented the spread of epidemics and pandemics, which were major causes of deaths in the past, such as the notorious Black Death.
* **Counterargument – Limited knowledge of Science**
* However, our limited knowledge of Science hinders the pursuits to cure all illnesses and prevent the inevitable end of our lifespans.
* For example, Science has yet to find the solution to prevent the incidence of many illnesses and diseases, from the common cold to cancer. (stem cells research – cloning)
* Furthermore, research and development is extremely costly. The low probability of success implies the wastage of finite resources.
* **Counterargument – uneven distribution of resources and benefits**
* Despite the successes in the field of medicine, developing countries have not benefited from these improvements. In fact, economic exploitations via the sale of vaccines at exorbitant prices and patent rights widened the inequality between the developed and developing countries.
  1. **Impact on religion**
* **Negative impact: science is perceived as a threat to religious beliefs**
* Religion has long been the hallmark of mankind. It was notably responsible for some of our greatest achievements; the unwavering religious structures in some countries are a testament to human faith. However, the upsurge of scientific and technological development since the Renaissance has eroded the power of culture and religion.
* The effects of globalization, ironically, have brought about negative responses in many developing countries, who perceive it as a threat to their religious beliefs. The influx of Western ideals has driven many to hold steadfast to their faith. It is no coincidence that the sudden swing towards fundamentalism occurred after Western ideas start to enter these Islamic countries.
* Science is an emotionless god, yet there are many that have unknowingly worshipped it. Those who believe in the absolute truth of science are merely replacing their old gods with new ones. They are speaking as though science can provide answers to everything. In fact, they are somewhat similar to a religious fundamentalist as they believe so much in it.
* **Positive impact: Relationship between science and religion**
* Science and religion need not be mutually exclusive. Both are necessary to benefit and enrich humankind. Science provides us with knowledge to improve our lives while religion provides us with the wisdom to handle this new knowledge.

**h. Impact on culture**

* **Negative impact: loss of culture**
* As we fully immerse ourselves in this age of science and technology, we tend to assume that cultural norms that have not been practiced for generations are of no basis and reason. Many tend to believe that things with no scientific proof should not be trusted and hence are resistant towards them. For instance, superstitions are becoming less practiced today as thsen cultuy are viewed to be unnecessary and baseless. Rituals like performing rain dances to please Gods and Goddesses are almost non-existent.
* **Positive impact: increased awareness and understanding about other cultures**
* Technology has allowed us to know more about other cultures in the world. This can help to build up greater understanding between cultures and reduce clashes between different races. However, despite the fact that we know more about other cultures, technology cannot change our mindsets, such as discrimination of certain cultures which are already deeply rooted in our minds. Advanced communications may serve to improve interaction between people but it does not mean mutual understanding.
* Does science and technology help to promote a more unified and homogenous culture or create greater diversity.
* What type of culture does science and technology create?

**i. Impact on the economy**

* **Positive impact – Facilitates job creation**
* The advancement of science and technology has led to the creation of new jobs and new industries, which will raise employment level and improve the livelihood of individuals
* For example, Singapore built two state-of-the-art biomedical research parks. The Biopolis, a biomedical research complex of seven buildings that houses 2,000 scientists, opened in September 2003.
* As a result, the government’s shift in focus towards the growth and development of new industries created job opportunities that propelled the economic growth
* **Counterargument – Structural unemployment due to skills incompatibility and displacement of workers**
* While technological advancement has brought about conveniences and new job opportunities to us, individuals who lack the skill sets to adapt to the restructured economies will be displaced from their jobs, resulting in unemployment.
* The emergence of automation has replaced many jobs that initially required human labour, contributing to displacement of workers such as the bank teller.
* **Positive impact – Facilitate international trade due to efficient transportation and communication**
* Science and technology allowed countries to integrate their communication and transportation networks, thereby preventing the wastage of resources and time
* The ease of accessibility between and within countries have allowed the transportation of goods and movement of labour, such that the efficient allocation of resources enabled consumers to purchase a wider variety and higher quality of goods and services.
* As such, technological advancement has accelerated infrastructural development, which will promote economic growth.
* **Counterargument – Greater economic competition**
* However, the emergence of interlinked markets would invite more intensive and frequent competition amongst firms, which may lead to trade wars.
* One such example is the competition in the smartphone industry between Apple, Xiaomi and Samsung.
* Also, outsourcing of jobs and the widespread formation of multinational corporations (MNCs) may lead to sudden influx or outflow of capital that creates extensive economic volatility.

**j. Political implications**

* **positive impact: creates publicity**
* Technology is being employed in political elections today. During campaigns, candidates make use of the mass media to publicize for themselves. The ability to generate more publicity for themselves is crucial for their success.
* **negative impact: strain in political ties**
* Political ties are being affected by technology as to many, technology is power. Even without any impending wars, countries see the need to wield the latest war technologies for defense. Countries need to constantly update their war equipment and seek out new technologies to manufacture more powerful weapons. The possession of nuclear weapons by North Korea has been a constant threat to many countries for fear of a nuclear warfare. This has led to a strain of political ties between North Korea and the rest of the world.