

## Guest Editorial

### Industrial Revolutions and Educational Reforms

Namal Priyantha

*Senior Professor in Chemistry, Department of Chemistry, University of Peradeniya*



It is the nature of humans to look for comfort, compare and compete with others, and search for opportunities. The brain power of humans is capable of doing these activities. In order to provide the requirements of humans, industrial revolutions took place. It is the human who was behind the success of industrial revolutions; it is the human who developed and controlled the extent of industrial revolutions. The facilities we use now and comfort we enjoy in day-to-day life are the results of a series of industrial revolutions, which have changed all aspects of the entire society. Consequently, the industrial revolution led to many changes to the field of education as well. Education which was limited to certain groups of people prior to the 1800s became accessible for children of all socioeconomic backgrounds, and more importantly, laws were formulated making education a requirement for all.

Rural agrarian societies in Europe and America were transformed into industrialized ones during the latter half of the 18<sup>th</sup> century. Mechanization of production was the main outcome of this transformation, which was possible through the use of steam power. This was a substantial change and was the initiation of the industrial revolution. This is now marked as the first industrial revolution as many revolutions, having different modes and different technological inputs, later succeeded this. The first industrial revolution was reported to be initiated in Great Britain, the most powerful country back then, and it spread towards America and other countries. As a result of mechanization, hand-craft and handlooms started to be produced in mass quantities by machines in factories, and production methodologies of metals from their ores were developed. The greatest breakthrough of

this revolution was the increased human productivity. Many years later, developments, such as the steam-powered ship and the locomotive led to further changes in the society leading to the initiation of globalization.

The second industrial revolution was marked for rapid standardization and industrialization. It is thus known as the Technological Revolution, which began in the late 19<sup>th</sup> century and continued into the early 20<sup>th</sup> century resulting in a great increase in economic growth. Living standards thus improved significantly, together with massive production of goods, as a result of enhancement in productivity. Further, significant improvements in public health and sanitation resulting from expansion of scientific medical knowledge were able to reduce the extent of infection and fatality rates from many diseases. During the second revolution, application of basic science opened many avenues. Application of the principles of thermodynamics in industrial processes, large-scale synthesis of inorganic chemicals and organic dye industries were among notable advances. More importantly, optimization of experimental and process parameters was initiated during this period. Other technological advances recorded during the second revolution are the application of chemical principles for purification of valuable metals, such as chromium, molybdenum, titanium, and vanadium, which were then used for the production of alloys with specific characteristics targeting desired uses. Various Ni-Fe alloys, with corrosion resistant properties were also developed during the latter part of the 19<sup>th</sup> century. Further, research on Ni-Mo alloys became successful in the early 20<sup>th</sup> century, which later led to the invention of Hastelloy, which is still being manufactured as a super alloy with much improved corrosion resistant properties, which can be used for the production of containers to store highly corrosive and reactive solutions. However, fine tuning of industrial processes through automation and improvement of accuracy of experimental results were yet to be developed. Together with the developments of industrialization and urbanization during this revolution, uncontrolled disposal of industrial and household waste led to severe undesirable effects on human health. This

prompted many countries to develop additional rules and regulations to safeguard the health of humans, and laws devoted to protecting natural landscapes and wildlife became in operation.

The third industrial revolution began in the latter part of the 20<sup>th</sup> century with a breakthrough on automation using electronics and information technology. Consequently, the automation production processes were possible without input of the human in some instances. Introduction of robots to carry out programmed sequences was possible without human intervention as a result of this revolution.

To be aligned with the changes and the requirements of mankind and society, as well as to contribute to the ever-changing modes of industrial revolutions, educational reforms were introduced all around the world. Toward the end of the 20<sup>th</sup> century, the standards-based education goals were set based on the principles of outcomes-based education (OBE), an educational theory that bases each part of an educational system around goals (outcomes). During this time period, the Government of Sri Lanka also introduced a comprehensive set of education reforms which were designed to promote equitable access to basic education and improvements in learning outcomes. OBE can be distinguished from the traditional education method, which was designed as a teacher-centered process, the way it incorporates three elements: theory of education, a systematic structure for education, and a specific approach to instructional practice. In this approach, the term "outcome" is the core concept which may be used interchangeably with the terms: competency, standards, benchmarks, and attainment targets. OBE also uses the same methodology formally and/or informally adopted in the actual workplace to achieve outcomes. It focuses on life skills, basic skills, professional and vocational skills, intellectual skills, interpersonal and personal skills, etc.

The fourth industrial revolution, which is named the Digital Revolution, is continuously taking place at present. It was in fact built during the 3<sup>rd</sup> revolution and started in the middle of the last century. Artificial intelligence was the key development in this revolution.

Progress in artificial intelligence has become substantial in recent years, as a result of increased computing power. Software programmes are now available for many scientific developments such as discovery of new drugs, and business functions. Importantly, investigation of symbiosis among various components of the ecosystem, including microorganisms, human body, food tuff and buildings inhabited. The fourth industrial revolution led by digitalization, in a way, touches the human more than the first three revolutions did. There are so many benefits and advantages of this revolution providing efficient services and pleasure to the human. This revolution has the potential to raise global income levels and improve the quality of life of humans, if the technology is used properly. It is a known fact that many of us are not able to function anymore without digital technology. It is a fact that digitalization has been the key to the success during the pandemic and crisis situations we are experiencing. Many activities would have otherwise been at a standstill if the fourth revolution had not taken place.

Digitalization-oriented lifestyle could weaken human capacity, such as the analyzing and thinking power. Strong bond the human has developed overtime with smartphones is a major drawback in this aspect. Unlimited connection with it would change valuable qualities of humans, such as patience, kindness and sensitivity, ability of collaboration and teamwork, degree of planning, and more importantly, interaction with the environment. Neither the technological developments nor the consequences resulted from technology are spontaneous. It is the human who is responsible for guiding all these revolutions and making decisions. Time has now come to use our brain to adjust to the unlimited developments of the fourth industrial revolution, as what is done today will reflect its consequences tomorrow. Otherwise, the human will become a robot of technology. On the other hand, technology will be developed further to alter the qualities of the human toward better direction. Further educational reforms revisiting the goals to focus on the present local and global situation is thus needed to tune human capabilities to contribute to the success of nations.

*Prof. Namal Priyantha obtained his BSc from the University of Peradeniya, Sri Lanka in 1982, followed by a PhD in 1990 from the University of Hawaii in USA. His research interests include the construction of low-cost electrodes for field measurements, Treatment of industrial effluents, electrochemical sensors and electrochemical detection of pesticides. He served as a senior Lecturer in the University of Peradeniya, from 1993 to 2001, and a visiting lecturer at many universities in Sri Lanka, including the College of Chemical Sciences, Institute of Chemistry Ceylon. Prof. Namal Priyantha currently serves as a Senior Professor at the Department of Chemistry, University of Peradeniya*