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## Insights about Electronic Technology in Digital Transformation Age & Neutrosophic Data Structure

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**Abstract:** In recent decades, Information and Communication Technology (ICT) has been advanced and widely spread around the globe in addition to ICT revolution and technological advances are considered the major role in the evolution of modern age, which is called "Digital Transformation Age". Therefore, Electronic Technology (E-Technology) has become one of the most prominent approaches such as Electronic Learning (E-Learning), Electronic Training (E-Training), Mobile Learning (M-Learning), Virtual Lab (V-Lab), Virtual University, etc. E-Technology includes some features, for instance anyone, anywhere, anytime and reducing of geographical barriers. E-Technology is a great trend and influences many fields and sectors such as Learning, Training, Military, Navy, Aviation, Medicine, and Digital space. According to nature of usage, E-Technology can be used in positive or negative trends. E-Technology is considered as a valuable tool in providing several opportunities for learning and training processes for individuals and organizations, especially in critical issues. Finally, we give a quick overview of neutrosophic data and some recent applications.

**Keywords:** Information and Communication Technologies (ICT), Electronic Technology (E-Technology), Electronic Learning (E-Learning), Mobile Learning (M-Learning), Virtual Lab (V-Lab), Neutrosophic Data.

### 1. Introduction

Currently, it is remarkable that the advancement of computers systems, the web and Information and Communications Technology (ICT) has become very large and rapidly increased. ICT is considered the main factor in the evolution of modern age called "Digital Transformation Age". Moreover, we live in the digital century and ICT services. ICT has been helpful in several sectors, for instance training, education, health, military and commerce. ICT refers to various groups of technological instruments and resources that provide the possibility to connect and communicate. It also provides the possibility to disseminate, create, manage and combine information. The widely spread of ICT, especially the Internet, is one of the most iconic phenomena related to the "Digital Transformation Age". ICT provides a lot of online services in several sectors, e.g. culture, defence, medicine, entertainment and training.

ICTs include a multitude of software, media, hardware and networks in order to gather, process, transfer, display and store information (images - text- voice) in addition to the related services. ICTs can be broken down into two main parts, the first part is Information and Communication Infrastructure which indicates tangible telecommunication systems and networks (cable, satellite, cellular) in addition to the services that relate those items (voice ,Internet, mail, television, and radio). The second part is Information Technology (IT) which indicates the software and hardware used for information saving, processing and displaying.

ICT approach prepares and supports a wide umbrella on the kind and nature of technology and the methodology to apply and use several technologies, as well as it impacts on individuals, communities and organizations [1]. According to UNESCO, ICT is defined as "The collecting of informatics technology and other relevant technologies, particularly communication technology" [2]. We can define ICT as follows:

The technologies, including communication, computers and information equipment, which are used by persons or organizations for many functions or tasks.

Mobile technologies are related to ICT. Mobile technology is being used in imparting information fast and effectively. Now, we would like to illustrate the wide spread of ICT in everyday life through the next Fig.1which presents the developments of different items of ICT from (2001 to 2019) regarding International Telecommunication Union (ITU) [3].

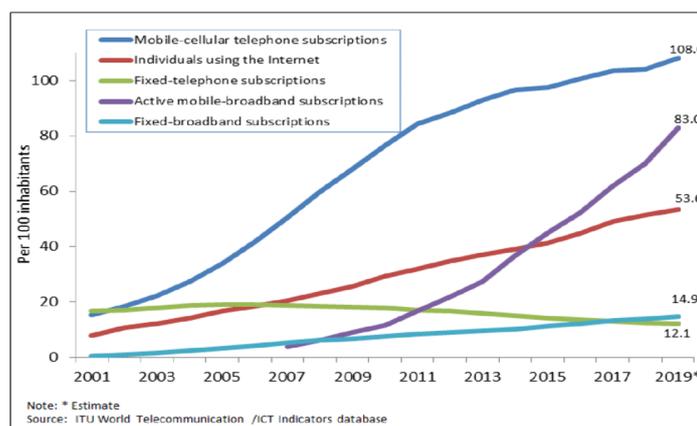


Fig. (1): ICT developments (2001 to 2019)[3]

In view of this, digital transformation has become a buzzword which draws attention and interest of many individuals, researchers, institutions, organizations and countries. According to the importance of digital transformation, there are several studies and publications about this trend. Fig. 2 indicates a notable increase in publications about digital transformation, especially in the previous few years [4].

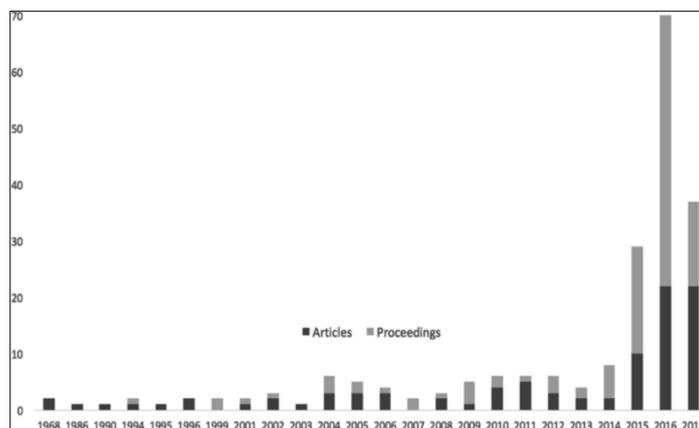


Fig. (2): Publications and studies distribution on digital transformation [4]

The ICT can be used in education, learning, training and giving lessons through the following trends [5].

- Teaching
- Psychological Testing
- Virtual Laboratory
- Evaluation
- Diagnostic Testing
- Remedial Teaching
- Online Tutoring
- Instructional Material Development
- Development of Reasoning & Thinking

### 1. Electronic Technology

Nowadays, Electronic Technology (or E- Technology) usage trends have become enormous all over the world. Smart digital devices, Internet, computers, software and other ICTs are common in training and education organizations.

E-Technology can be used in positive trends, e.g. in learning, training, entertainment, industrial systems, medical, commercial and military environments or negative trends, e.g. in electronic war, electronic crime and etc. It is useful to throw light on positive and negative forms of E- Technology. In Fig.3, we classified and illustrated some examples of most common idioms of positive and negative forms relevant to E-Technology.

With no doubt, the global spreading of the Internet is rapidly growing and it is considered as a major spark of E-Technology. In this context, according to ITU statistics Fig.4, it indicates the percentage of users who use the Internet during the last years from 2005 – 2019[6].

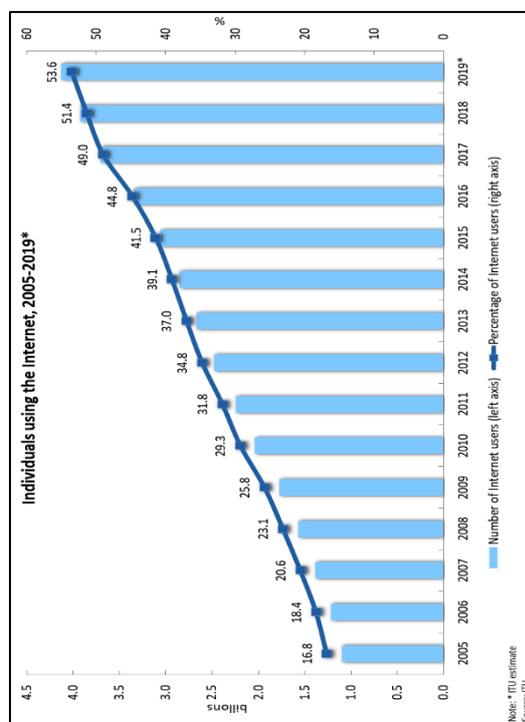
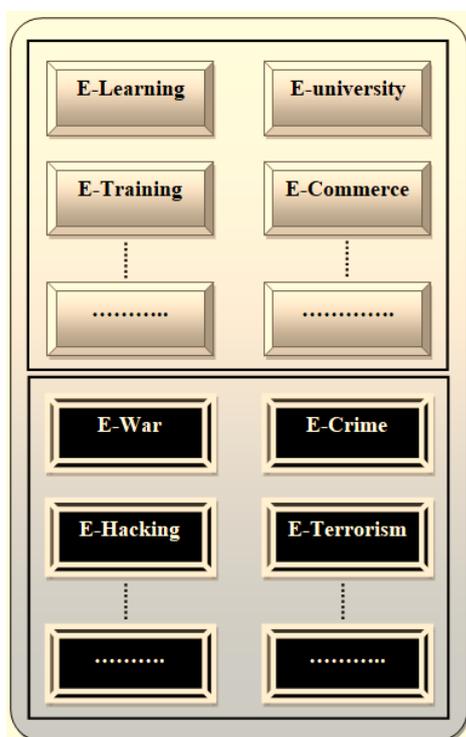


Fig. (3): P./ N. forms of E-Technology      Fig. (4): Internet usage by Individuals [6]

### 2. Electronic Learning

Over recent years, Electronic-Learning (E-Learning) has been commonly increased as one of the new digital technologies around the world. The interest and demand for E-Learning have been growing around the world. In Egypt, E-Learning has been greatly supported in the last few years. In this regard, the supportive trend of E-Learning technology has been performed in the last few years, e.g. the Egyptian authorities have established the Egyptian University of E-Learning in addition to E-Learning project which is related to the Supreme Council of Universities. The term 'E-Learning' can be confusing. Next lines will demystify the term and outline key terminology. There are several definitions and concepts to describe and determine modern and various sides of E-Learning technology.

- "E-Learning technology represents all forms of electronic supporting, learning and teaching which are procedural in character and aim to affect the construction of knowledge with reference to individual's experience, practice and knowledge. Information and communication systems, whether networked or not, serve as specific media (specific in the sense elaborated previously) to implement the learning process"[7].
- E-Learning technology is defined as "individualized instruction delivered over public (internet) or private (intranet) computer networks. E-Learning is also referred to online learning, Web-Based Learning (WBL) and virtual classroom. E-Learning was first called Internet-Based Training (IBT) then Web-Based Training (WBT). Today you will still find these terms being used, along with variations of E-Learning"[8].
- From our point of view, E -Learning Technology is the use of ICT in the process of education, training or learning anytime and anywhere. E-Learning is a vital phenomenon in many areas.
- There exit two major kinds of E-Learning. On one hand, synchronous E-Learning. On the other hand, asynchronous E-Learning [9].
- Synchronous-Learning( simultaneous method) is considered as a participation between instructors and learners in the same time at different places .Synchronous E-Learning approach takes a set of ways, e.g. real-time conferencing and multicast.
- Asynchronous E-Learning (not simultaneous method) is free of simultaneous manner participation between instructors and learners. It provides more opportunities for learning or training at any time. Asynchronous E-Learning approach usually takes patterns, for instance, collaborative systems for discussion-organization or corporation Intranets which spread the training to its member's electronic mail.

In Synchronous E-Learning type, persons feel more interactive with other members of learning society. Asynchronous E-Learning type is a suitable type in some cases. Persons or organizations can choose between Synchronous method or Asynchronous method according to their needs.

### 3. Mobile Learning

Mobile-Learning (M-Learning) trend merges E-Learning technology and mobility approach [10]. M-Learning is considered as a special form and subset of E-Learning in addition to the use of mobile devices and modern mobile technologies. M-learning changes the manner of learning or training due to its availability, flexibility and interactivity. Fig.5, determines M-Learning and E-Learning [11].

The first researches, articles and studies which are published about M-Learning had started around 2000. M-Learning approach is freely afforded by Mobile devices that encourage the person to learn or train without traditional learning methods constraint [12]. The term M-learning includes the features of mobility and wireless network technologies in addition to be used in the learning, training and education processes [13].

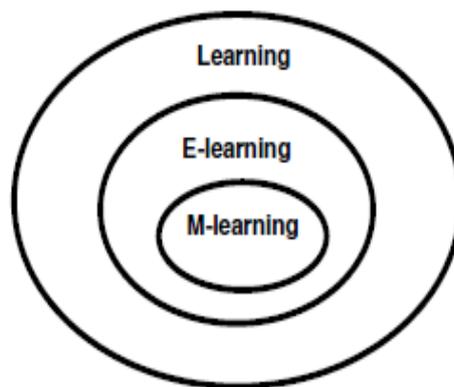


Fig. (5): Relationship between E& M-Learning [11]

M-Learning is a creative and flexible way in learning, education, teaching and training. People can easy access Internet, move and travel freely at any location such as club, institute, store, organization, capital city and village. They can learn or train at any place and anytime, single or in group. M- Learning can be defined as "a type of learning that takes place through portable devices which provide its users to meet their needs within seconds in terms of accessing, changing data and communicating with others without sticking to anything or anywhere".

According to Fatih Project in the field of Education (2006-2010) at Turkey which was supported by Ministry of National Education. In this project, there exist objectives which mentioned in Table 1 and there are organizations, for instance institutes, universities, and companies have been using some applications about mobile learning approach. The trend to M- Learning will increase [14].

Table (1): Goals of Fatih Project [14]

OBJECTIVES OF FATIH PROJECT IN EDUCATION
To develop life-long learning, make the individuals improve themselves through e-learning, to improve the e-content they use
Every student graduating from a high school should have the ability to use information technology and basic knowledge
By means of using internet effectively, one out of every three should get the benefit of e-education services,
Offering every individual opportunity to use and learn information and communication technology
One out of two should be internet user
To make the internet a safe environment for all the community

In short look, Fig.6 can determine the concept of M-Learning as the using of mobility, mobile devices and mobile technologies at anytime/anywhere for training or learning. M-Learning achieves high level of user friendly and user interaction aspects. Flexibility from fixed places constraint is a vital property of M-Learning.

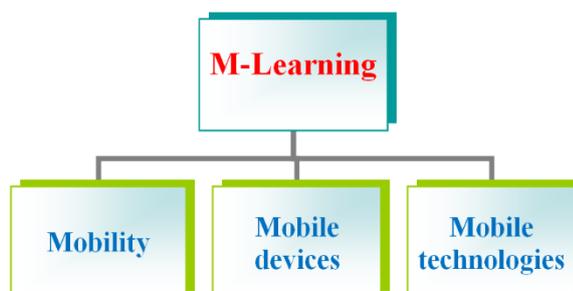


Fig. (6): M-Learning concept

M-Learning is extremely widespread multidisciplinary study trend around the world. It has attracted a prominent interest from many researchers who have realized the importance to support and apply mobile technologies to improve learning process. There are perspectives and theories of mobile learning in addition to some M-Learning practices that are executed in many different trends, for example university, corporate and military. Attention of persons about M- Learning is coming due to the availability of mobile devices to many people, handheld, ubiquitous and flexibility of access. Some scientists describe M- Learning as an expansion of E-Learning [15]. M-Learning can be used in some cases such as disabled and injured students or teachers, suspension of the study process and emergencies.

#### 4. Electronic Training

The developments of ICT and computer systems are important factors of emergence of Electronic-Training (E-Training) which is considered as a form of E-Learning and used in many fields such as organizations and corporate E-Learning (or E-Training). Web-based training (WBT) and Video conferences technologies are considered as major types for E-Training. According to previous study, E-Training technology can be described as "any type of training provided in organizations via electronic media which include self-paced learning from Intranet, learning from CD-ROM at work, training provided by instructors live through Webcast and recorded sessions of past webcast trainings available to employees and others"[16]. Fig.7 shows and indicates training term from E-Learning Technology perspective [17].

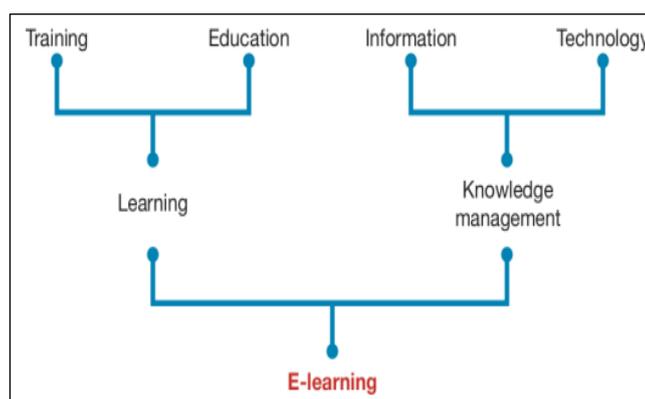


Fig. (7): An overview of areas of Thought and Practice connected to E-Learning [17]

It is worthy to describe and discuss Training and E-Training terms as follows:

- Training term is an activity to enhance performance, achievement and behavior of persons. The training process goal often supports the need to increase productivity, as well as to motivate, encourage and inspire persons [18].
- E-Training is a process of knowledge acquisition and increasing of performance through using of technological means.
- E-Training has features such as anytime, anywhere, cost effective, low risk, user interaction, convenience and facilities.
- E-Training can be described as the use of technology to enable trainees to acquire certain skills and knowledge from a trainer via electronic means [19].

E-Training is considered as a powerful tool in eliminating geographical obstacles aspect between the trainee and trainer in addition to effort and time aspect. The user can train at anywhere and anytime without obstacles. E-Training approach can contribute in the acquiring skills, employee training and human resources areas. It is considered as a powerful source for developing and

drawing the future strategy. The styles of E-Training can be summarized in the following Fig.8 [20]. E-Training is a vital way in particular sectors such as engineering, medical, nursing and risk experiments.

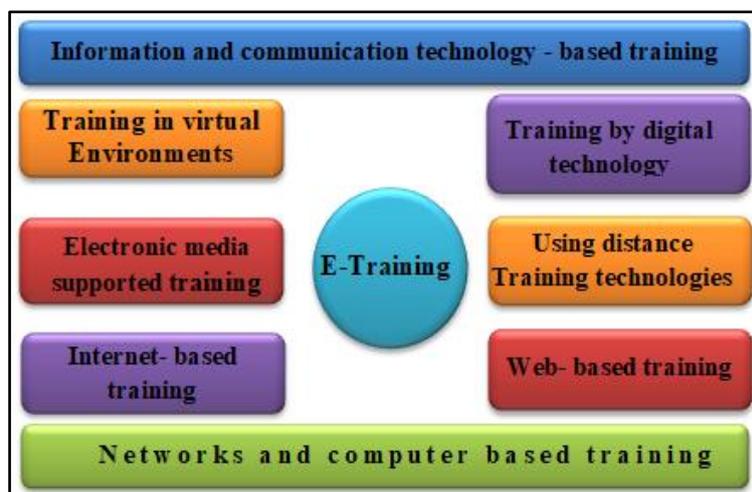


Fig. (8): E-Training styles [20]

## 5. Virtual Lab

Virtual Lab (V-Lab) is an effective trend in many fields and scenarios. V-Lab is a cheaper method than the founding of the traditional laboratory [21]. It is worthy to illustrate and describe the concept of V-Lab. V-Lab can be defined as "an electronic workspace for distance collaboration and experimentation in research or other creative activities, to generate and deliver results using distributed ICTs. In the broadest sense, a V-Lab is "a collaboration focused on achieving particular ingenuity and/or decision support objectives. Therefore, the V-Lab may encompass almost all spheres of human intellectual endeavours"[22]. V-Lab is a possible extension to traditional lab while it creates new chances not available through traditional lab at an inexpensive cost. For example of V-Lab, Fig.9 shows V-Lab in chemistry field with activity of water hardness determination and removal [23]. V-Lab provides a flexible way and user-friendly manner to perform experiments. V-Lab is an effective learning and training tool, especially suited for E-Learning and E-Training fields. A distinct example of V-Lab also in chemistry field can be shown in Fig.10 [24]

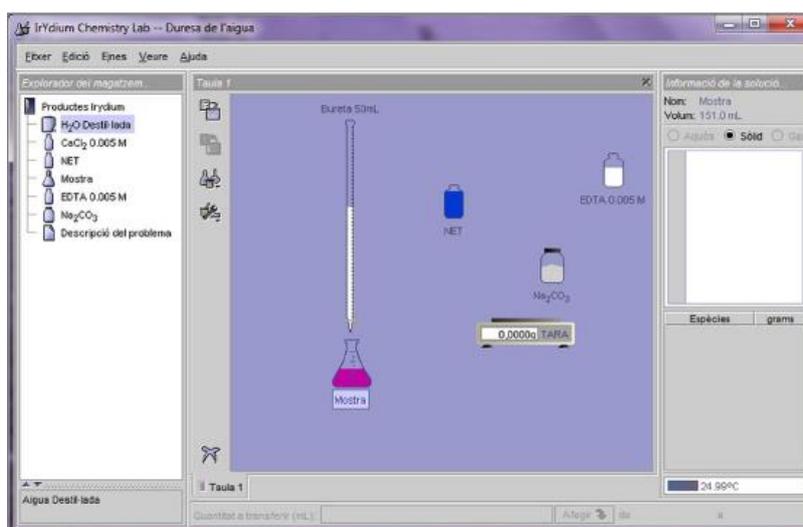


Fig. (9): Water hardness determination and removal activity in V-Lab [23]

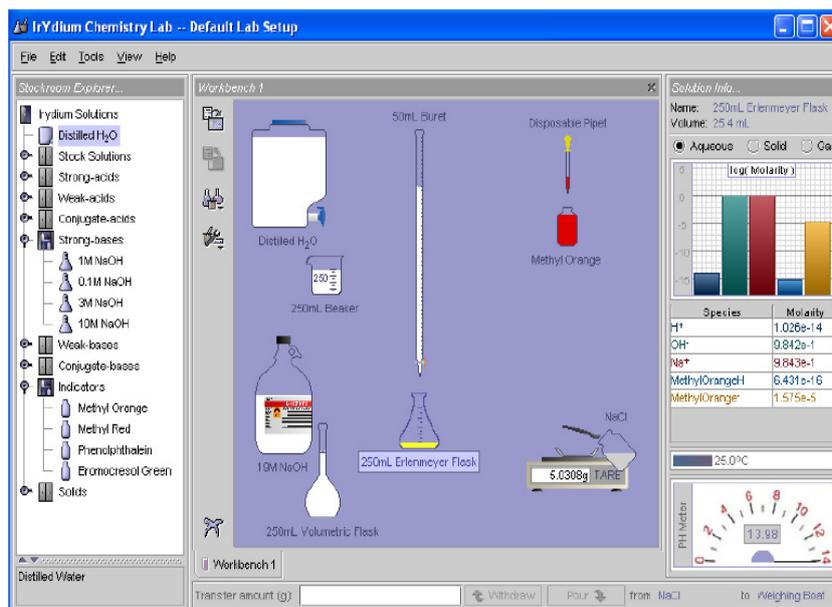


Fig. (10): Screenshot of V-Lab in chemistry field [24]

In view of this, undoubtedly, simulation is a powerful technique in several fields due to decreased cost, good quality and avoided risks. The using of simulation and packages in E-Learning brings the learners or the trainees close to the real life experiments and tests. The new tendency of requirement for the upcoming community of E-Learning Technology is "simulation-based E-Learning". Simulation allows us to reduce risk by enabling us determine the right and correct procedures instead of doing incorrect ones. Simulation technique can be described as follows:

"The process of designing a model of a real system and conducting experiments with this model for the purpose of understanding the behaviour of the system and /or evaluating various strategies for the operation of the system "[25].

Moreover, simulation technique is connected with E-Learning. Many studies and researchers believe that simulation technique is one of the most kernels and strategies of E-Learning technology as depicted in Fig.11 [26].

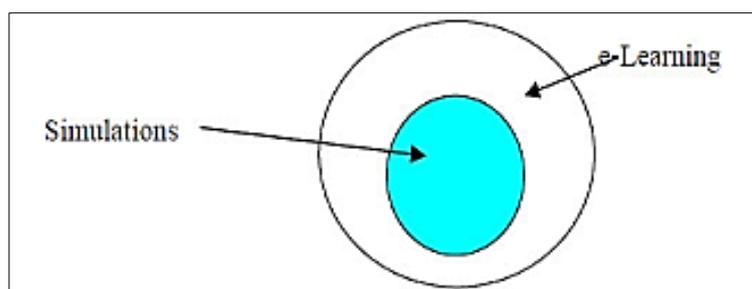


Fig. (11): The relationship between simulation and E-Learning [26]

## 6. Recommendation and Vision

Undoubtedly, there are some significant factors which can reflect negatively on the process of education such as mentioned in Fig. 12. Currently, the hot example is spreading of the novel corona virus COVID-19 around the world which is forcing for suspension of the educational process.

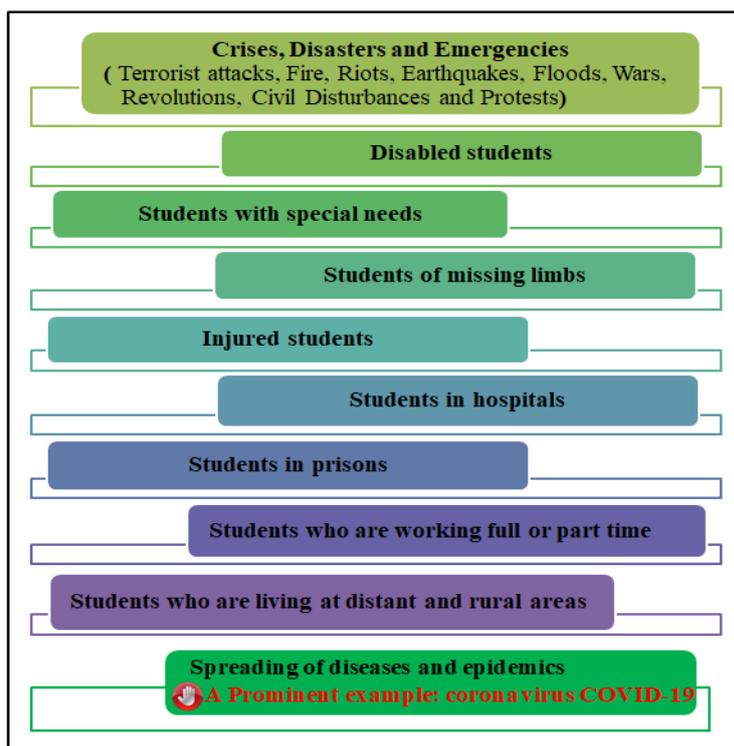


Fig. (12): significant factors that reflect on the process of education [27, 28]

There is a digital vision for facing this issue that is digital potentials of E-Technology such as E-Learning, M-Learning, E-Training, and V-Lab which can create extraordinary opportunities for the student community. The major slogan of E-Technology in digital transformation age and current century in the education field can be shown in the following Fig.13.



Fig. (13): A slogan of E-Technology

In particular, the progress and growth in technologies and techniques such as E-Learning, M-Learning, E-Training, V-Lab and Simulation are becoming noteworthy. Therefore, an extremely use of these technologies and techniques is recommended, especially in critical times. In this context, with the outbreak of a novel coronavirus, the virtual scientific conferences and symposiums are becoming more available.

### 7. Neutrosophic Data and Technology

Currently, Neutrosophic approach is one of the most approaches, which considered as a precious modern approach. With the increasing popularity of Neutrosophic approach, the development of this approach became a great trend of science, which has its own rules and principles. The overwhelming spread of Neutrosophic approach in the late 20th century has provided a new trend into the debate and research. As well as, it has offered a worthwhile forum and symposiums. Florentin Smarandache 1995 in [29-32] provided the first touches of Neutrosophic approach and Neutrosophy. Salama et al. in [33-38] introduce and study many applications in mathematics, computer sciences and information systems Data-driven problems are relevant to a variety of disciplines and can be constituted, examined, and solved in numerous possible ways. It is common

for the information involved in such problems to not be perfect and to include uncertain, imprecise, and vague data. For this reason – because they are likely to involve indeterminate data - data-related problems cannot be satisfactorily solved by using fuzzy set, intuitionistic fuzzy, or their extensions. Neutrosophic theory, on the other hand, is an efficient tool for solving data-driven problems connected with indeterminacy. This based on the capacity of neutrosophic theory to deal with every element of a problem in addition to their conflicts and their hybrid behavior with other types of sets like rough sets, soft sets, and bipolar sets. Such a potential has resulted in the increasing use of neutrosophic theory in the development of applications relevant to a variety of data-driven problems, including data mining, e-learning, image processing, classification of pattern, clustering, medical diagnosis and so forth.

Employing neutrosophic theory in the field of artificial intelligence is becoming more and more popular as it is considered to offer optimum results. In this respect, neutrosophic logic, sets, probability, and statistics, have all been used in the development of artificial intelligence applications and tools, including among others robot mapping, automatic decision making, satellite image segmentation, medical diagnosis, neutrosophic cognitive maps, linear and non-linear programming. This vast variety of uses of neutrosophic theory in artificial intelligence has given rise to unique questions and has introduced novel ideas to solve critical problems.

Applications of neutrosophic theory have begun to develop AI applications in a variety of scientific fields, including modeling and simulation, physics, computer science, engineering, biology and chemistry, and industrial and computational engineering, which address issues related to uncertainty, uncertainty, and imprecision. Ambiguity, inconsistency and incompleteness of information

## 8. Conclusion

This study shows the importance of modern technologies and techniques which can be applied to eliminate geographical locations between countries and use them during critical times. Certainly, ICT is a vital field and can provide appropriate solutions in many sectors. E-Technology has positive and negative forms. Hence, it is necessary to avoid the bad approach of E-Technology. The slogan of E-Technology in digital transformation age is anyone- anywhere- anytime- any content. Remote experimentation is a suitable, flexible and alternative solution for avoiding some problems for instance unique or expensive equipment/materials. Therefore, V-Lab has none of the restrictions faced traditional laboratories due to flexibility of accessing to lab resources and decreasing budget constraints. Besides, V-Lab is a proper technique for provide safety approach instead of expensive cost of material and it lowers the risk of some experiments and hazardous materials.

Ultimately, E-Technology is a magic tool and appropriate lifelong solution or remote learning, especially to continue the education process at academic institutions during critical circumstances or locations such as novel corona virus COVID-19, distant places, rural areas and issues in Palestinian territories. Finally, the concluding remarks could be made as follows:

- Neutrosophic approach is a rapid growing trend and it is a robust and effective tool in varied fields such as computer sciences, information systems Mathematics, Statistics medicine, nursing, engineering, commerce, etc.
- Neutrosophic approach provides a worthwhile means of scientific research and opens new prospects.
- Neutrosophic approach has increased popularity around globe and drawn attention for the research audience.

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