El impacto de la formación para el programa de concienciación de la tecnología IoT en las universidades de Arabia Saudí

The impact of training for IoT technology awareness program In the Saudi Arabian Universities

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RESUMEN.
Hoy en día, Internet of Things (IoT) ha estado haciendo cambios drásticos en el aprendizaje electrónico y otros campos de nuestra vida cotidiana, como los sectores de la salud, la agricultura, el transporte, los negocios y el comercio y diversos servicios de ingeniería. Se pronostica que cincuenta mil millones de dispositivos IoT y seis mil millones de dispositivos móviles estarán en esta tierra en 2020. Las industrias de todo el mundo planean implementar IoT, ya que reduce los gastos en energía en un cincuenta por ciento y, finalmente, aumenta las ganancias. Por lo tanto, las instituciones académicas también deben trabajar en servicios habilitados para IoT para competir a nivel global. Los dispositivos IoT están conectando a las personas a la web, por lo que todos se acercan entre sí. El sector laboral se volvería más competitivo a partir de ahora, ya que muchas personas optan por el aprendizaje electrónico para obtener títulos fácilmente accesibles y las habilidades requeridas mientras continúan sus compromisos profesionales.
Esta investigación intenta como un paso preliminar para evaluar la capacitación básica de IoT para los estudiantes con el fin de aumentar su motivación para usar equipos basados en IoT, que es el requisito principal para un campus habilitado para IoT. Se realizó una prueba T para calcular la efectividad de la capacitación, ya que las universidades de Arabia Saudita buscan lanzar programas de IoT en sus diversos departamentos, también están motivadas para capacitaciones para preparar a su personal docente y estudiantes para cursos basados en IoT.

PALABRAS CLAVE.
Entrenamiento, IoT, e-learning IoT en salud, IoT en agricultura, ciudad inteligente.

ABSTRACT.
Nowadays, Internet of Things (IoT) has been making drastic changes in e-learning & other fields of our daily lives such as the sectors like healthcare, agriculture, transportation, business & trade and various engineering services. It is predicted that fifty billion IoT devices and six billion mobile devices will be on this earth in 2020 itself. Industries around the world are planning for implementing IoT as it reduces the expenses on energy by fifty percent and eventually increases profit. Therefore, academic institutions must also work on IoT enabled services to compete at the global level. IoT devices are connecting people to the web thus everyone comes closer to each other. Job sector would become more competitive from now

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on as many people opt for e-learning to obtain easily affordable degrees and required skills while continuing their professional commitments.
This research attempts as preliminary step to assess the basic training of IoT to students in order to enhance their motivation to use IoT based equipment which is the prime requirement for an IoT enabled campus. T-test had been conducted to calculate the effectiveness of training as the universities in Saudi Arabia are seeking to launch IoT programs in their various departments, are motivated as well for trainings to prepare their teaching staff and students for IoT based courses.

KEY WORDS.
Training, IoT, e-learning, IoT in healthcare, IoT in agriculture, smart city.

1. Introduction.

This research presents the notable benefits of Internet of Things (IoT) and awareness programs in Northern Border University (NBU), Saudi Arabia that has planned to launch IoT. This awareness program covers Medicine, Education, Business, and Agriculture & Engineering departments. Smart labs & LMS (Blackboard) are already functional in NBU that promote e-learning so the students are very well familiar with e-learning tools and resources. E-learning has gained fast updates and transformations recently due to IoT usage that provides concurrent data, so IoT awareness program becomes pertinent for all the stakeholders. Training sessions on IoT were conducted at NBU to fulfill that purpose. The training materials covered almost all walks of life for the evaluation of IoT requirement as to how it is beneficial for us, especially for the institutions of higher learning like NBU and how it could prove to be helpful for the nation to save energy and costs and also to become food reliant. Before conducting training, we asked some questions about IoT to students and we repeated the same questions post-training.
The motive of this research was to obtain feedback from the students about IoT. If it proves encouraging, launching new academic courses in IoT for in-depth study besides self-development programs pertaining to devises meant for IoT operations. Thus, the courses would be developed as per the specific requirements of respective deanships. For instance, for the engineering students, development programs for IoT devices to sensors would be focused at whole, and for those studying medicine, use of certain sensor devices is to be brought into fore. Raising awareness about IoT amongst the school going students in Italy by organizing workshops to train them by asking a few questions proved remarkable (Azamat et al., 2017). Upon the completion of training, an evaluation of training based on the questionnaires was conducted and a very positive response about IoT post training was received.
IoT has been linking thousands of smart devices through the Internet to collect data. The active support from sensors makes it possible to easily share information with numerous other devices. Things mean various physical devices that are embedded with sensors to software and many other technological tools that ease the process of sharing of data, and to combine with the remaining systems through Internet. According to recent trends it is predicted that the use of IoT devices might exceed more than 10 billion in 2020 itself, and this number will

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increase to 22 billion by the year 2025. IoT is a network of various types of things that are embedded with sensors, electronics and software linked through the internet as highlighted by the International Telecommunication Union & Global Standards Initiative (wikipedia.org & International Telecommunication Union).

1.1. Healthcare.

IoT applications are on the verge of changing both medical and healthcare system drastically. Traditional devices used in the current scenario lack in the real world and real time information. IoT software and devices are bound to offer best analysis of the data pertaining to the patients' exact situation in the current assessments.

A case study of a Brazilian hospital showcased that it worked better than traditional systems and remained useful to save the patients' life by obtaining concurrent data through sensor and wearable support (Fernandes et al., 2016). It not only brings out the current data but also proves helpful for the diagnosis as well through a particular domain ontology support. Mathew et al. (2018) described how the exclusive use of IoT based healthcare devices proved supportive for the professionals to smoothen treatment, diagnosis & prevention of injuries, and also in handling the accident related cases in a well-organized manner. IoT applications are capable of bringing a metamorphosis in healthcare. Jeong, S., Han, O. & You, Y.Y. (2016) designed IoT health care that provided better scope for an early diagnosis of disease for suitable guidance about offering intensive care solutions.

Traditional devices in use today are hardly worthy for overall support to patients in the remote emergency cases. By the support obtained from sensors through Internet, it has now become possible to diagnose local level patients even remotely. Almadania, B., Yahyaa, B.M., & Shakshukib E.M. (2015) suggested how e-ambulance can be proved worthy. It provides health monitoring data of patients from remote locations, automatic response of suggestions and warning systems etc. It could continuously provide the exact real time data from the availability of an ambulance service to medical center information. A similar type of project was initiated earlier in which Hamida, E.B., Alam, M.M., Maman, M., Denis, B., & D'Errico, R.(2014) described the establishment of wireless communication and monitoring system to support and rescue in critical operations, especially during emergency by the use of wearable devices. IoT in healthcare focuses to empower people's lives for better and healthier outcomes by the use of IoT devices such as automated microscope, MIRCaM (to do cardiac monitor), 3nethra (eye related diagnosis), continuous glucose monitor (CGM) and insulin pens besides AppleWatch App to get the depressions monitored and ADAMM Asthma Monitor.

1.2. Agriculture.

Till 2050, the world population will become 10 billion and the biggest challenge will be to feed such a huge population. Hence, the only solution available is to increase the yield of crops to eliminate the present problem of the agriculture sector. It will be possible by the use of the latest technological tools only. IoT enabled devices are already offering great solutions to several problems nowadays. Several researches have been conducted and many are already going on to comprehend and thus overcome such alarming situations. Baranwal et al. (2016) too suggested that major step should be taken to develop a unique model for crop security

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and prevention. It offered timely remote information to the farmers about the rodents and insects. Such IoT based sensors alongside other related electronic devices paved the way for timely security measures. The success rate of this system was about 84.8%, which is considered a significant result.

Greenhouse farming is now gaining popularity as its environment can be easily controlled in the current context. Environment controlling systems are no more manual now-a-days. Such systems are usually sensor-controlled supported by specific software meant to ease their automatic adjustment, therefore, making it possible for the farmers to attain the concurrent reports remotely. Farmers are now capable to monitor as well as easily regulate all such devices from anywhere at their convenience; it reduces the time and cost while supporting the increase of crop production. For agriculture sector to grow, irrigation, water management and labor cost are the factors need to be considered. Mohanraj et al. (2016) launched a prototype which was prepared IoT based on instruments that could easily reduce the labor cost besides proper and most efficient utilization of water resources unlike the traditional systems used earlier.

Puranik et al. (2019) stated that agriculture system required ample automation if the aim was to increase the yields. To achieve this, automation of the entire agriculture system is necessary, comprising of water management, crop monitoring and controlling insecticide steps. Farmers require the best and the recent information of the farming techniques to employ in their practices. To provide timely and prompt information to farmers, especially cotton farmers, a unique prototype was developed by Chaudhary et al. (2015). They developed a prototype for the android phones that could easily answer the queries and connect that to other data sources to get appropriate information.

1.3. Transportation.

IoT technology has been providing amazing solutions in transportation System as well. It provides better safety, proper maintenance and effective traffic management for all types of vehicles including aviation and navigation as well. The *Internet Plus* transportation system had been developed which was based on IoT technology; its effectiveness had been tested in a transportation enterprise. The case by Ma et al. (2019) to monitor the passenger flow in Beijing railways is worth noting. Wei Li & Liying Sui (2018) proposed an IoT system which could prove extremely helpful from the sensing stage to transmit the concurrent data for easy flow of the rail transit without facing any additional worries. It further enhanced the vehicle safety and quality standards. Srinivasan (2018) studied the numbers of daily accidents and found that poor vehicles' efficiency was the sole factor which caused such accidents. For this, we required a real time monitoring system and algorithm for the smart predictions. An added advantage with IoT devices was that they needed least human intervention. Sensors, digital cameras and internet increased the capacity of systems for perfectness and to enhance the safety standards, and that too with low cost and minimum risk. Message signs for smart transportation systems by displaying real-time data of roads, lane status and travel times automatically provided from the sensors and cameras. Automatically self-controlled cars that could sense the status of road and forecast behavior could easily transmit data with the vehicles for timely decisions as per real life traffic scenarios.

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The IoT technology is developed to automate security system at even public areas such as airports, railway and bus stations by the help of CCTV cameras. Intelligent software can predict suspicious behaviors of people and even warn the concerned officials. Some useful applications include *Inrix* (displays real time parking & traffic information), *Chariot* (clear the traffic congestion & improve the movement), *Quest Motor App* (publishes on screen real time factors like speed, braking, frequency, traffic pattern collision data and local weather), *Dash Technology Mobile App* (an app to monitor driving and predict maintenance, check engine status & provide location based App).

1.4 Education.

Education sector has experienced tremendous improvement due to the constant technology use. Now-a-days, almost all universities worldwide use e-learning, smart classes & other virtual methods for easy reach to even the remotest areas. To provide anytime, anywhere and everywhere education it is available for students and professionals for twenty four hours a day. Technology saves time and cuts down the cost to run educational organizations. Recently, IoT increased quality of educational technologies & their real time access. It helped to interact and share our knowledge from the distant people. IoT applications are doing the works faster than the humans. The research by Sung et al. (2017) is about the programmed scoring system for short answers. There is no difference between human rating and automated system rating. They are reliable as human ratings. By the use of IoT applications, easy and effective question generation is possible now. According to Huang, Y & He, L. Z. (2016), preparing short answer questions through IoT is now possible for better comprehension assessment. IoT in Education sector acts as a catalyst for learning. These devices help in forests preservation and enhance the *Go Green* idea because education industry has been using more paper than any other industry. With the help of technology now, there is no need of paper from student attendance, examination and power savings systems. Shah et al. (2019) proposed one IoT based device that can take student attendance automatically. Sudha (2015) developed a project for a computerized attendance system for labs using barcode system which effectively saved time and eventually unnecessary expenses on papers. Ani et al. (2018) proposed a system to save electricity based on the IoT sensors which can sense automatically the presence of students in a particular area of the classrooms & switch off the fans and lights where there is no presence of students.

Iskandar et al. (2017) developed an IoT based management application (Merit2U) which automatically calculated the merit point of students for the allocation of hostel for competent students. There is no need of human intervention in the whole process. Some automated IoT educational tools are *Promethean* (interactive display, multi touch technology, cloud based), *Scanmarker* (scans for editable text like books & papers into laptops or phones, translates into 40 languages) *SweetRush* (creates & tests e-leaning, M-learning solutions & real time feedback system during the trainings by Instructors), *Blackboard* (e-learning support system to schools, collages & universities to create virtual classrooms, e-exams, marking attendance, grades and other events).

1.5. Business.

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The expected share of IoT in the global GDP is 10 to 15 trillion USD. Approximately 11 billon devices are IoT enabled apart from computers and phones. IoT software and hardware boost business intelligence field. It gives perfect analysis of the data and suggests business models too. It also analyzes huge real time data and provides solutions. Chandra et al. (2019) described the use of IoT applications as common daily activities. To obtain certain predictions through IoT devices and big data uses, neural networks and machine learning used big data platform which is relevant as the accurate data of online or offline categories. Annabeth et al. (2019) explained the use of IoT in six ways to develop DBM. It focused on the hurdles and implications for the decision makers to use IoT in the digital business development. It explained manual for digital transformation and business model basics in understanding the impact of IoT and digital transformation on the digital business models.
Conlon et al. (2016) maintained that current or real time information is a problem, as markets change fast in the financial investment services. It needed updated information to assist business decision-makers. Online documents are in unstructured text formats. This research focuses on providing online source texts which are information rich and can automatically update the web services implemented in service-oriented architecture (SOA) environments. Some applications of IoT for business are *IoT Analytics, Pega7, Spinal BIM, Qorus Integration Engine, SkySpark, Obzervr, Alleantia, Armis* among many others.

1.6. Smart City.

The city that gets designated the status of *Smart City* is one that uses unique category of IoT sensors to gather data to bring in use the perceptions obtained from that data to manage assets, resources and services systematically. It covers data accumulated from people, tools, and the assets that gets processed and analyzed to monitor and control transportation systems, power plants, other utilities such as water systems, waste management, police crime control system (www.interestingengineering.com, 2018). According to McLaren et al. (2015) & Sam Musa (2018) IoT is effective in educational institutions, health organizations, information systems and other community services.
Ugljanin et al. (2017) described the Business-2-Social (B2S) platform and studied the causal relation of Smart City's components from IoT enabled business operations to social networks. B2S has been accumulating IoT based data to prepare a ground for decision making support. From IoT data and prescribed guidelines, B2S paved the way for an automatic social action thus received genuine opinions. Zanella et al. (2014) surveyed the technology enabled tools for an urban IoT to describe technical solutions as the guidelines adopted in the Padova Smart City project in Italy under municipality collaboration. Sarun et al. (2018) presented the development of smart sensors of air pollution to monitor air quality in smart cities. They described how smart sensors designed from specific matters did matter. Ali et al. (2019) explained smart governance and data flow connectivity for the performance monitoring of government entities through optimal technique classifications.

2. Literature review.

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While IoT has been gaining immense popularity everywhere, it is high time students go for obtaining thorough training for it. The world has been witnessing fast transformations in the context of businesses and so are the challenges of environmental uncertainties. It is here that the realization of all sorts of limitations and steps to deal with the new challenges becomes paramount (Tai, 2006). Furthermore, Tai also confirmed that by conducting trainings any organization can reassure making the employees competent enough to face all sorts of challenging situations to counter the uncertainties. It will resultantly empower them to take timely decisions to sustain in the competitive marketplace. According to Afshan et al. (2012) a case study brought effective results. It was aimed at boosting an organization through enough investment in a suitable training program that could bring out the desired performance and skill enhancement of the employees concerned. It would also enhance competing experience with the upcoming technologies and trends that are introduced in the market as and when they are introduced. Akinori & Hidehiko (2017) described the efficiency which trainings bring out after their comparison of two groups for the said purpose: one group was trained with virtual reality while the other with non-virtual reality. Both the groups were observed and compared and it was found that virtual reality group obtained greater efficiency than the non-virtual reality training group.

Nassazi (2013) studied the outcomes of trainings on the employees' performances. The aim was to know the impact of trainings on the performance of employees in the telecommunication sector in Uganda. Likewise, Otoo & Eric (2012) studied the impact how trainings as developmental initiatives directly affected the performance level of Accra Polytechnic sector. The focus was to know the impact of trainings for overall growth in the employee performance level. Tahir et al. (2014) focused on the strategic effect of training programs for growth in the performance level of employees besides rise in the overall productivity level. The focus of that study showed that with trainings for overall development a greater impact was witnessed in the employees' performance level as well as in the fast paced productivity growth. Gonge et al. (2017) researched and conducted a statistical analysis as well as evaluation of the latest tools, especially those in education technology for the student, and found that various branches of engineering graduates' outcomes through the use of T-test had remarkable distinction.

Alabi & Olanike (2010) evaluated the willingness of Nigerian students towards e-learning. The researcher collected data by using questionnaires and applied a random sampling at the University of Lagos in Nigeria. The data was statistically treated using t-test and the results showed that students were eager and well prepared to adopt e-learning and that too with having a positive learning attitude towards this. Mangara (2019) investigated class attendance effects on gender basis besides focusing on the laboratory experiment performances of undergraduate engineering students' performance in an Electronic Fundamentals course (Fall semester, 2018) at one of the South African universities. The class attendance was the medium of data collection; the t-test results suggested no significant effect of gender on attendance in the classes.

2.1. Importance of the study.

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This research discusses the ardent need of training for IoT awareness and questions why it is important in the present context. There is an ardent need to comprehend the effect of training for IoT in E-learning and Instructional Design, and also to assess IoT potentiality for educational transformation.

2.2. Objective of the study.

a. To evaluate students' observations upon the completion of their IoT trainings using t-test.
b. To encourage faster e-learning process through IoT devices and software supports.
c. To train the students studying in various streams like medicine, engineering and education technology for IoT tools use.

3. Methodology.

A brief training was conducted for the students to get them exposed to IoT in the very first training session. Thereafter, a survey was conducted that was based on a questionnaire distribution. The next step was the conduct of subsequent training programs during which IoT devices were used in the practical sessions. Such sessions covered multiple devices representing medicine, education, agriculture, smarty cities, transportation, engineering and business domains.

This research is based on an analytical survey method, and it relies on the quantitative data that had been gathered from multiple groups. Various data collection tools were used to collect different data with an aim to identify the problem and to test the hypothesis for the same. The researcher attempted data collection in two phases, out of which the first one collected as the *basic training* concluded and the subsequent second phase data collection got completed upon the completion of *advanced training*. For both phases, same questions were repeated to the same population upon the completion of the training phases. The researcher tested the difference between all population as well as sector-wise that included *general awareness, education, agriculture, healthcare, engineering* in the pre and post training phases.

3.1. Sample collection.

a. Data Collection for the Pre-training Phase
   For this, the total population included those representing different departments and colleges and their numbers were approximately 340 students represented by the *engineering, medicine, business and education* departments. A serial number had been allotted to each student. Sample selection process was randomized as random method. This researcher then randomly chose 50 percent of the total population i.e. 170 to study further. This survey witnessed huge success with nearly 85% responses. The researcher had to reject 10 Questionnaires as they weren't properly answered properly. The exact population for correct responses was 160 for the study.
b. Data Collection for the Post-training Phase
   Upon the completion of the second phase training, this researcher collected the data again from the NBU student population that was approximately 340. It was gain a simple random selection for the research purpose. For the further study, the researcher

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took 169 out of the total 340 populations and rejected 100 as they were improperly filled and were not usable.

3.2. Tools of the study.

This researcher had attempted to collect the questionnaires based primary data with an aim to learn the students' perceptions on IoT devices and tools. The questionnaires shared were based on the Likert scale method, and the researcher had offered an option to the participants to opt from *Strongly Agree, Agree, Neural, Strongly Disagree & Disagree* to answer the questions.

3.2.1. Questionnaires.

Based on the total 36 questions, the researcher categorized the questionnaire into 6 question sets to obtain answers. Out of the 13 questions, first five focused on the students' general awareness on IoT resources. Thereafter, the next five questions were exclusive on IoT tools in the healthcare sector. For the use of IoT in education as tools, four questions were asked on that aspect. Furthermore, eleven questions remained exclusive on IoT as an engineering tool and were asked from that perspective. Similarly, four questions had been exclusively on agriculture based IoT uses while the rest and last four questions remained exclusive on IoT in the business forecasting context. The same set of questions were presented before the same population by the researcher on papers after the pre & post training sessions for data purpose.

3.3. Variables.

The Independent Variables- The Effect of Trainings.
The Dependent Variables- Students' Awareness and Skill for IoT Tools.

4. Results & discussion.

This research concludes with the results obtained from the data that was obtained by presenting questionnaires as the means and tools to gather data. Two-phased data collection was followed in the course of post-trainings that were conducted twice. Without making any modifications, the questions that were presented to the participating population remained unchanged. This research based on the T-test analysis with an aim to do the hypothesis test to obtain the research outcomes.
The test result for both the sections besides the entire population that had differentiation between first & second phase training were taken into account.

Table 1. Pre Training Data

SL N.	General Awareness	Healthcare Sector	Education Sector	Engineering Sector	Agriculture Sector	Business Sector	Total Population
N	160	160	160	160	160	160	160
Mean	19.1875	12.175	9.23125	28.80625	9.5	7.3625	86.2625
ST. DEV	2.978302	3.165359	2.965678	4.794516	2.174755	1.844548	9.823273
SEM	0.235455	0.250244	0.234457	0.37904	0.171929	0.145824	0.776598

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Table 2. Post Training Data

SL N.	General Awareness	Healthcare Sector	Education Sector	Engineering Sector	Agriculture Sector	Business Sector	Total Population
N	160	160	160	160	160	160	160
Mean	28.825	20.35	15.05625	42.98125	14.30625	12.59375	134.1125
ST. DEV	3.526272	2.238036	2.163874	3.765904	2.055815	1.67218	6.811004
SEM	0.278776	0.176932	0.171069	0.297721	0.162526	0.132197	0.538457

Table 3 . T Test Result between Pre and Post Training Group.

SN N.	General Awareness	Healthcare Sector	Edu. Sector	Engg. Sector	Agri. Sector	Business Sector	Total Population
1	Value of t= 26.4110	Value of t= 26.6743	Value of t= 20.0701	Value of t= 29.4097	Value of t= 20.3147	Value of t=26.5780	Value of t= 50.6345
2	SEM=0.365	SEM=0.306	SEM=0.290	SEM=0.482	0.237	0.197	0.945
3	Value of p is <.00001. at p < .05	Value of p is <.00001. at p < .05	Value of p is <.00001. at p < .05	Value of p is <.00001. at p < .05	Value of p is<.00001. at p < .05	Value of p<.00001. at p < .05	Value of p<.00001. at p < .05

Hypothesis Testing
H1 = H2
H1 ≠ H2
If H1= H2 There is no significant difference.
If H1 ≠ H2 There is significant difference between the groups.
H1= Pre training.
H2 = Post training.
In all the above t-test calculations (in Table 3) value of p is < .00001. The result is very significant at p < .05. T-Test between Pre & Post Training Data (*general awareness, healthcare, education, engineering, agriculture, business* & all sector population).
Hence H1 ≠ H2, then it means that there is a significant difference between the two groups. So, we can say that students' understanding level of IoT technology is enhanced.

Through this research, the researcher aimed at testing students' IoT awareness in the context of the respective for which T Test method was taken for help purpose. As the results has been shown in tables 3 above for both pre and post training remained crucial. The research results are in line with Senthilkumar's study (2017) in the context of maps concept and its effectiveness in physics education through quasi-experimental design had extensive result. The post-test had been brought into use to measure instrument while the post-test scores had been analyzed statistically. Furthermore, t-test results brought out the mean of the post-test scores of both the experimental and control groups that remained statistically crucial.
The researcher obtained positive outcomes through IoT uses as it has become mandatory in the current context that skills should be upgraded to the best extent possible and that IoT paves the way for students as much as its application in almost all walks of life. Al-Emran et al. (2020) have already indicated this probability make the best use of IoT in the education sector, especially in the popular sections such as *Vocational Education* and Green IoT in this vast sector besides medical education and technical education amongst others. This research

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concluded with a focused attention of IoT as an advanced modern tool and its effective usage in the education sector to counter many challenges as much as availing many opportunities for a new dawn.

4. Conclusion & implications.

This research explained how trainings remain a significant factor. In fact, training always directly impact and effect the participating members' perception and mental level. This research used the T-test for the comparative study of both pre and post training sessions' outcomes. The results of the experiment showed a positive achievement for IoT propagation to promote it in various deanships of the university by encouraging various training sessions. Over the period of time and when future researches are done, maximum students' population should be trained for the said purpose. That will perhaps bring out a truly real scenario of trainings organized in the various labs of the respective departments to come up with affirmative outcomes. As more than two groups would be involved in future with the expansions in trainings the future tests should augur ANOVA or MANOVA uses to obtain the results.

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