

**APPLICATIONS OF NEURAL NETWORKS, DECISION SCIENCES AND
ARTIFICIAL INTELLIGENCE, ICT AND INTELLIGENT BASED MOBILE
SYSTEMS IN ENHANCING E-GOVERNANCE IN SUSTAINABLE EDUCATION**

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Abstract— The use of AI and IOT in education has not been studied before. This paper attempts to study the variables that enhances the application of AI and IOT in education. Using neural network software the study was conducted and the findings were drawn using SPSS software. The study included the empirical study of HEIs in education. The findings suggest that the application of AI in education can make it more sustainable and allowing the students to learn on the job training using virtual reality technology. The other findings suggest that the areas of sustainable education may include the medical imaging services developed for telemedicine, application in financial analytics and entrepreneurial decision sciences about resource allocation in venture creation and start-ups. The originality of the study includes the study contributions in terms of the areas of application and its usage in enhancing the student's learning abilities using virtual reality techniques of modelling the production and supply chain management systems and consumer behavioral studies for predictive analytics of market research of new product development and service development.

Keywords— AI, IOT, Student's Learning Abilities, virtual reality

I. INTRODUCTION

The present world is moving into the digital media and information. With this, the role of ICT in education has become very critical. This paper studies the impacts of ICT on contemporary training institutions of education.

Computer networks also consist of many layers, similar to the machine learning technique of neural networks. Neural networks have several hidden layers of processors to process inputs between the input layer and the output layer. Our objective is to examine how AI and machine learning techniques have been used in computer networks, particularly to strengthen the security of the computer networks. So this paper reviews how machine learning techniques and ai have been used in cybersecurity over the years and examines gaps, to see if other ml techniques can be used to bridge these gaps.

It also aims to check if a hypothetical model designed by integrating multiple machine learning techniques, supervised or unsupervised, can help bridge these gaps and improve the security and connectivity of computer or mobile networks. It also aims to examine the gaps in the research and what can be done to resolve them. It also reviews the accessibility of the models developed and the extent of their use and availability in the market and in various field applications including the medical research and decision sciences and technology enabled research in consumer behavior and supply chain management and production intelligent systems driven by neural network management systems.

The study argues that there is a very significant role of ICT in changing influences how these programs are offered and delivered in the institutions. The research paper follows the given structure. First, we have discussed the literature review. Then, research methodology based on the hypothesis is has been given. Finally, the findings and analysis is given.

II. LITERATURE REVIEW

The study focuses on evaluating ICT strategies for measuring and demonstrating effective use of technology in education. It explores various factors such as the teaching-learning process, quality and accessibility of education, learning motivation, learning environment, and ICT's role in enhancing scholastic performance. The study is based on field research conducted in professional institutes in the Delhi/NCR region of India. The findings reveal that challenges related to multilingual states in Indian institutes can contribute to a digital divide among learners. Social inequalities, including lack of technology access or broadband connectivity, also impact educational access. The study emphasizes the need for familiar language use in ICT for initial learners and the importance of local capacity and needs for effective ICT integration. Additionally, the study highlights the significance of appropriate ICT adoption in creating a knowledge-based society. The paper discusses policy implications and proposes indicators for assessing the influence of ICT on communication, information sharing, feedback, and technical knowledge. The study emphasizes the role of online modules in improving student performance and highlights the transformative impact of ICT on education and business administration. The acquisition of basic skills, student motivation, and engagement are identified as key enablers of a knowledge-based economy. The study references the European Parliament and Council's recognition of competence as one of the key competences, with ICT skills being a core indicator. The study concludes by suggesting that technology not only needs to align with current teaching and learning practices but also lead the way in shaping education in the future. The European Commission has initiated several studies intended to summarize existing and available information in the field. ICT in education has, in recent years, emerged as a policy area. Many countries have developed ICT strategies, either as separate strategies or as strands embedded in national strategies for education or for the development of the

information society at large in the country. The strategies and their underlying rationales share many common features. Kozma (2008) has identified important reasons for investing in ICT for education.

- To support economic growth mainly by developing human capital and increasing the productivity of the workforce.
- To promote social development by sharing knowledge, fostering cultural creativity, increasing democratic participation, improving access to government services and enhancing social cohesion.
- To advance education reform, i.e. major curriculum revisions, shifts in pedagogy or assessment changes.
- To support educational management and accountability, with an emphasis on computer-based testing and the use of digital data and management systems.

These features relate the issue of ICT in education to its function in a broader, societal context. The role of ICT in education must also be linked to educational needs. In many countries, the role of ICT is linked to issues of educational attainment and the importance of ICT for advancing robust learning strategies on the side of the students. A second area is ICT as a tool for the support of personalization strategies in teaching and learning. ICT can also be used to increase visualization and variation in many subjects. As a greater proportion of our homes are linked to the Internet, the role of ICT, AI, IOT, m-platform in home/ college access is now being exploited. Many children start to use ICT at an early age, and the home and the family are, in many cases, an arena for the initial acquisition of digital skills. Thus, education has a role to play in furthering these skills, based on pedagogical principles. Our educational systems should bear in mind that ICT should be an integral part of learning, in order to provide learners from families with a low socio-economic status with necessary digital skills for learning, work and life in order to avoid digital divides (Farrell, Glen, Isaacs, Shafika and Trucano, Michael, 2007c).

One of the most significant studies to date is the ImpaCT2 report from 2002 (Harrison et al., 2002). The study shows that ICT, AI, IOT, m-platform leads to statistically significant improvements in some subjects, whereas there are no significant improvements in other studies. The OECD, through its work on the PISA studies, has been able to demonstrate interesting correlations between home access and use of ICT on the one hand and PISA score on the other hand. The relation between ICT use at college and PISA score is far more complex. So far, these correlations have not been explained. The study 'E-learning Nordic' (Van Reijswoud, 2009), which looks at the perceived impact of ICT, shows that all stakeholders (students, parents, teachers, principals) believe that ICT can have a positive impact on teaching and learning. The studies and reports mentioned above represent a plethora of studies (Glenn & Gordon, 1998).

A. MULTI-CHANNEL: ICT IN EDUCATION COVERS A WIDE SPECTRUM

The first pillar of my approach to a sustainable knowledge base is the realization that ICT in education covers a wide spectrum — both thematically and along the administration–pedagogy axis. This is a consequence of the incremental integration of ICT into all domains of education. Cuban (2001) has highlighted this in his work, and he acknowledges that ICT strategies in many countries cut across diverse fields.

- Infrastructure development is necessary in order to ensure access to colleges, networks and resources for learning.
- Teacher training, both initial and in-service, is a prerequisite for the ability of education to use ICT in learning processes.
- Technical assistance is needed both in the administrative as well as in the pedagogical domain.
- Curricula and pedagogical approaches may have to be changed in order to cater for educational change with ICT.
- Content development is necessary in order to facilitate the interactive potential ICT can offer in the teaching and learning process. In my opinion, a multi-channel approach to the knowledge base is necessary in order to be able to ask the right questions and to grasp the plethora of issues related to ICT in education. Let me elaborate on a few issues.
- It is necessary to continue the monitoring of infrastructure development. Although many countries have developed a superb infrastructure, access to ICT AI, IOT, m-platform is still an issue in many European countries. This is truly the case if you look at access issues on a global scale. The same goes for the need for monitoring the evolving patterns of use. We need to be able to assess the speed of uptake of different technologies for learning as well as assessing the degree of variation across the spectrum of learning technologies. A particular challenge with regard to monitoring the patterns of use is the high degree of technological and cultural diversity that is to be expected in many countries around the globe.
- Gender issues are visible. PISA data show that although the gap between genders is closing, there are still interesting differences to be found with regard to patterns of use. A fairly new dimension regarding gender issues is that it might be just as important to study differences within a gender as between genders.
- Digital learning resources (DLR) enabled by AI, IOT, m-platform are characterized by complexity

— a crossroads between pedagogy, technology, IPR and the marketplace. This is an area which, in my opinion, has been under-assessed, and we need a stronger focus both on benchmarking of digital learning resources as well as a research agenda for DLR and learning.

The study explores the use of machine learning techniques in cybersecurity, focusing on prediction and classification models. It discusses various applications of machine learning, such as spam detection, malware detection, and phishing detection. The importance of network security systems and intrusion detection systems (IDS) is highlighted. The paper also discusses the similarities between machine learning and deep learning, emphasizing their role in analyzing network data for intrusion detection. Different datasets and algorithms, including support vector machines, deep belief networks, and convolutional neural networks, are examined. The study concludes by emphasizing the significance of cybersecurity in today's online business landscape and the need for further research to strengthen security using machine and deep learning techniques, including the exploration of combinations of datasets and techniques.

B. ARTIFICIAL INTELLIGENCE (AI) IN SUSTAINABLE EDUCATION

Application of the conceptual framework on a set of indicators is proposed as an exercise to facilitate a comprehensive view at the system level (sub national, national, regional or global) and at the project level for implementation of AI and ICT in education.

Regarding use in monitoring systems, we propose creating an index based on a set of indicators to help describe the respective system. When applying indicators at the project level, this set of indicators lends support to and organizes the project evaluation process, but in no case is it completely exhaustive, since this process involves many other variables. For purposes of organizing the indicators and associating them to the proposal framework, we have considered the need for input, process and impact indicators, depending on the data type you want to describe and its scope of application. Nonetheless, process indicators are applied exclusively at the project level and refer specifically to the components that each project proposes to develop; consequently, it is defined ad hoc (Billon, Rocio & Lera-Lopez, 2009).

Information and communication technologies (ICT) have become common place entities in all aspects of life. Across the past twenty years, the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavor within business and governance. Within education, ICT has begun to have a presence but the impact has not been as extensive as in other fields. Education is a very socially oriented activity and quality education has traditionally been associated with strong teachers having high degrees of personal contact with learners. The use of ICT in education lends itself to more student-centered learning settings and often this creates some tensions for some teachers and students. But with the world moving rapidly into digital media and information, the role of ICT in education is becoming more and more important and this importance will continue to grow and develop in the 21st century. This paper highlights the various impacts of ICT on contemporary learnings of the students in education and explores the potential for future developments. The paper argues the role of ICT in transforming teaching and learning and seeks to explore the awareness of teacher educators about use of information and communication technology for effective teaching learning process and how this will impact on the way programs will be offered and delivered in the learning process in the institutions (Sahay & Walsham, 2006).

C. FRAMEWORK OF LEARNINGS OF ICT USING IOT

Information and communication technologies (ICT) have become commonplace entities in all aspects of life. Across the past twenty years the use of ICT has fundamentally changed the practices and procedures of nearly all forms of endeavor within business and governance. Education is a very socially oriented activity and quality education has traditionally been associated with strong teachers having high degrees of personal contact with learners. Information communication technologies (ICT) at present are influencing every aspect of human life. They are playing salient roles in learning places, business, education, and entertainment. Moreover, many students recognize ICTs as catalysts for change; change in learning conditions, handling and exchanging information, teaching methods, learning approaches, scientific research, and in accessing information.

The use of ICT in education lends itself to more student-centered learning settings. But with the world moving rapidly into digital media and information, the role of ICT in education is becoming more and more important and this importance will continue to grow and develop in the 21st century. In this paper, a literature review regarding the use of ICTs in education was provided. Effective use of ICT for education, along with ICT use in the teaching learning process; quality and accessibility of education; learning motivation. Learning environment, and ICT and scholastic performance are important factors.

The institute level ICT issues having dominant influence on ICT, AI, IOT, m-platform outcomes as supported by multiple research evidences from the literature have been identified for empirical investigation under the study. Variables having similarity of concepts, or those contributing to the same result(s), have been grouped together in terms of macro variables. These antecedents are listed below:

(a)ICT enhancing teaching and learning process Measured in terms of potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate college experience to learning practices, create economic viability for tomorrow's learning, as well as strengthening teaching and helping institutes change (Trucano, 2005).

(b)ICT enhancing the quality and accessibility of education

Measured in terms of increase in the flexibility of delivery of education so that learners can access knowledge anytime and from anywhere. It can influence the way students are taught and how they learn as now the processes are learner driven and not by teachers and seamless communications technologies support 24x7 teaching and learning (Moore & Kearsley, 1996).

(c)ICT enhancing learning Environment

Measured in terms of enhancing critical thinking, research, and evaluation skills are growing in importance as students have increasing volumes of information from a variety of sources (Sahay, & Walsham, 2006).

(d)Provides Learning Discretion to students and faculty

Measured in terms of (i) freedom to develop ideas, (ii) own boss, (iii) autonomy of learning methods, (iv) autonomy of judgment, (v) autonomy of abilities, (vi) autonomy in selection of business ideas, (vii) autonomy of decision-making and (viii) autonomy of job (Kendall, Kendall, & Kah, 2006).

(e)Provides Flexibility to students to learn at their ease

Measured in terms of (i) learning performance (in terms of time, amount, quality, and timeliness), (ii) clarity of standards of performance, (iii) absence of standard operating procedures, (iv) written rules and procedures and (v) administrative processes (Gholami, Anon Higon, Hanafizadeh, & Emrouznejad, 2010).

(f)Intelligence Generation by students through ICT

Measured in terms of (i) good communication, (ii) polling end users, (iii) intelligence generated independently (by different departments), (iv) periodical review, (v) collection of macroeconomic information, (vi) maintaining contacts (with regulatory bodies), (vii) evaluating information on social trends, (viii) spending time with suppliers and (ix) few students collecting information (Cuban, 2001).

(g)Intelligence Dissemination by students through ICT

Measured in terms of (i) spending time discussing student needs, (ii) periodical study material circulation, (iii) cross functional meetings, (iv) inter-departmental meetings, (v) spending time sharing information about technology and (vi) information spreading at all levels (Farrell, Glen and Isaacs, Shafi ka, 2007a, Farrell, Glen, Isaacs, Shafi ka and Trucano, Michael, 2007c).

(h)Time Availability through ICT using ICT

Measured in terms of (i) not too heavy learning load (design of learning methods), (ii) plenty of time, (iii) right amount of time and learning load, (iv) little time to think about wider

institutional problems, (v) learning with time constraints and (vi) time for long-term problem solving (Kozma, 2008).

C. RESEARCH METHODOLOGY

A review of literature has identified key dimensions of a supportive environment for ICT. ICT has become ubiquitous in all areas of life, transforming practices and procedures in business and governance. While ICT has made some inroads in education, its impact has not been as extensive as in other fields. Education, being a socially oriented activity, has traditionally relied on strong teachers with personal contact with learners. The use of ICT in education often creates tensions for some teachers and students as it promotes more student-centered learning settings.

Based on the literature survey, a conceptual model for ICT, AI, IOT, and m-platform outcomes has been developed. Study variables and relevant constructs have been identified and defined. Research hypotheses have been formulated for each area. A questionnaire-based survey was conducted in educational institutes in India, with the unit of analysis being the institute and its teaching initiatives. The questionnaire was designed using inputs from the literature survey and empirical case studies. A total of 389 responses were obtained from 29 institutes across India, with some institutes providing multiple responses. The qualitative data collected through the survey has been validated, and statistical analysis has been performed to test the research hypotheses. The conceptual model of ICT outcomes, derived from the literature survey, has been empirically tested through analysis of the survey responses.

The study acknowledges its limitations and suggests potential future research extensions. It aims to provide guidance to institutes for the effective implementation of ICT and to explore new frontiers in distance learning. The study is divided into three phases: a pilot study to identify the role of ICT, and a questionnaire study to establish relationships related to ICT's role.

A. METHODOLOGY FOR THE QUESTIONNAIRE STUDY

This part of the study aims to establish relationships between the research variables using a questionnaire survey method. The unit of analysis is the institute, and the questionnaire was developed, pre-tested, and sent to the selected institutes. Correlation analysis is used to understand the correlation among the variables, while cross case analysis is used to identify differences between education sectors. The hypotheses, based on the conceptual model developed in this chapter, are statistically tested using stepwise multiple regression technique. The results are synthesized to identify the role that impacts ICT outcomes. Multivariate statistical tools, including the moderator method and structural equation modeling, are used to identify the interrelationships between the different roles and ICT outcomes.

4. DATA ANALYSIS

Principal component factor analysis was conducted to test the construct validity of the role and ICT outcome variables. The extraction method resulted in ten factors with eigenvalues greater than 1.0, explaining a collective variance of 94.16%. These factors, obtained after varimax rotation, are presented in Table 1, including variables such as Management Support, Learning Discretion, Flexibility in accessing study material, Intelligence Generation, Intelligence Dissemination, Time Availability, Education, and Learning outcomes.

A total of 389 student respondents provided data for the questionnaire. Data editing was performed to detect errors and omissions in the responses. The reliability of respondents' answers was tested through control questions incorporated in the questionnaire. Three responses were rejected due to contradictory answers to control questions. Additionally, some respondents did not answer all sections of the questionnaire, responding only to relevant sections based on their actual experiences during ICT implementation. Data analysis was conducted using the 'Software Package for Social Sciences' (SPSS) Version 10.0.

The analysis reveals that ICT facilitates communication, information sharing, and improved feedback within teams. However, limited technical knowledge can hinder student access to ICT.

TABLE 1: MODEL SUMMARY FOR ICT OUTCOMES

Model	R	R Square	AdjustedR Square	Std. Error of the Estimate
1	.851(a)	.725	.679	.70563

a Predictors: (Constant), ICT helps teams in communicating, sharing information, and providing better feedback., Lack of technical knowledge impacts student's access to ICT., Online modules help students to perform better., ICT helps in changing education and business administration., ICT enhances student's access to education (online modules),, ICT help by facilitating the acquisition of basic skills., ICT help in enhancing the student's motivation and engagement.

TABLE 2: ANOVA FOR ICT AND STUDENTS' OUTCOMES

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	55.088	7	7.870	15.805	.000(a)
	Residual	20.912	42	.498		
	Total	76.000	49			

a Predictors: (Constant), ICT helps teams in communicating, sharing information, and providing better feedback., Lack of technical knowledge impacts student's access to ICT., Online modules help students to perform better., ICT helps in changing education and business administration., ICT enhances student's access to education (online modules),, ICT help by facilitating the acquisition of basic skills., ICT help in enhancing the student's motivation and engagement.

b Dependent Variable: ICT help in enhancing the quality of education.

Table 3: Coefficients for ICT and Students Outcomes

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.458	.846		-.542	.591
	ICT help in enhancing the student's motivation and engagement.	.452	.149	.415	3.030	.004

	ICT help by facilitating the acquisition of basic skills.	.212	.134	.207	1.577	.122
	Lack of technical knowledge impacts student's access to ICT.	.235	.093	.239	2.529	.015
	ICT enhances student's access to education (online Modules)	.240	.126	.206	1.914	.063
	Online modules help students to perform better.	.001	.131	.001	.011	.991
	ICT helps in changing education and business	.047	.132	.035	.358	.722

a Dependent Variable: ICT help in enhancing the quality of education.

Moreover, the study also shows that Online modules help students to perform better., ICT helps in changing education and business administration., ICT enhances student's access to education (online modules)., ICT help by facilitating the acquisition of basic skills., ICT help in enhancing the student's motivation and engagement.

It is seen from Table 2 and 3 that all variables, as originally envisaged, are included in the constructs Management Support, Learning Discretion, Intelligence Dissemination, Education and Learning outcomes. The macro variable Intelligence Dissemination show loading on Spending Time Discussing Student Needs, Periodical Study material Circulation, Cross Functional Meetings, Inter-departmental Meetings, Spending Time Sharing Information about subject matter. These items have been included in the respective constructs. Thus, the factor analysis of the role and ICT outcomes constitutes the validity of these antecedents' and ICT outcomes constructs. These items have been included in the final questionnaire for survey study (Table 4).

Table 4: Analysis of ICT doing the most useful task for the students.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	self study	41	41.0	41.0	41.0
	contribution forum	16	16.0	16.0	57.0
	contribution chat	14	14.0	14.0	71.0
	collaborative task	19	19.0	19.0	90.0
	submission in your e-portfolio	3	3.0	3.0	93.0
	checking/readier links/contents in a list of resources	7	7.0	7.0	100.0
	Total	100	100.0	100.0	

Table 4 shows that the variables originally envisaged in the study have been included. The study shows that ICT helps students in enhancing self-study, participation of the students in contribution forum, enhances learning through contribution chat, collaborative task. It is seen

in the analysis that ICT also encourages students' submission in the e-portfolio, and also encourages students in checking/reading links/contents in a list of resources. This implies that ICT implementation has helped in achieving distance learning programmes objectives of reaching the masses.

The major predictors as per the hypotheses accepted relate to independent variables namely Intelligence Dissemination (ID), Management Support (MS) and Learning Discretion (WD), which are either immediately preceding the dependent variables or at the best having a second level impact. The most critical among these variables is Intelligence Dissemination.

Hence, the institutes intending to promote ICT should have proper processes such as regular interdepartmental meetings to ensure the proper dispersion of valuable information. This will help the institutes to get the critical expertise and information to serve the students better. Moreover, without providing the autonomy and financial support to the students for developing the ideas, they will not be able to generate/develop ideas.

5. CONCLUSION

ICTs and AI have significantly impacted the field of education, transforming teaching, learning, and research. These technologies have the potential to enhance skills, motivate students, connect learning experiences, ensure economic viability, and support teaching practices. In today's rapidly changing world, access to and application of information through ICTs are crucial for basic education. Conventional teaching approaches have focused on content delivery, but contemporary settings emphasize competency and performance-based curricula, prioritizing how information is used rather than what it is.

ICTs can effectively support these requirements, and there are numerous exemplary instances of world-class settings that utilize these technologies to facilitate competency and performance-based curricula. The integration of ICTs in teaching and learning processes brings about a flexible time-space dynamic, fostering increased interaction and information reception. This opens up new scenarios for both individual and collaborative learning, transforming communication models and teaching methods. ICTs, AI, IOT, and m-platforms act as catalysts for change in education. They encourage and support independent learning, immersing students in the learning process. As more students utilize computers as information sources and cognitive tools, the influence of technology on how students learn continues to grow. The study emphasizes that students engaged in learning through ICTs experience a transformational impact, paving the way for enhanced learning experiences (Farrell, Glen, Isaacs, Shafi ka, Trucano, Michael, 2007b).

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