Smart Technologies for Artificial Intelligence supporting the Learning Skills of University Educators

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ABSTRACT

The purpose of this research paper is to stress on the latest developments in the Information Technology field which could impact the teaching/learning skills of the University Faculty. The study aims to focus on the application of the latest Artificial intelligence Technologies like IoT/Web3.0/Machine learning/Robotics technologies which would help in teaching skills of University Faculty. Secondary data from well-known journals, books, conference proceedings, reports and websites are used in the preparation of this paper. The very application of the latest AI technologies (Machine Learning, Robotics, IoT, Ubiquitous computing, Web 3.0) has aided achieving skill competencies particularly cognitive skills in every field. Also, AI has helped researchers in getting near perfect information through ChatGPT and helped them rectify semantic and spelling mistakes through AI applications like Grammarly. It is recommended that to solve problems encountered while employing traditional face-to-face teaching methods/offline methods we should use the latest AI today. It is a Case Study paper.

Keywords: Skill, Machine Learning, Robotics, IoT, Ubiquitous Computing, Web 3.0.

1. INTRODUCTION:

In addition to current technologies like web 2.0 (dynamic websites along with social networks with video conferencing facilities), researchers are looking to bring in Artificial intelligence (Machine learning, IoT, Ubiquitous computing, Web 3.0 and Robotics) into the discussion for teaching competence of University Educators.

The phenomenon of achieving computational ability to achieve goals through intelligent machines/computer programs/computers for understanding human intelligence is called as Artificial Intelligence (Hunt, E. B., 2014). [1]. With networked computers becoming a reality in all places, it became a necessity to consider the entire network as one, big intelligent brain with much distribution – called distributed intelligence (Warwick, K., 2012). [2]. AI technologies are used in different processes (Berente, N. et al., 2021). [3].

The biggest innovations have come in two topics: perception and cognition. In the perception category big changes are happening in speech. Voice recognition apps - think Siri, Alexa, and Google Assistant far from perfect are used by lakhs if not crores of users across the world. The cognition and problem-solving have seen a major improvement. Machine Learning systems were used by Google's DeepMind team to improve the data center's cooling efficiency by more than 15%, after human experts optimized them [4]. Both PayPal to prevent money laundering and cybersecurity company Deep Instinct to detect malware use Intelligent agents (Brynjolfsson, E. et al., 2017). [4]. "Turing Test" is primarily based on the notion of using the computer ability to get human-level performance in cognition-based tasks. There are two subtypes of AI in medicine: First, the virtual part ranges from electronic health data applications to neural network-based support in the treatment process. The second, physical part deals with carrying out surgeries and intelligent prostheses for handicapped people using the services of the robots (Amisha, Malik et al., 2019). [5]. The term AI is reflected in given below tools:
• Gaming (Chess)
• Theorem-proving and Symbolic reasoning (Logic Theorist, MACSYMA)
• Robotics (Humanoid Robots Sophia)
• Vision (facial recognition)
• Natural language processing, Speech Recognition (Siri, Alexa)
•Evolutionary & Distributed AI (drone swarms) (Venkatasubramanian, V., 2019). [6]

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2. OBJECTIVES:

The research study aims

1) To investigate how the latest ICT smart technologies like Artificial Intelligence (AI) and AI-related technologies like Machine learning, Robotics, Ubiquitous computing, IoT and Web 3.0 can be leveraged to be used in Higher Education.
2) SWOC Analysis of the different AI technologies used in the Education sector.

3. LITERATURE REVIEW:

AI-aided education includes prediction, intelligent education, data analysis and innovative virtual learning. Emerging technologies like Embedded computers and sensors have facilitated the transfer of artificial intelligence to machines, buildings and robots (Chen, L. et al., 2020). [7]. AI can match 53% of adult competence level and are closing in on another 36% competence level as in the OECD survey.

First implementing AI-based tools to aid learning and the second employing AI tools to help in learning are the two complementary strands in AI in Education (AIEd) (Holmes, W. et al., 2020). [8]. Learning issues are solved using AI techniques in three different paradigms. In Paradigm One, to describe knowledge models and direct cognitive learning AI is employed where the beneficiaries of AI service are learners. In Paradigm Two, learners act as co-workers with AI to support learning. AI allows learners take the help of agency to learn in Paradigm Three (Ouyang, F. et al., 2021). [9]. Both AIEd and educational technology are computer applications, that challenge the teacher's role, change the idea of class strength, and pedagogy (Schiff, D., 2021). [10]. There are 3 viewpoints on the growth of AI. The first viewpoint is "education for understanding AI", the second viewpoint is "education using AI", and the third viewpoint is "AI expert training" (Paek S, & Kim N., 2021). [11]. Structured learning design changes learning to the individual strongpoints, likings, requirements and ambitions of a learner is called Personalised learning (Tapalova, O. et al., 2022). [12]. Now AI is applied in areas like visual/voice recognition, smart devices, IoT and robots. Probable research issues of AIEd are the following:

1. Designing Learning models based on AI
2. Assessment systems on AI for student learning
3. Viewpoints based Performance inquiry of learning systems
4. Considering roles of AI in education for Reevaluating and readdressing the existing educational theories
5. Giving creative AI-supported learning strategies
6. Reassessing and relook current learning tools to content learning using AI
7. Analyze learning systems through Big data analytics
8. Implementing ethical guidelines for using AI in education
9. Human-AI collaboration (Hwang, G. J. et al., 2020). [13].

AI is a promising means for progress and innovation (Nemorin, S. et al., 2022). [14]. Open Learner Models are used in AIEd. Most research in AIEd can be grouped into four subdomains:

1. Reducing teachers' workload
2. Contextualized learning for students
3. Revolutionising assessments
4. Intelligent tutoring systems (ITS) (Chaudhry, M. A. et al., 2022). [15].

Data-driven technologies like AI, can be interpreted to work in more complex ways serving the purpose and functioning of technology in today's society (Knox, J., 2020). [16]. Technology, Pedagogy knowledge, and content knowledge are curiously looked upon by higher education teachers which is clearly described in his weblog (puentedura, 2010). [17]. SAMR and TPCK model (puentedura, 2010) would be required by AI for its widespread usage or large-scale penetration in the higher education sector. Artificial Intelligence (AI) algorithms usage would ensure Fairness, Accountability, Transparency, and Ethics (FATE) in the Education sector. To increase trust AI systems might use eXplainable AI (XAI), to provide transparent answers for decisions AI systems make (Khosravi, H. et al., 2022). [18]. General AI is very different from the "domain-specific AI", which does work on one area/problem – say mastering chess, driving a car, or identifying a photograph as a representation of an individual. The three key models in the AIEd system that are designed to provide appropriate individualized learning to a student are:

• Effective ways of teaching (pedagogical model)
• The topic being learned (domain model)
• The student (learner model)

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An adaptive learning environment is one basic building block for Open Learning models which presents the feedback of learner's achievements, improvements in learning techniques and outcomes which are quite essential in any learning process. AI-based Intelligent Tutoring Systems (ITS) simulate one-to-one human learning activities for learners' cognitive needs and give targeted feedback (Luckin, R. et al., 2016). [19]. Sociotechnical systems are AI systems where humans and machines collaborate with each other (Howard, S. K. et al., 2022). [20]. People across the globe are using AI to perform basic tasks, includes:
• Virtual personal assistants like Siri and Alexa
• Video games
• Self-driving cars
• Purchase prediction tools for companies such as Target and Amazon
• Fraud detection used by banks to protect against credit card fraud (Michelle Zimmerman., 2018). [21]
  Machine behaviour applies in three different scales:
1. The first is **Individual Machine Behaviour:** This element of machine behavior tries to study the behaviour of each AI agents by itself. To study the particular AI agent behavior there are two approaches (within-machine approach and between-machine approach).
2. The second scale is **Collective Machine Behaviour:** This area looks to know the behaviour of AI agents from collective machine behaviour.
3. And finally, the scale of **Hybrid Human-Machine Behaviour:** we could have occasions when the behaviour of AI agents is affected by interactions with humans (Flogie, A. et al., 2022). [22].

The mass usage and deployment of AIEd would result in a cyclic divide of 5 types:
1. Algorithmic divide: diverse vs homogeneous teams implementing and validating algorithms.
2. Interpretation divide: reasonable interpretation of analysis results vs misinterpretation of analysis.
3. Citizenship divide: divide in terms of skills, economy, health and area(civic).
4. Access divide: divide in access vs lack of access to hardware, software, and connectivity.
5. Representation divide: divide in representation vs over-representation of the population in data (Dieterle, E., Dede, C. et al., 2022). [23].

Self-regulated learning is the process of learners using cognitive processes to learn a topic, and metacognitive processes to command and motivate themselves for extended learning (Molenaar, I., 2022) [24]. The "Learning" involves the communication between 8 various neural systems, including processing systems and movements automatization systems (Thomas, M. et al., 2022). [25]. In education ethics in AIEd is a big concern since most ed-tech companies /schools don't know where AI can harm in field of education (Chaudhry, M. A. et al., 2022). [26]. Event-Condition-Action (ECA) model in MAS (Multi-Agent System) architecture is designed to introduce personalisation/adaptivity. The protocol between the client application and the gateway/router/broker is HTTPS (Viswanathan, N. et al., 2022). [27]. The protocol for Gateway/Broker/Router to server Agent communication is often the FIPA(Foundation for Intelligent Physical Agent) protocol in Figure 1.
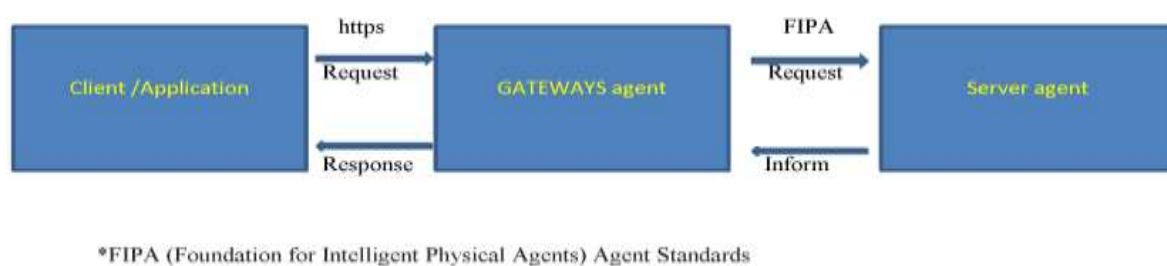

*FIPA (Foundation for Intelligent Physical Agents) Agent Standards

Figure 1 Source: (Nethra Viswanathan et al., 2022). [27]

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Programming computers to apply past data and experience to work out a given problem in fields like Bioinformatics, Education, Computer vision, Pattern recognition and Natural language processing are goals of machine learning. Machine learning is the phenomenon of permitting access to data and letting autonomous learning happen to a machine or model. Imagine the model as a Black box: data input at the start, and different data output at the end – the process called "model training" in machine learning (Kucak, D. et al., 2018). [28]. Machine learning is a mathematical model that helps computers turn into predictors and helps to fight natural disasters(flood/cyclone) and global problems (terrorism) (Nafea, I. T., 2018). [29]. Figure 2 below is sourced from the article (Villegas-Ch, William et al., 2020). which shows the phases involved in the integration of machine learning in LMS [30].
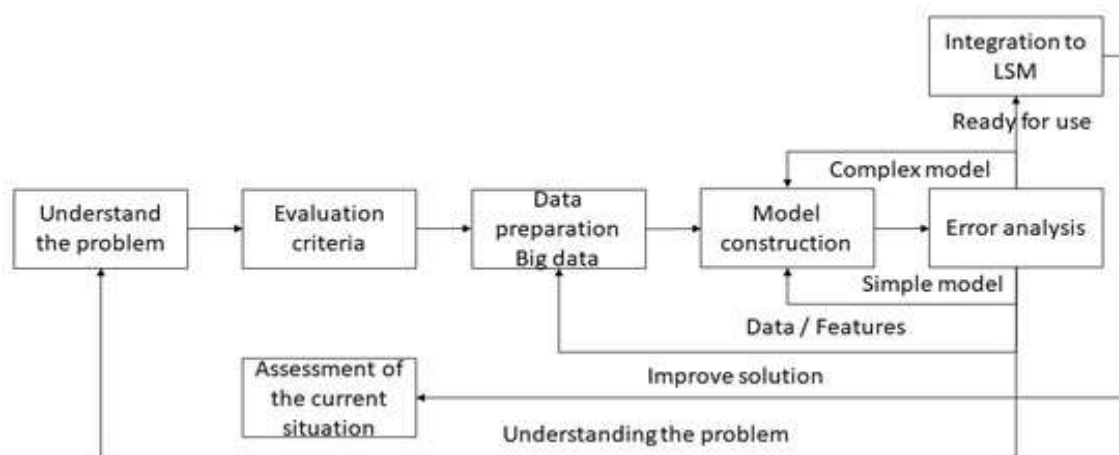
Figure 2: The phases involved in the integration of machine learning in LMS (Villegas-Ch, William et al., 2020). [30]

The above figure 2 shows an integration of the Machine learning model onto the existing LMS in phases:

1. First try to know the problem to solve the problem. If you don't know the sector or area of the problem thoroughly then it is a prerequisite that you know the sector through the literature available online or through experts in industry or academia.
2. To understand the data one can do statistical analysis using mathematical tools like correlation, regression, normal distribution, probability model and other descriptive statistics can be done on the data to better understand the data.
3. Evaluation criteria is one value which can be used to evaluate the data collected, usually this is the error value or significance of confidence or alpha value or p-value. This can be the root mean square error value for regression analysis.
4. Assessment of the current solution. For evaluating a student's grade over a period in a course, the teacher has to determine the average marks of a student in that course over a particular period. Machine learning solution is required mostly to prove that the current solution is slower than more intelligent spreadsheet solutions or any other intelligent software.
5. Prepare the data. While preparing or collecting the data one has to collect the data from various sources like databases, files, reports or spreadsheets so that data is heterogeneous and machine learning models can intelligently take the right data from the right sources.
6. Building the model. Once the data is ready, several machine learning free and open-source libraries are available. Machine learning models or libraries would fetch right results using the past results already existing in data repositories.
7. Error analysis. In this phase, the model must do generalization, the capability of machine learning models to generate good results when the new data is entered. It becomes easy to get good results when we iterate the preceding phases many times, the knowledge of the data and the problem will grow and decrease the generalization error.
8. Model integrated into a system. While the model has been tested against error, the machine learning model is integrated into the LMS. Other parts of the system repeatedly communicate with the machine learning model to prepare the data/results which are used in the system. The model warns either manually or automatically (when data error grows), that new data is used to rebuild the ML model. The model can

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collect data through interface construction and the system can make predictions automatically (Villegas-Ch, William et al., 2020). [30].

TinyML is a subset of machine learning (ML) that brings the goodness of ML to embedded systems. TinyMLedu is an architecturally collaborative working group, TinyML4D develops articles based on unique challenges faced by Developing Countries, TinyML4STEM tries to solve problems for STEM disciplines by developing exciting hands-on curricula (Brian, P. et al., 2022). [31]. Supervised learning and unsupervised learning are the two types of machine learning in data mining. The form where input and output layer mappings are done for rule and insights discovery is called Supervised learning. Dataset is grouped according to patterns(similarities) and is represented in compressed format in unsupervised machine learning (YAVUZ, Ö., 2022). [32].

In the future of digital education, seamless virtual and physical access has to be given to every stakeholder such as educators, students and parents. **Table 1** below gives features of existing Telepresence Robots which are being used in university and college premises in Europe (Wernbacher, T. et al., 2022). [33].

Table 1: Different Telepresence Robots and their features

Model → Feature	Double 3	Ohmni robot	Boteys-Pad ++	Padbot P2	UBbO Expert
Encryption	WebRTC 128-bit AES	WebRTC 256-bit AES	WebRTC 128-bit AES	AES and TLS	WebRTC 128-bit AES
Screen size	9.7"	10.1"	11"	10"	13.3"
Display resolution	1280×720	1280×800	2560x1600	1280×720	1280×720

Figure 3 below is different Telepresence Robots that are used in distance classroom from left to right: GoBe , Double 3 , Ohmni Robot , BotEyesPad++(Samsung Galaxy S7), PadBot P2 , UBBO Expert

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said Educators who used telepresence robots as more credible than automated robot instructors (Lei, M. et al., 2022). [34]. The students who received robotics-assisted programming education were having higher academic success, problem-solving skills and motivation (Cam, E. et al., 2022). [35].

Table 2 given below gives the roles of robotics in language, science and technological education (Mubin, O. et al., 2013). [36].

Discipline	Tutor	Peer	Tool
Language	Remembering vocabulary becomes easy with help of robots.	The robot says well done when student pronounces the word accurately.	By playing games with a robot a student learns phrases in another language.
Science	The robot creates the arithmetic exercises based on the performance of the student.	The exercises in a science class are solved collaboratively by both student and robot.	Students learn about physics by seeing sensors and actuators in robots.
Technology	Difficulty of the programming task is learned by students through robots.	When the students successfully program the robot, which plays a happy animation sound.	To learn about programming, students use LEGO Mindstorms NXT.

Honda starts research into two-legged human robots in 1986. **Figure 4** below shows a Humanoid Robot that can do all the activities (Sowmiya, S. et al., 2022). [37].

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Figure 4: Humanoid Robot (Sowmiya, S. et al., 2022). [37]

The body/frame, control system, manipulators, and drivetrain are the components of a robot.

1) Body/frame: The frame of any shape and size provides the physical structure to the robot.

2) Control System: The control system controls and coordinates all actions of the robot, is same as the central nervous system of a human. Sensors provide input(feedback) from the robot's environment(nearby places), which is forwarded to the Central Processing Unit (CPU) for processing.

3) Manipulators: Robots have to interact with their environment to do their jobs properly. Sometimes they need to displace objects from their environments without instruction of operators(human). A robot can exist without a manipulator but not without a body or control system.

4) Drivetrain: Robots have to move to new place from the existing location for doing their job. They require a Drivetrain for this mobility, Humanoid robots use legs, whereas other robots use wheeled solutions as described in website [38].

Google search is the search engine used in the searching the literature available in the internet domain. **Table 3** given below gives an account of the literature available in the internet domain published in 2021 and 2022 with the keywords AI, MOOCs, smart cities and Robotics related to the title of the paper.

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Table 3: Related literature to Topics AI, MOOCs, smart cities and robotics

S.No	Keyword	Methodology	Contribution	Research Gaps	Reference
1.	Artificial intelligence	Data from secondary resources are used.	The paper highlights on the different Ethical issues like improper use of technology, racism, safety issues and biased malware-ridden algorithms in applications or designing AI. So the paper also gives general solutions to these problems.	More details on applications-specific events like what are the ethical issues in language processing, autonomous cars or gadgets, predictive policy and many more.	(Nasim, S. F. et al., 2022). [39]
2.	Artificial intelligence	This report is the result of study by engaging to a broader, multidisciplinary community of scholars.	The 2021 Study Panel prepared this report.	Lengthy questions and answers make readers lose interest quickly. References should have been given which is missing sadly.	(Littman, M. L. et al., 2022). [40]
3.	AI and smart cities	Summary from secondary data collected from various literature sources are used for the preparation of the paper.	This paper shows business and technical problems of artificial intelligence and blockchain centered smart city design.	More data and tables would have made paper easy to understand for laymen.	(Singh, J. et al., 2022). [41]
4.	AI in education	Secondary data from various literatures are discussed in brief manner.	The paper talks about different areas where AI can be leveraged and how it can be best used in the Education field and list of	Numeric data support for various claims is missing.	(Sarhan M. Musa. et al., 2021). [42]

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			educational institutes which are already using AI in the learning process.	
5.	MOOCs	Sampling Scopus and WOS journal papers were subjected to analysis of which only papers with MOOCs were selected and finally authors had found that only 6 clusters were relevant; others were just redundant data or papers.ML and VNA tools were used for extensive analysis and elimination.	Identifying only good and relevant research work is possible with this method which otherwise done manually would have required a lot of people-time and effort.	Authors did not give a proper reason why the distribution curve for research on MOOCs is increasing from 2012 - 2018 and then goes downwards.	(Despujol, I. et al., 2022). [43]
6.	Robotics Learning	The paper is taking an effort in modelling Robotics learning in a safe environment with mathematical theories like cost function and probability theory as the real world is a proper mix of model and data-driven approaches.	Mathematical notion of safety constraints in probabilistic, hard and soft ways.	Too many details make the whole paper confusing.	(Brunke, L. et al., 2022). [44]

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7.	AI robots	Paper reviewed 50 different applications of robots. Each application was analysed for its engineering characteristics and potential impact on the COVID-19 pandemic.	AI robots like Cleaning Robot, XDBot, dis-infecting robots, Portable hand sanitizer robots, Aerosol Disinfection Robot, autonomous service delivery, Smart patrol robot, and self-driving delivery vehicles are dealt with in this article.	Article only touches upon the technical side of these AI devices but missing economical consideration is making it difficult to penetrate into the homes of the masses.	(Zhao Z. et al., 2022). [45]
8.	Robot's influence on humans	Experiment was carried out on participants who received instruction on waste disposal from 2 modes: computer mode and robots(humanoid) mode. Participants subjected to humanoid mode had more impact on sorting of waste for waste disposal.	Robots influence humans because of their anthropomorphic features. This survey results can be used in a variety of applications like traffic rules enforcements, Queue enforcements in crowded places for exit and entry activity.	The instructions given to the participants missing in the article and voice modulation (female or male frequency) were also missing.	(Lo, S. et al., 2022). [46]
9.	Robotics and swarming	The paper studies different papers on insect evolution, habits, their movement and correlates it to the intelligent robots which can benefit	Insect behaviours like swarming, and sensory-motor coordination are vital to the development of efficient fast robots in the present era.	Paper lacks an algorithm for the simple robotic task in natural language.	(de Croon, G. C.et al., 2022). [47]

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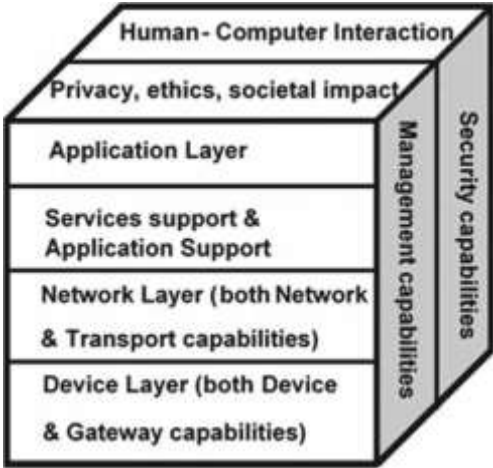|					
		from intelligent living creatures.			
10.	Robotics and student motivation	A 2-years study process involving teachers and students was conducted for getting the data and study revolves around the same data.	A student's motivation, engagement, and concentration can be increased is the reason for employing humanoid robots in the educational system. Robots can be constructed for the multiple roles of peer, tutor or teacher.	Paper does not explain how it solves complex problems like weather, economy etc.	(Ekström, S., & Pareto, L., 2022). [48]
11.	Robotics and reflective learning.	Study is conducted on classroom participants involving human students and humanoid teachers during learning sessions involving definite process and learning aids.	The paper confidently says robots can be used for solving complex numeric problems by using a sequence of reflective learning (hooking => motivation => curiosity => challenge)	Paper doesn't have algorithms or step-by-step procedures for learning which would further simplify the process.	(Cruz-Ramírez, S. R. et al., 2022). [49]

4. MATERIALS AND METHODS:

Google search is a useful tool or search engine extensively used to carry out the research work by going through the literature available in Journals, Blogs, Books and Conference proceedings. The researcher finds that choosing the right content from lakhs of literature is not an easy task after the careful elimination of some topics that are fully out of context. The methodology adopted in this study is the citation or reference method. The reason for choosing AI-related technologies is that the future is total computerisation since Industry 4.0 wants total digitalisation/smart factories and cities where each subsystem is connected with one another to give its citizens an ease of living which the government must provide by smart governance.

5. RESULTS AND DISCUSSION:

Google search is the search engine used extensively for carrying out the research. Keywords used for the study are Artificial intelligence, Machine learning, Robotics, IoT, Ubiquitous Computing, Web 3.0.

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Table 4. Details of findings available for the keywords mentioned above related to the title of the paper.

S. No	Keywords	Secondary data from Literature
1.	Artificial Intelligence	If we want to develop AI tools for all actors then there should be integration of AI and big data and that tool should be used in an ethical manner (Laï, M. C. et al., 2020). [50].
2.	Machine learning	The ML algorithms "learn" to identify patterns and disturbances/noise in data from intelligent sensors without programming (Kuleto, V. et al., 2021). [51].
3.	Robotics	Robots are everywhere starting from analyzing stocks, working alongside humans in factories, interacting with customers and fighting alongside soldiers on battlefields (Aoun, J. E., 2017). [52]. For class sizes of more than 10 or 20, the Nao robot costing £6.5k per unit makes it an impracticable solution. The e-puck, which cost £ 700 per vehicle, is used for research into swarms and collectives and cannot be used for class sizes of 50 or more (Arvin, F. et al., 2019). [53]. A fully autonomous robot can displace itself or some of its parts throughout, acquire information about the environment, work for long period, keep away from environment that are harmful to people, property, or itself without manual operation (Zahariev, R. Z. et al., 2019). [54]. Object Detection and Recognition, Predictive Maintenance, Gesture and Speech Recognition, Robotic Surgery, Medical applications, Military robotics, Service robotics, Robotics manufacturing are areas where AI, ML, and DL are used (Soori, M. et al., 2023). [55]. Industry 4.0 skills; simulated virtual learning; interdisciplinary teaching, problem solving, team work, and project-based learning (PBL) can be associated with Educational Robotic aided Learning (Chaka, C., 2023). [56].
4.	IoT	The IoT which links people, processes, devices and data also called Internet of Everything/data/anything/people/Processes playing a pivotal role in teaching, learning and assessment enabling the people of the educational area to transform data into valuable information (Pai, S. S. et al., 2017). [57]. Three important components of IoT are hardware (Sensors and embedded hardware), the Middleware (storage and data analytics tools), the Presentation (visualization tools) (Agarwal, P. et al., 2021). [58]. The IoT architecture in **Figure 1** consists of the application layer representing an IoT applications interface. The service and application support layer help some generic and specific applications. The network layer performs the network & transport layers tasks in Open Systems Interconnection (OSI) model. The device layer performs tasks of the physical layer (Ramlowat, D. D. et al., 2019). [59]. The **Figure 1** IoT architecture

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Figure 1 Source : (Ramlowat, D. D. et al., 2019). [59].
The Internet is also the network of all types of objects like cars, medical tools, manufacturing systems, traffic equipment people, animals, and houses connecting to each other (Al-Malah, D. K. A. R. et al., 2020). [60].
IoT can boost, support, and stimulate lifelong study (Chweya, R. et al., 2020) [61].

5.	Ubiquitous Computing	In Internet of Things (IoT) based systems the service reliability/concentration are satisfied by the ubiquitous computing systems (Suma, V., 2021) [62]. The experience model can be used to calculate the experience score using the history, ubiquity, reliability and transitivity parameters of Ubiquitous Computing devices to create a security system based on ubiquitous systems (Mhetre, N. A. et al., 2021). [63]. Serving the anytime and anywhere right information based on the learners' requirement is the purpose of ubiquitous learning. There are three entities in ubiquitous learning namely: learning collaborators, learning contents, and learning services (Suartama, I. et al., 2020). [64].
6.	Web 3.0	Intelligent web or 'semantic web' where services are providing most relevant data according to users' preference/interest (Powell, M. et al., 2012). [65]. Main principles of Web 3.0 framework: ▪ Intelligent Web ▪ Organized Information ▪ Openness ▪ Interoperability ▪ Global Database ▪ 3D Visualization Main tools associated with web 3.0 are intelligent systems, semantic web, decentralization, metaverse, digital assets (Miranda, P. et al., 2014). [66].

From the secondary data gathered from the literature, we can say that AI is the future with computational ability to achieve goals through simulating human intelligence. The two categories where much of the work is happening is perception and cognition. In perception the text recognition and processing are almost over and voice recognition also the major advancements are made. The applications where we can

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find them are text recognition is in ChatGPT and Voice recognition in Alexa/Google Assistant. Image recognition application was available long ago so text, voice and Image recognition (perception module) were completed. Now comes the learning from the environment and other systems here there are some problems since here we need to have robots learning from other systems and operators(humans). Learning from other systems is easy since these are machines so we need machine-to-machine interaction for learning whereas human–computer interaction is not that easy since a human can talk, and make non-verbal communication like sign language while conveying something. Human-computer interaction is a challenge but a vast amount of work is done already. Now robots a complex simulated artificial(autonomous) intelligence machine which has all the component of AI like machine learning, Deep learning, and IoT features like sensors for obstacle finding, temperature measuring or a fire alarm. It may also have a Web 3.0 Component for reading from the internet for getting new data. Ubiquitous computing is smart Technology employed for driving drones for laser display in big events or group of robots carrying out complex task with divide and conquer methodology where each individual robot is assigned part of the complex task like software design, and other working on development and some other looking for existing component from the internet. So bigger task can be easily be solved by breaking into simpler tasks.

Google search is the search engine used for SWOC findings and tabulated in format to produce SWOC analysis below. The Strength, Weakness, Opportunities, and Challenges of AI technologies are given in **Table 5** below.

Table 5: SWOC ANALYSIS OF AI Technologies in Education

Strength	Weaknesses
i. Future smart Innovative AI-based library services like chatbots/Expert systems for Reference/automated services (Ali, M. Y. et al., 2022). [67].	i. Telecommunications infrastructure is needed for most of AI components like virtual Reality, Augumented reality (Hardjanto, R. W., 2022). [70].
i. Data-driven knowledge of lot of visitors to the digital library and users of its services ultimately end up having lot of data which when analysed can be used for scaling up their business or expansion wherever there is demand (Ali, M. Y. et al., 2022). [67].	i. Ineffective links among academia and industry; turning into modest innovation potential (Angelova, G. et al., 2021). [71].
i. An expert knowledge for infusing engineering knowledge in training of ML algorithms (Hajizadeh Y., 2019). [68].	i. A critical weakness is that if there are many systematic errors in the dataset, then network will make systematic errors itself (Dobbelaere, M. R. et al., 2021). [72].
v. Improving production performance of agricultural organizations by reducing cost using predictions based on historical climate and environmental data through AI (A. V. Rozhkova. et al., 2022). [69].	
v. Increasing the level of knowledge, optimizing management decisions and business processes (A. V. Rozhkova et al., 2022). [69].	
Opportunities	Challenges
i. Many key deployed AI solutions are related to business process optimisation which improves business efficiency (Eager, J. et al., 2020). [73].	i. AI usage may involve taking data from the patient and doing data analysis on those data. So consent is required for doing data processing AI (Gerke, S. et al., 2020). [75].
i. In February 2020, halicin (an antibiotic) was discovered which prevents further growth of E. coli bacteria using machine learning (Eager, J. et al., 2020). [73].	i. Characteristics 1) high transparency, 2) vulnerabilities, and 3) limited training data learning must be there in AI military applications (Svenmarck, P. et al., 2018). [76].
i. Smart Farming is a process a where actors use soil monitoring, Robocop, Predictive analysis,	

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smart weather information alert systems (Indrajeet Kumar et al.., 2021). [74].	i. Limited reliability of AI algorithms, Limited AI technical infrastructure in schools, non-portability of the AI system to multiple settings, Lack of technological knowledge of teachers on AI use (Celik, I. et al., 2022). [77].

6. CONCLUSION:

After research study or investigation, it has been found that the future is complete computerization where different sectors or departments (Fully computerized) would connect with each other providing Big Pool of Data that can be analyzed using software to predict what future citizens want from Government services and how governance can be made easy to sort out the problems faced by people around the world. Since Education is also a service like others that the government provides to its people, AI related Technologies will enter this sector or have already entered some classrooms (in some countries) and these Institutes are reaping the benefits. Education-related real-world complex problems like Travelling salesman problem can be solved easily since AI can predict the future using an existing pool of data(history) like weather, war, and other disasters. Hence in the near future, we could find robots teaching students and learning from students (machine learning). AI has already entered our premises be in Home, office, public library, supermarkets, Restaurants, Transport, Healthcare, Newsrooms, Education institutions, Military battlefield and list is endless. Without AI we can't imagine future world because we humans get tired and are under stress for performing most basic calculations which makes us go near these technologies to relieve ourselves and utilize that time for innovations or creative purposes. Optimized world in the future would want AI role to be bigger and better. Future is surely better world with AI taking the centerstage in all the places for time efficiency, space efficiency and monetary efficiency too. But many researchers and scientist also believe if AI usage or development is not exercised with caution or licensing it could generate Anti-human machines destroying our race from the planet hence AI research and Development must be regulated with strict check(licensing) that could control on machines going against humans. Some of the AI technologies like cryptocurrencies and Block chains can't be used by masses but by big corporate and governmental institutions.

REFERENCES:

[1]   Hunt, E. B. (2014). *Artificial intelligence* (1-463). Academic Press. New York, USA. Google Scholar✕

[2]   Warwick, K. (2012). *Artificial intelligence: the basics* (1-179). Routledge. New York, USA. Google Scholar✕

[3]   Berente, N., Gu, B., Recker, J., & Santhanam, R. (2021). Managing artificial intelligence. *MIS quarterly*, *45*(3), 1433-1450. Google Scholar✕

[4]   Brynjolfsson, E., & Mcafee, ANDREW. (2017). Artificial intelligence, for real. *Harvard business review*, *1*(1), 1-31. Google Scholar✕

[5]   Amisha, Malik P, Pathania M, Rathaur VK. (2019). Overview of artificial intelligence in medicine. *Journal of Family Medicine and Primary Care, 8*(7), 2328-2331. Google Scholar✕

[6]   Venkatasubramanian, V. (2019). The promise of artificial intelligence in chemical engineering: Is it here, finally? *AIChE Journal*, *65*(2), 466-478. Google Scholar✕

[7]   Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *Ieee Access, 8*(4), 75264-75278. Google Scholar✕

[8]   Holmes, W., Bialik, M., & Fadel, C. (2020). *Artificial Intelligence in Education, Promise and Implications for Teaching and Learning* (1-39). Center for Curriculum Redesign, P Boston, USA. Google Scholar✕

[9]   Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, *2*(2021), 1-6. Google Scholar✕

International Journal of Management, Technology, and Social Sciences (IJMTS), ISSN: 2581-6012, Vol. 10, No. 1, June 2025

SRINIVAS PUBLICATION

[10] Schiff, D. (2021). Out of the laboratory and into the classroom: the future of artificial intelligence in education. *AI & society*, *36*(1), 331-348. Google Scholar⬦

[11] Paek S, Kim N. (2021). Analysis of Worldwide Research Trends on the Impact of Artificial Intelligence in Education. *Sustainability, 13*(14), 1-20. Google Scholar⬦

[12] Tapalova, O., Zhiyenbayeva, N., & Gura, D. (2022). Artificial Intelligence in Education: AIEd for Personalised Learning Pathways. *Electronic Journal of e-Learning*, *20*(5), 639-653. Google Scholar⬦

[13] Hwang, G. J., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of Artificial Intelligence in Education. *Computers and Education: Artificial Intelligence*, *1*(2020), 1-5. Google Scholar⬦

[14] Nemorin, S., Vlachidis, A., Ayerakwa, H. M., & Andriotis, P. (2022). AI hyped? A horizon scan of discourse on artificial intelligence in education (AIED) and development. *Learning, Media and Technology*, *1*(2022), 1-14. DOI/CrossRef: ⬦⬦

[15] Chaudhry, M. A., & Kazim, E. (2022). Artificial Intelligence in Education (AIEd): a high-level academic and industry note 2021. *AI and Ethics, 2*(1), 157-165. Google Scholar⬦

[16] Knox, J. (2020). Artificial intelligence and education in China. *Learning, Media and Technology*, *45*(3), 298-311. Google Scholar⬦

[17] Puentedura, R. (2010). SARM and TPCK: Intro to advanced practice. Retrieved from https://www.researchgate.net/deref/http%3A%2F%2Fwww.hippasus.com%2Frrpweblog%2Farchives%2F2011%2F10%2F28%2FSAMR_TPCK_In_Action.pdf on 28.12.22.

[18] Khosravi, H., Shum, S. B., Chen, G., Conati, C., Tsai, Y. S., Kay, J., & Gašević, D. (2022). Explainable artificial intelligence in education. *Computers and Education: Artificial Intelligence*, *3*(2022), 1-22. DOI/CrossRef:

[19] Luckin, R., Holmes, W., Griffiths, M. & Forcier, L. B. (2016). Intelligence Unleashed. An argument for AI in Education. *Pearson, 15*(1), 1-61. Google Scholar⬦

[20] Howard, S. K., Swist, T., Gasevic, D., Bartimote, K., Knight, S., Gulson, K., & Selwyn, N. (2022). Educational data journeys: Where are we going, what are we taking and making for AI?. *Computers and Education: Artificial Intelligence*, *3*(2022), 1-8. Google Scholar⬦

[21] Michelle Zimmerman. (2018). *Teaching AI: exploring new frontiers for learning* (pp. 1-151). International Society for Technology in Education, Oregon, USA. Google Scholar⬦

[22] Flogie, A., & Aberšek, B. (2022). Artificial intelligence in education. *LutsenkoO. LutsenkoG.(Eds.), Active Learning: Theory and Practice*. (97-118). IntechOpen. DOI/CrossRef ⬦

[23] Dieterle, E., Dede, C. & Walker, M. (2022). The cyclical ethical effects of using artificial intelligence in education. *AI & Soc, 39*(2), 633-643. Google Scholar⬦

[24] Molenaar, I. (2022). The concept of hybrid human-AI regulation: Exemplifying how to support young learners' self-regulated learning. *Computers and Education: Artificial Intelligence*, *3*(2022), 1-11. Google Scholar⬦

[25] Thomas, M; Porayska-Pomsta, K. (2022). Neurocomputational Methods: From Models of Brain and Cognition to Artificial Intelligence in Education. In Houdé, O and Bosrt, G, (eds.) *The Cambridge Handbook of Cognitive Development* (pp. 662-687). Cambridge University Press: Cambridge, UK Google Scholar⬦

[26] Chaudhry, M.A., Kazim, E. (2022). Artificial Intelligence in Education (AIEd): a high-level academic and industry note 2021. *AI Ethics, 2*(1), 157–165. Google Scholar⬦

[27] Viswanathan, N., Meacham, S., & Adedoyin, F. F. (2022). Enhancement of online education system by using a multi-agent approach. *Computers and Education: Artificial Intelligence*, *3*(2022), 1-14. Google Scholar⬦

International Journal of Management, Technology, and Social Sciences (IJMTS), ISSN: 2581-6012, Vol. 10, No. 1, June 2025

SRINIVAS PUBLICATION

[28] Kucak, D., Juricic, V., & Dambic, G. (2018). Machine Learning in Education - a Survey of Current Research Trends, *Proceedings of the 29th DAAAM International Symposium*, *29*(1), 0406-0410. Google Scholar✕

[29] Nafea, I. T. (2018). Machine Learning in Educational Technology. In (Ed.), *Machine Learning - Advanced Techniques and Emerging Applications* (175-183). IntechOpen, London, United Kingdom. Google Scholar✕

[30] Villegas-Ch, William, Milton Román-Cañizares, and Xavier Palacios-Pacheco. (2020). Improvement of an Online Education Model with the Integration of Machine Learning and Data Analysis in an LMS, *Applied Sciences*, *10*(15), 1-18. Google Scholar✕

[31] Brian Plancher and Vijay Janapa Reddi. (2022). TinyMLedu: The Tiny Machine Learning Open Education Initiative. *Proceedings of the 53rd ACM Technical Symposium on Computer Science Education, 2*(2022), 1159-1159. Google Scholar✕

[32] YAVUZ, Ö. (2022). An Optimization Focused Machine Learning Approach in Analysing Arts Participative Behavior with Fine Arts Education Considerations. *International Scientific and Vocational Studies Journal*, *5*(2), 241-253. Google Scholar✕

[33] Wernbacher, T., Pfeiffer, A., Häfner, P., Buchar, A., Denk, N., König, N., DeRaffaele, C., Attard, A., Economides, A.A., & M. Perifanou (2022). TRinE: Telepresence robots in education. *Proceedings of the 16th annual International Technology, Education and Development Conference (INTED) 2022*, *16*(2022), 6514-6522. DOI/CrossRef:

[34] Lei, M., Clemente, I. M., Liu, H., & Bell, J. (2022). The Acceptance of Telepresence Robots in Higher Education. *International Journal of Social Robotics*, *14*(2022), 1-18. Google Scholar✕

[35] Cam, E. & Kiyici, M. (2022). The impact of robotics assisted programming education on academic success, problem solving skills and motivation. *Journal of Educational Technology & Online Learning, 5*(1), 47-65. Google Scholar✕

[36] Mubin, O., Stevens, C. J., Shahid, S., Al Mahmud, A., & Dong, J. J. (2013). A review of the applicability of robots in education. *Journal of Technology in Education and Learning, 209*(0015), 1-7. Google Scholar✕

[37] Sowmiya, S., Ramachandran, M., Chinnasamy, S., Prasanth, V., & Sriram, S. (2022). A Study on Humanoid Robots and Its Psychological Evaluation. *Design, Modelling and Fabrication of Advanced Robots*, *1*(1), 48-54. Google Scholar✕ DOI/CrossRef:

[38] VEX ROBOTICS unit 2- Introduction to Robotics. Retrieved from https://www.revereschools.org/cms/lib02/OH01001097/Centricity/Domain/64/VEX%20Robotics%20Unit%202-Intro%20to%20Robotics.pdf on 23/01/23.

[39] Nasim, S. F., Ali, M. R., & Kulsoom, U. (2022). Artificial Intelligence Incidents & Ethics A Narrative Review. *International Journal of Technology, Innovation and Management (IJTIM)*, *2*(2), 52-64. Google Scholar✕

[40] Littman, M. L., Ajunwa, I., Berger, G., Boutilier, C., Currie, M., Doshi-Velez, F., & Walsh, T. (2022). Gathering strength, gathering storms: The one hundred year study on artificial intelligence (AI100) 2021 study panel report. Stanford University, Stanford,USA, *1*(2022), 1-82. Google Scholar✕

[41] Singh, J., Sajid, M., Gupta, S. K., & Haidri, R. A. (2022). Artificial Intelligence and Blockchain Technologies for Smart City. *Intelligent Green Technologies for Sustainable Smart Cities*, *1*(2022), 317-330. Google Scholar✕

[42] Matthew N. O. Sadiku, Tolulope J. Ashaolu, Abayomi Ajayi-Majebi, and Sarhan M. Musa. (2021). Artificial intelligence in Social Media. *International Journal of Scientific Advances, 2*(1), 15-20. Google Scholar✕

[43] Despujol, I., Castañeda, L., Marín, V. I., & Turró, C. (2022). What do we want to know about MOOCs? Results from a machine learning approach to a systematic literature mapping review. *International Journal of Educational Technology in Higher Education*, *19*(1), 1-22. Google Scholar✕

International Journal of Management, Technology, and Social Sciences (IJMTS), ISSN: 2581-6012, Vol. 10, No. 1, June 2025

SRINIVAS PUBLICATION

[44] Brunke, L., Greeff, M., Hall, A. W., Yuan, Z., Zhou, S., Panerati, J., & Schoellig, A. P. (2022). Safe learning in robotics: From learning-based control to safe reinforcement learning. *Annual Review of Control, Robotics, and Autonomous Systems*, *2*(5), 1-36. Google Scholar⬚

[45] Zhao Z, Ma Y, Mushtaq A, Rajper AMA, Shehab M, Heybourne A, Song W, Ren H, Tse ZTH. (2022). Applications of robotics, artificial intelligence, and digital technologies during COVID-19: a review. *Disaster Med Public Health Preparedness, 16*(4), 1634–1644. Google Scholar⬚

[46] Lo, S. Y., Lai, Y. Y., Liu, J. C., & Yeh, S. L. (2022). Robots and sustainability: Robots as persuaders to promote recycling. *International Journal of Social Robotics*, *14*(2022), 1261-1272. Google Scholar⬚

[47] de Croon, G. C. H. E., Dupeyroux, J. J. G., Fuller, S. B., & Marshall, J. A. R. (2022). Insect-inspired AI for autonomous robots. *Science Robotics, 7*(67), 1-11. Google Scholar⬚⬚

[48] Ekström, S., & Pareto, L. (2022). The dual role of humanoid robots in education: As didactic tools and social actors. *Education and Information Technologies*, *27*(2022) 1-36. Google Scholar⬚

[49] Cruz-Ramírez, S. R., García-Martínez, M., & Olais-Govea, J. M. (2022). NAO robots as context to teach numerical methods. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, *16*(4), 1337-1356. Google Scholar⬚

[50] Laï, M. C., Brian, M., & Mamzer, M. F. (2020). Perceptions of artificial intelligence in healthcare: findings from a qualitative survey study among actors in France. *Journal of translational medicine*, *18*(1), 1-13. Google Scholar⬚

[51] Kuleto, V., Ilić, M., Dumangiu, M., Ranković, M., Martins, O. M. D., Păun, D., & Mihoreanu, L. (2021). Exploring Opportunities and Challenges of Artificial Intelligence and Machine Learning in Higher Education Institutions. *Sustainability, 13*(18), 1-16. Google Scholar⬚

[52] Aoun, J. E. (2017). *Robot-proof: higher education in the age of artificial intelligence* (pp. 1-150), The MIT Press, London, England. Google Scholar⬚

[53] Arvin, F., Espinosa, J., Bird, B., West, A., Watson, S., & Lennox, B. (2019). Mona: an affordable open-source mobile robot for education and research. *Journal of Intelligent & Robotic Systems*, *94*(2019), 761-775. Google Scholar⬚

[54] Zahariev, R. Z., & Valchkova, N. (2019). Existing robotics technologies for the implementation of special education. In *Cyber-Physical Systems for Social Applications* (pp. 44-61). IGI Global. Google Scholar⬚

[55] Soori, M., Arezoo, B., & Dastres, R. (2023). Optimization of Energy Consumption in Industrial Robots, A Review. *Cognitive Robotics*, *3*(2023), 142-157. Google Scholar⬚ DOI/CrossRef:

[56] Chaka, C. (2023). Fourth industrial revolution—a review of applications, prospects, and challenges for artificial intelligence, robotics and blockchain in higher education. *Research and Practice in Technology Enhanced Learning*, *18*(2), 1-39. Google Scholar⬚

[57] Pai, S. S., Vikhyath, Shivani, Sanket, & Shruti (2017). IOT application in education. *International Journal for Advance Research and Development*, *2*(6), 20-24. Google Scholar⬚

[58] Agarwal, P., Idrees, S. M., & Obaid, A. J. (2021). Blockchain and IoT Technology in Transformation of Education Sector. *International Journal of Online and Biomedical Engineering (iJOE), 17*(12), 4–18. Google Scholar⬚ DOI/CrossRef:

[59] Ramlowat, D. D., & Pattanayak, B. K. (2019). Exploring the internet of things (IoT) in education: a review. In *Information Systems Design and Intelligent Applications: Proceedings of Fifth International Conference INDIA 2018, 2*(1), 245-255. Google Scholar⬚

[60] Al-Malah, D. K. A. R., Jinah, H. H. K., & ALRikabi, H. T. S. (2020). Enhancement of educational services by using the internet of things applications for talent and intelligent schools. *Periodicals of Engineering and Natural Sciences*, *8*(4), 2358-2366. Google Scholar⬚

[61] Chweya, R., Ajibade, S. S. M., Buba, A. K., & Samuel, M. (2020). IoT and big data technologies: opportunities and challenges for higher learning. *International Journal of Recent Technology and Engineering (IJRTE), 9*(2), 909-913. Google Scholar⬚

International Journal of Management, Technology, and Social Sciences (IJMTS), ISSN: 2581-6012, Vol. 10, No. 1, June 2025

SRINIVAS
PUBLICATION

[62]   Suma, V. (2021). Wearable IoT based distributed framework for ubiquitous computing. *Journal of Ubiquitous Computing and Communication Technologies (UCCT)*, *3*(01), 23-32. Google Scholar✕

[63]   Mhetre, N. A. et al. (2021). Experience Modelling For Ubiquitous Computing: A Mathematical Approach. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(6), 5476-5488. Google Scholar✕

[64]   Suartama, I., Setyosari, P., Sulthoni, S., & Ulfa, S. (2020). Development of ubiquitous learning environment based on moodle learning management system. *iJIM, 14*(14), 182-204. Google Scholar✕

[65]   Powell, M., Davies, T., & Taylor, K. C. (2012). ICT for or against development? An introduction to the ongoing case of Web 3.0. *IKM Emergent Research Programme, European Association of Development Research and Training Institutes (EADI)*, *16*(2012)*, 1-34. Google Scholar✕

[66]   Miranda, P., Isaias, P., & Costa, C. J. (2014). E-Learning and web generations: Towards Web 3.0 and E-Learning 3.0. *International Proceedings of Economics Development and Research*, *81*(2014), 92-103. Google Scholar✕

[67]   Ali, M. Y., Naeem, S. B., Bhatti, R., & Richardson, J. (2022). Artificial intelligence application in university libraries of Pakistan: SWOT analysis and implications. *Global Knowledge, Memory and Communication*, *1*(1), 1-23. Google Scholar✕

[68]   Hajizadeh Y. (2019). Machine learning in oil and gas; a SWOT analysis approach. *Journal of Petroleum Science and Engineering*, *176*(2019), 661-663. Google Scholar✕

[69]   A V Rozhkova and S E Rozhkov. (2022). Artificial intelligence technologies in the agro-industrial complex: opportunities and threats. *IOP Conf. Ser.: Earth Environment Science, 981*(2022), 1-8. Google Scholar✕

[70]   Hardjanto, R. W. (2022). Digital Economy and Blockchain Technology Using the SWOT Analysis Model. *Int J Innov Sci Res Technol*, *7*(2), 513-520. Google Scholar✕

[71]   Angelova, G., Nisheva-Pavlova, M., Eskenazi, A., & Ivanova, K. (2021). Role of education and research for artificial intelligence development in Bulgaria until 2030. *Mathematics and Education in Mathematics*, *50*(1), 71-82. Google Scholar✕

[72]   Dobbelaere, M. R., Plehiers, P. P., Van de Vijver, R., Stevens, C. V., & Van Geem, K. M. (2021). Machine learning in chemical engineering: strengths, weaknesses, opportunities, and threats. *Engineering*, *7*(9), 1201-1211. Google Scholar✕

[73]   Eager, J., Whittle, M., Smit, J., Cacciaguerra, G., & Lale-Demoz, E. (2020). *Opportunities of artificial intelligence* (pp. 1-97). European Parliament. Luxenbourg. Google Scholar✕

[74]   Indrajeet Kumar, Jyoti Rawat, Noor Mohd, Shahnawaz Husain. (2021). Opportunities of Artificial Intelligence and Machine Learning in the Food Industry, *Journal of Food Quality*, *1*(2021), 1-10. Google Scholar✕

[75]   Gerke, S., Minssen, T., & Cohen, G. (2020). Ethical and legal challenges of artificial intelligence-driven healthcare. In *Artificial intelligence in healthcare* (295-336). Academic Press. Google Scholar✕

[76]   Svenmarck, P., Luotsinen, L., Nilsson, M., & Schubert, J. (2018). Possibilities and challenges for artificial intelligence in military applications. *Proceedings of the NATO Big Data and Artificial Intelligence for Military Decision Making Specialists' Meeting*, *160*(1), 1-16. Google Scholar✕

[77]   Celik, I., Dindar, M., Muukkonen, H. et al. (2022). The Promises and Challenges of Artificial Intelligence for Teachers: a Systematic Review of Research. *TechTrends(Springer), 66*(4), 616–630. Google Scholar✕