INTERACTIVE AND INNOVATIVE ARTIFICIAL INTELLIGENCE TECHNOLOGIES ENHANCED WITH IOT FOR SMART EDUCATION IN HIGHER EDUCATION.

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Abstract–

Learners, teachers, and the knowledge being transmitted are all present in today's educational environment, and smart education has facilitated greater learning flexibility. Smart technology and connected gadgets are used to access digital resources to make this notion a reality. The term "smart education" refers to a novel method of teaching that has received much attention, especially in light of the 2020 Covid-19 Pandemic. Artificial intelligence is very important for education because it has a strong ability to adapt to all aspects of work. When faced with different types of students, artificial intelligence can also analyze the individual differences of students from multiple perspectives, formulate different teaching goals for students, and also promote individual development on a deep level. Diversifying education from multiple perspectives is conducive to the inherent value of education, and it can help students achieve their full potential. Artificial intelligence is deeply ingrained in the teaching profession; through its own characteristics of informatization, it can also support the reform of education informatization and offer teachers better teaching resources. The outcomes also showed that four categories behavior, learning, educational technology, and physical facilities can be used to categorize the development of smart education. According to the study's findings, the technological model must be incorporated into organizational operations. Using IoT should be in line with a university's adoption preparedness. In order to compensate for the lack of artificial intelligence in contemporary education, increase student enthusiasm in studying, and develop high-quality students, blockchain technology and artificial intelligence must be integrated with modern education. This article aids in comprehending the fundamental idea behind smart education and paves the way for further investigation into how to improve the environment for such a system.

Keywords - Smart education, Technologies, Innovation, Interaction, e-learning, Learning Management System, Internet of Things, future education, dynamic learning, remote experiments, virtual reality.

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I. INTRODUCTION

Smart education is a type of education that is growing widely accepted and enthusiastically adopted by younger generations in the current digital era. This demonstrates how information transfer to students may be done more effectively and conveniently when based on modern technologies [1]. Smart education is the learning process that has been modified for the modern digital era. It offers a more interactive, collaborative, and visual technique to increase learner engagement and enables instructors to better understand student abilities and learning preferences. Smart education is a method of instruction that has been embraced by the contemporary era of digital orientation to offer a more dynamic, interactive, and visible way to enhance students' engagement and enable instructors to recognize student skills and student motivation. In today's world, learning management systems (LMS) are a developing technology that offer online learning materials production, delivery, management, tracking, reporting, and evaluation. This centralized software programme combines pedagogical elements with the rapidly developing technology of virtual learning environments.

Students can access resources, submit assignments, take tests, and discuss information with peers and instructors using personal devices like smartphones and tablets, which creates a dynamic learning environment. By registering users, monitoring courses, gathering learner data, and managing reports, LMS software automates the learning process.

An LMS typically consists of a server component that handles the core functions (creating, managing, and delivering courses, authenticating users, serving data and notifications), and a user interface that administrators, instructors, and students use. This user interface runs inside the client's browser as a web service (like Gmail or Facebook). A university receives important advantages by integrating and using an LMS inside its educational system, including: centralized learning, time savings, cost savings, and tracking and reporting functions.

In the upcoming years, it is anticipated that LMS will continue to develop and add new elements into existing operations. The most anticipated future LMS enhancements, according to Moodle [2], include Virtual Reality (VR), enhanced personalization, gamification, and more feedback.

Although the Internet is well-established in educational systems, emerging developments like the Internet of Things (IoT) are anticipated to have a greater impact on the field. IoT gadgets used in education include interactive whiteboards and digital highlighters, for instance. Similar to how digital scanners facilitate learning by sending text to cellphones digitally. These tools allow students to communicate with peers, educators, and professionals around the globe while still in their classrooms [3].

AI will make learning, teaching, and education more innovative, yet it also has the potential to reshape society in ways that provide new difficulties for educational institutions. Either it will equalize learning possibilities, or it will magnify skill disparities and polarize jobs. The application of AI in education may result in new understandings of how learning takes place and may alter how learning is evaluated. Technology may improve teaching effectiveness, rearrange classrooms, render them obsolete, or force pupils to adjust to technological demands, robbing people of their agency and opportunities for moral behavior. Artificial intelligence technology can rely on its own high-intensity computing ability to formulate reasonable learning methods and learning plans for students, mobilize all educational resources, and for students, artificial intelligence education can also find out the problems of students in the learning process in time and provide answers and corrections for students. It can also formulate learning goals for students that are suitable for their own development. Being constrained by tradition makes teaching more logical and focused, which helps teachers avoid adopting traditional teaching concepts while creating courseware. Also, the inclusion of artificial intelligence can improve learning environments for children, combine classroom instruction with entertainment, and locate more kid-friendly minigames on the Internet. The result of deep intelligence and learning is AI Plus education. Smart devices are used in education to enhance learning and teaching, establish new educational environments, give schools access to resources for self-paced learning, and ultimately meet the goal of educating people. [4].

II. IOT TECHNOLOGIES IN HIGHER EDUCATION REVIEW

The Internet of Things (IoT), which offers global networks for linking devices and items to the Internet infrastructure, has gained popularity recently. In order to identify the combination of intelligence and knowledge, as well as to promote the global generation of new knowledge, the IoT enables connections between objects and people at anytime and anywhere.

An interactive learning environment, access to international information, and adaptive learning based on data gathered and evaluated inside the network are all features of a smart university. To enhance the educational process, the IoT is currently present in many universities as security cameras, temperature control devices, access devices to buildings, power, and heating systems [5].

Rapid technological advancements allow for the implementation, networking, and integration of anything with clever and creative design, and education is no exception. The development of new ideas inspires the development of new technologies, which progress the delivery of better educational activities. Comprehensive and innovative technology has given academic institutions rare opportunities in terms of new approaches to teaching, learning, and instructional practices [6-7].

Even though significant technological advancements have historically been disregarded, upcoming events like the 2020 pandemic call for a swift adaptation of the use of smart devices and technology to support smart learning and education. Several essential skills are taught using cutting-edge, interactive technology, giving students the opportunity to experience smart education using numerous interactive technologies [8]. Several breakthrough technologies, such as augmented reality (AR), virtual reality (VR), internet of things (IoT), metaverse, immersive 3D etc., have shook the education system with their astounding potential. although worries are still made regarding human distortion or laziness in the adaptation of these technologies, which is related to the anxiety that led the late adaptive reaction of these technologies in the educational institutions.

Mobile and handheld technologies have been shown to be beneficial for students. IoT successfully gathers data with the aid of these gadgets and offers pupils topic-based interests [9]. Under the IoT umbrella, these portable devices are employed in a variety of ways for smart education, including interactive smart boards, temperature sensors, attendance tracking systems, building security alarms, etc. These portable devices lessen the workload of teachers in several ways and boost productivity.

2.1 IoT-Based Framework for Digital Campus Design

The authors put up a brand-new paradigm for campuses that employ e-learning methods, dubbed "Smart I-Campus." This model offers a few smart services, including "Smart Classroom" and "Smart Lab," that are incorporated into the e-Learning system or LMS and have capabilities that can be accessed via mobile devices. Real-time data will be gathered and uploaded by smart classrooms for later use. An additional function called "Smart Notes Sharing" enables an IoT-enabled smart board to automatically upload real-time data to the e-Learning application, allowing anybody connected to the campus network to contribute lecture notes. The augmented reality and 3D virtual objects in the "Smart Classroom" are yet another crucial component of the "Smart I-Campus," allowing students to find out crucial information in real time when they approach teaching tools that will be outfitted with sensor devices [10].

2.2 Utilizing IoT Devices

It is not difficult to see that, with the advancement of science and technology, education is gradually undergoing innovation and optimization [11]. At the end of the nineteenth century, technologies like photography and slide projectors contributed to visual education, while phonographs and tapes contributed to audio visual education. In the present era, the invention of computers and networks has contributed to modern education.

The authors proposed [12] a model for a "smart university" that makes use of sensors from five different categories: environmental sensors for noise, temperature, and lightning; security sensors for motion detection, opening/closing doors or windows, and fingerprints; safety sensors for smoke, fire, and water detection; utilitarian sensors for electrical voltages and NFC tags; and information sensors for RFID cards, QR codes, and barcodes. IoT services would be beneficial for several applications inside the smart university, including: (1) Smart Parking, which enables the monitoring of vacant parking to prevent backups or accidents; (2) Smart lighting that automatically lowers classroom lighting based on information about outside natural light collected from a sensor, so consuming less electricity; (3) Smart Tracking, which uses RFID technology to keep an eye on supplies and equipment inside a university and assess any emergency situations; (4) Smart Inventory, which uses a barcode scanner to identify any equipment with a barcode by reading its QR tag.

2.3 Technology Using Artificial Intelligence in Smart Education

Nowadays, artificial intelligence serves a number of purposes in education, making it smarter. The development of artificial intelligence has ushered in a new era of computer-assisted learning. Computer systems with cognitive capabilities can assist with strategic planning in the context of education in addition to acting as intelligent teachers, resources, or pupils. The integration of artificial intelligence with education creates new opportunities for enhancing the quality of education and learning. Intelligent systems help teachers with assessments, data collection, academic performance enhancement, and the creation of fresh approaches. Smart teachers and asynchronous learning help pupils improve their academic performance [13]. A revolution in human thinking, cognition, and civilizations as a whole is also being brought about by the integration of artificial intelligence with education.

2.4 Innovative Techniques for Smart Teaching

In fact, one can predict that as soon as new technologies are made available, they will be adopted in the field of education. Yet, compared to other industries, the education sector is slower to adopt new technological concepts [14]. Yet, technology has advanced decades beyond the traditional educational system since the invention of mobile devices and the internet. More discussion is provided on additional cutting-edge strategies for smart education, including augmented reality, virtual reality, IoT, metaverse, immersive 3D, and others.

2.5 Virtual Reality, Mixed, and Augmented Reality in Smart Education

Despite their similarities, AR and VR are two different technologies. Global Positioning System (GPS) and cameras are two instances of AR, which is an immersive experience in which computer-generated information and features are coupled to the real world [21]. Unlike AR, VR often occurs in a controlled setting where people can interact with and alter computer-generated components in a virtual world utilizing sensory equipment. Modern gaming systems like the PlayStation and the Oculus Rift are examples of VR [15]. Fig. 1 illustrates how mixed reality combines augmented reality and virtual reality (MR). According to [16], suggests that augmented reality and virtual reality present important opportunities for assisting students in developing their skills and knowledge. Additionally, incorporating AR and VR into the classroom may result in engaging and productive learning opportunities.

Recent technology developments have made VR and AR easier to use and more widely available. According to [17] research claims that many consumers already own smart devices like the ARCore and Oculus Quest 2 that are compatible with VR/AR (VR headset). Therefore, there's no need to carry about a bulky, expensive headgear. Another recent practical use of this technology is to display instructions or information in large interior locations like malls and airports. Additionally, it has been used in education as well as other industries including healthcare, remote assistance, convenient shopping, auto manufacturing, and so forth.

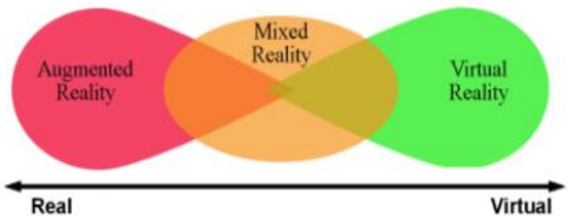

Fig. 1. A representation of AR, MR, VR classification [16]

2.6 Technology in the Metaverse for Smart Learning

Everyone with a terminal and access to the Metaverse can participate in everything from trading to entertainment there. It is a three-dimensional virtual reality environment. As a result of the creation of the metaverse, much of human daily contact has been moved to the virtual realm, which has had a huge impact on human communities and culture in the real world [18]. Since it has been applied into several businesses, it is currently being advertised as the technology of the future. The metaverse is said to have the potential to be a new learning environment that fosters interpersonal interaction, greater creativity and distribution flexibility, the introduction of better perceptions, and increased engagement via virtual machines. Fig. 2. A class delivered in the metaverse can be seen. Students can carry out investigations like looking at the anatomy lab's depiction of the human body's interior in Figure 3 thanks to the metaverse's present development in the educational system. Face-to-face communication is becoming more challenging as a result of the Covid-19 pandemic, so activities that were once thought to be only possible outdoors are now being transformed into virtual worlds and are quickly expanding into sectors like entertainment, education, and medical services [19].

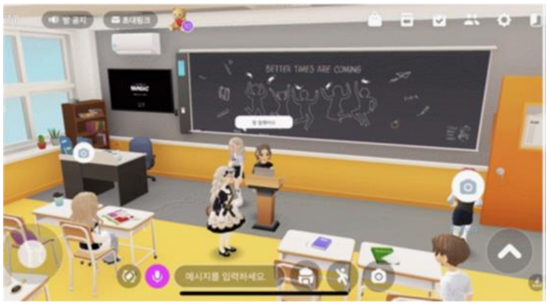

Fig. 2. Classroom map in Zepeto [19]

Fig. 3. Metaverse avatars watching a surgical scene in the smart operating room [20]

2.6 Technology for Cloud Computing in Smart Education

Cloud computing has attracted a lot of attention in the education sector as a way to provide higher-quality education that is more reliable and secure. [21] established a cloud-based, intelligent system of education for e-learning digital experiences with the aim of disseminating and exchanging cutting-edge types of instructional information, including texts, photographs, videos, and three-dimensional (3D) objects. Smart education has always included digital learning, even before the advent of educational TV shows. It grew into electronic learning, mobile learning, and now smart learning. Academies are becoming smarter thanks to the usage of cutting-edge technology like IoT and cloud computing. It enhances the standard learning environment in the classroom to enhance student learning [22].

2.7 Smart Education with Blockchain Technology

Blockchain technology has recently attracted a lot of attention because of its unique characteristics, including decentralization, reliability, security, and data integrity. To fully utilize blockchain's potential, many businesses are looking at the possibility of integrating it into their own professions. Despite its rapid growth, the school sector has minimal access to contemporary cutting-edge technology like blockchain [23]. Blockchain technology has a number of creative applications in education that go beyond credential management and success assessment. For formative evaluations, lesson planning and delivery, and tracking the progress of the entire learning process, blockchain technology offers a lot of opportunities for both educators and students [24].

2.8 Technology Using Big Data in Smart Education

Big data technology, which is mostly related to smart education, has developed at a breakneck pace and integrates data gleaned from student interactions with technology as well as their academic and personal profiles. How to derive meaning from the data collected is one of the most puzzling aspects of big data in academics, as it is in other industries [31]. Further proof of the benefits of big data technology is continuously being published and revealed by researchers and practitioners. The term "big data" is not yet widely understood in smart education. Big data technology in smart education refers to all behavioral data collected from people's regular educational acts that includes hierarchy, sequence, and contextual aspects. Also, it is relevant to information gathered from student activations, which is primarily produced by student monitoring systems, interactive learning systems, and curriculum management systems, among other sources [32].

III. IoT Methodologies And Approches In Smart Education

This research aims to achieve the following:

1) To develop a thorough grasp of intelligent learning within the framework of IoT technologies in higher education.
2) To comprehend more fully how student and teacher interactions with IoT technologies are related to smart education.
3) To propose a paradigm for dealing with the improved learning process in higher education made possible by the Internet of Things.

In this study, the following research questions were addressed:

1. What is the perception of the students regarding the significant impact of the IoT factors in the learning process in higher education?

2. What do educators think about the higher education model's ability to teach about such IoT factors?
3. How are IoT platforms being used in higher education's teaching and learning processes perceived by both teachers and students?

Using the digital system in higher education, active learning strategies have been employed to strengthen the cognitive abilities of both professors and students. The study technique of the suggested model is completely explained statistically and theoretically in this part. The student-teacher smart interaction is depicted in Fig. 4. Students can improve teacher and student experiences by utilizing the intelligent interaction between student and teacher via IoT-based services, such as boards or forums. The technical advancements in networking known as the Internet of Things (IoT) enable real-world items in the context of higher education to connect through the internet. A specific type of educational lecture now known as online education is one that is recorded in audio, video, or both formats and then posted to and accessed on a specific website. To watch the online lecture at a convenient time, students must go to a certain location. In order to apply exercises and alter some practices, this study introduces active learning in smart education. The IoT-IS gives students opportunities to relate to the subject personally and encourages them to pursue smart education.

The collaborative system of active learning strategies, which is promoted throughout this work, helps students and teachers in higher education develop their critical thinking skills. Additionally, it aids students in developing a system for self-evaluation and progress monitoring, allowing them to work on course or curriculum materials, and serving as facilitators.

These techniques use two cases to analyse the students learning abilities, including Case 1: Attention Scoring Method and Case 2: Students' Performance Calculation.

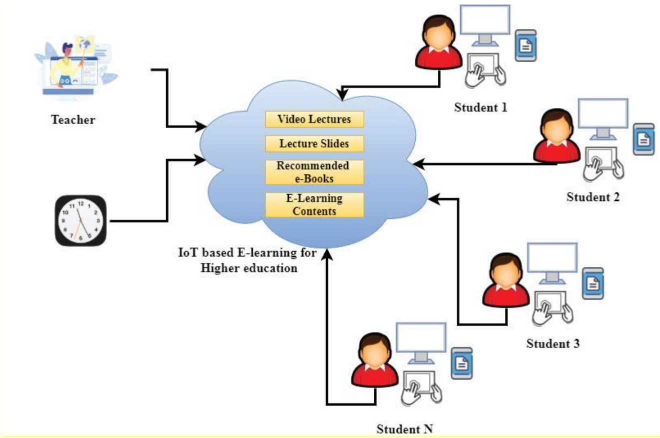

Fig. 4. Student-Teacher smart interaction

3.1 Case 1: Attention Scoring Method

The attention scoring method's design flow is depicted in Figure 2. Education has several advantages in addition to the smart classroom. The number of pupils wanting to participate in the learning is not constrained by the size of a classroom. The IoT-IS approach that was discovered online generates and disseminates modules and courses. The Attention Scoring System incorporates an existing model (ASM). By having a solid understanding of student behavior and instructor-student interactions, this methodology is able to pinpoint student behavior. During recorded lectures, the students' movements are captured on camera. In the video, medium-to-large amounts of scholarly content are produced to create significant amounts of multimedia data. The evaluation of the student's operation video sequence and the sequential storing of the image frames are done with the help of a digital library for the development of computer vision systems. As shown in Fig. 5, a photograph is evaluated to determine the condition of the eyes, face, and eyes, including whether they are open or closed. A video stream of the learner is first captured using a video camera or webcam, and then the next few processes are performed:

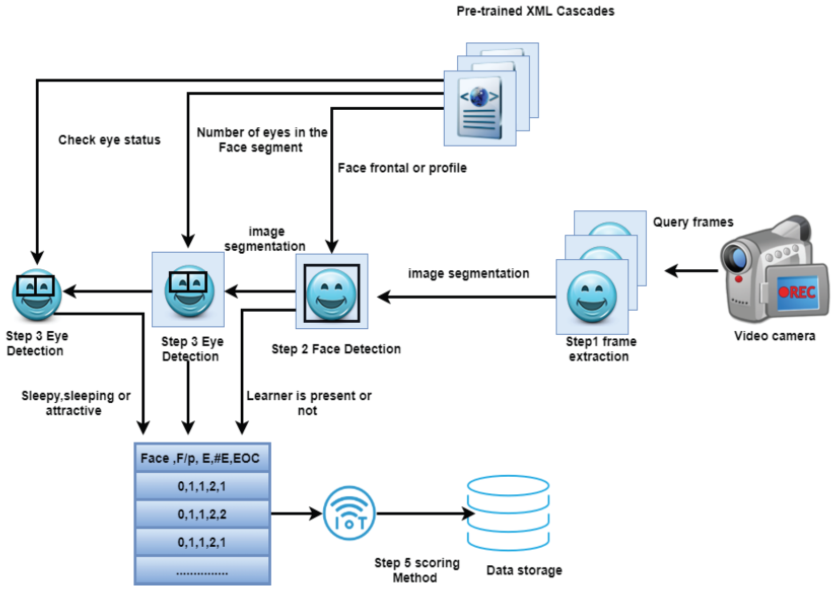

Fig. 5. Attention scoring method.

Step 1: Picture frames are retrieved from the video stream.
Step 2: After identifying the face in each frame, the image segment is trimmed.
Step 3: The facial feature is scanned for and removed if eyes are found.
Step 4: An open or closed eye state is determined.
Step 5: The IoT platform stores data from processes 2 through stage 4 along with additional information.

If the image does not detect a face, it would not be further examined. The attention score algorithm is used to analyses the image and compute the score. The algorithm would have an impact on a series or video stream if a face was spotted. The video source's frames are eliminated one by one. Each frame's multi-scale faces are scanned. IoT-IS records the facial recognition score in the log file, crops the face image, and keeps all of the face images in a predetermined order.

The eyes are then scanned after a picture from the list is removed. The characteristics for eye recognition are recorded and kept in a separate collection. Now, an image of the eyes is pulled from the image IoT database and checked to see if they are open or closed. The appropriate values are subsequently allocated to the log file.

For additional processing and performance verification, this performance has been saved. When creating the model, the focus should be on
(i) Predicting how learning will proceed in the future by developing models that connect crucial data, such as student
(ii) Learning knowledge, motivation, and actions;
(iii) Defining or improving learning models describing the learning topic and providing excellent education; and
(iv)Analyzing the outcomes of various pedagogical aids and advancing related learning and student knowledge by developing computer models.

3.2 Case 2: Students' Performance Calculation

Smart education has analyzed student performance to enhance learning abilities. Additionally, the data sets have been used to calculate student performance using mining techniques based on page rank.

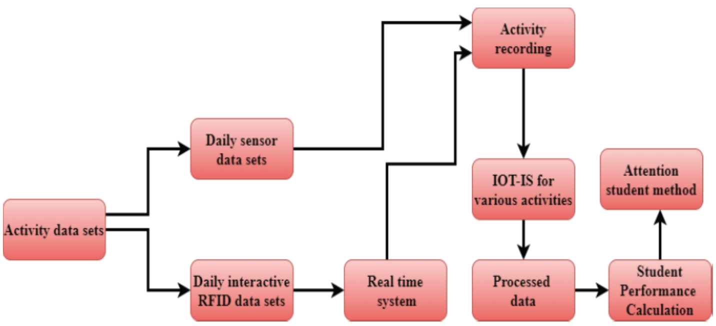

Fig. 6. Student performance calculation.

With the use of IoT devices and online processes, this paper IoT-IS evaluating various approaches to smart education. datasets are up of several types of information about all the activities that took place during the day. To effectively explain the concept, data sets can be split into (i) sensory data set and (ii) interaction-based data set (Fig. 6). The use of RFID sensors, biometric measurements, GPS, biological sensors, and smart-wearable reading devices is being explored in this area to evaluate study group characteristics, location-specific appearance, and student success in the classroom.

RFID technology provides the greatest definition of interaction behavior datasets.

Create interactional patterns to track the success of the interaction-based operation, RFID tags are placed on the faces of the teacher and students in classrooms. This is one of the effective approaches to entity recognition that works automatically. A smartphone equipped with an RFID scanner may detect the RFID tag that is implanted in another item. Reports of RFID-based classroom experiences are generated using temporary premises sensing (TPS). Databases with cloud storage are used to store student-based operations.

The relationship between nodes benefits from a real-time system that works. Cloud keeps data that is referenced in real-time frameworks for analytical purposes and is timestamped with the radio packets created from objects. IoT computers, text data, and images give activity recording data linked to events. The main challenge in this procedure is managing heterogeneous data to produce useful findings later. It has been proposed to regularly store such data with a tensor dubbed a student-activity data tensor for this purpose. Spatial co-location mining and space-time mining techniques on sensory patterns at several locations throughout the day can be used to obtain the sensory knowledge. Depending on the operation's context, Page Rank is utilized to assess the RFID graph.

3.3 Al Genetic Algorithm Approach

A genetic algorithm (GA), which employs a natural selection process akin to evolutionary biology, is an artificial intelligence (AI) method for solving both constrained and uncontrolled categorization problems.

3.4 Hidden Markov Model

A statistical intelligence method that is frequently used to depict biological processes is the Hidden Markov model (HMM). A pattern is the result of an ongoing random process that advances through a series of "secret" levels hidden from the viewer. The methods utilized in the deployment of machine learning and artificial intelligence in the educational system and other areas are measured using some performance indicators, such as specificity, accuracy, area under the curve, sensitivity, and others [30].

3.5 Specificity

Specificity is the proportion of true negatives that the model correctly predicts. Specificity is equal to (TN) / (TN+FP). Sensitivity's antithesis is called specificity. The acronyms TP (True Positive), TN (True Negative), FP (False Positive), and FN are important to note (False Negative). These metrics or indicators are used after a model is developed to assess the model's efficacy, as further defined by [25]. Significant metrics were employed to assess the AI model. The metrics are used to decide how the effectiveness of machine learning approaches is judged and evaluated.

3.6 Accuracy

Accuracy matrices outline the degree of accuracy of each sort of made assumption in the classification model. When the point factor categories in the data are overwhelmingly one category, accuracy is a less than ideal measure to use. Accuracy is a great measure to use whenever the target factor categories in the data are almost equal.

Accuracy is equal to (TP+N) / (TP+FP+FN+TN).

3.7 Sensitivity

Sensitivity analysis is a way to determine the relationship between model performance and dataset size for a certain model and prediction problem. Sensitivity is more about finding all examples that match than it is about finding instances precisely. So, if there is always matching data in a dataset, there is 100% sensitivity.

Sensitivity is equal to (TP) / (TP+FN).

Regarding the teaching strategies depicted in Fig. 7, AI in education can act as a smart teacher, student, learning tool or partner, or policy advisor [26].

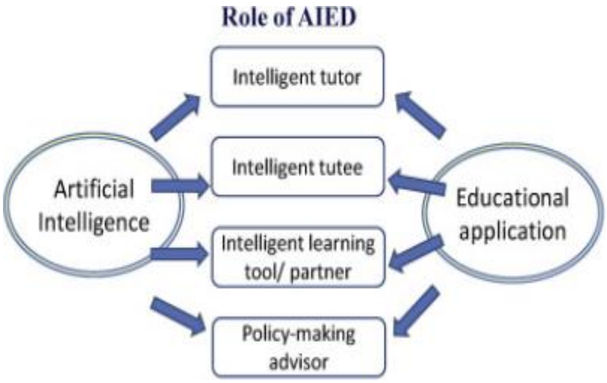

Fig.7. Structure for AI's roles in educational systems [26]

An suitable statistical methodology is utilized as a support to evaluate the hypothesis that was proposed in the previous part in order to verify and measure the validity and analysis of the findings in this study.

Data Sampling

The relevant data is gathered from participants, including students and teachers, using a twelve-item questionnaire. This questionnaire used a mixed method approach (verbal and written) to collect data on a total of 15 predetermined parameters. Considering that the target population is 1000, the Cochran formula for the pilot research will be used to determine the appropriate sample size, which will be somewhere around 257 [29]. The results of the questionnaire based on responses from both teachers and students are graphically represented in Figures 8 and 9. The survey's findings are based on the opinions of both university students and professors.

IV. Results And Discussion

According to survey results, many teachers think that the Internet of Things is made up of a vast number of hyperconnected items interacting with one another. According to the findings, a large majority of professors (between 80 and 90 percent) concur that implementing IoT in the higher education environment has a substantial impact on the general cognitive element of learning, including collaboration and learning efficiency.

Additionally, the effective application of IoT in higher education institutions, schools, and universities can provide research prospects for scholars, teachers, and students. Figure 8 makes a statistical prediction that IoT may have a negligible impact on the scalability of the Internet of Things for Education.

Moreover, persuading teachers and students to participate in the learning process will not be made easier by IoT. Based on Fig. 8, the probability that IoT will provide unique ideas and values to alter existing models and replace them with new ones is not very high and will probably range between 60 and 70 percent. Figure 8 also shows that there is a significant difference between the impact of (teacher & student) performance and other factors. About 50% of the interviewees believe that the Internet of Things does not value creativity as a component of the learning process.

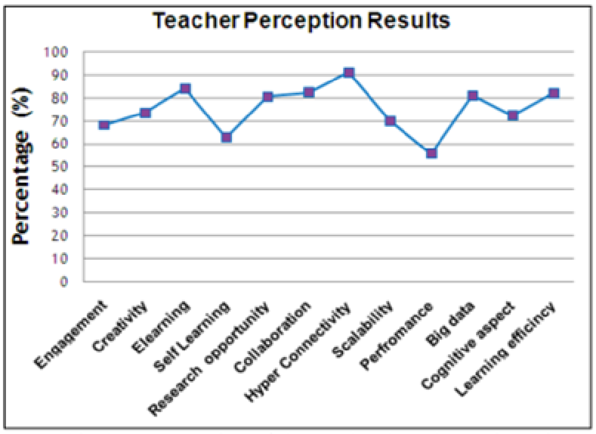

Fig. 8. Results of the teacher-based questionnaire represented graphically.

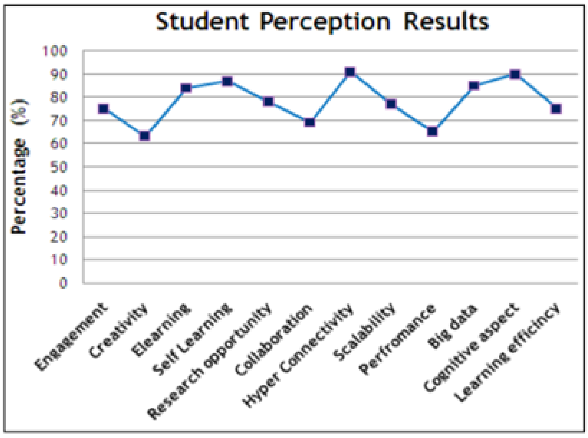

Fig. 9. Results of the student-based questionnaire represented graphically.

In Fig. 9, the outcome of the students' perception is displayed. As shown in Fig. 9, the student's prediction version can differ from the teacher's perception in some situations and exhibit some similarities in others. A comparison of two prediction versions is shown in Fig. 10.

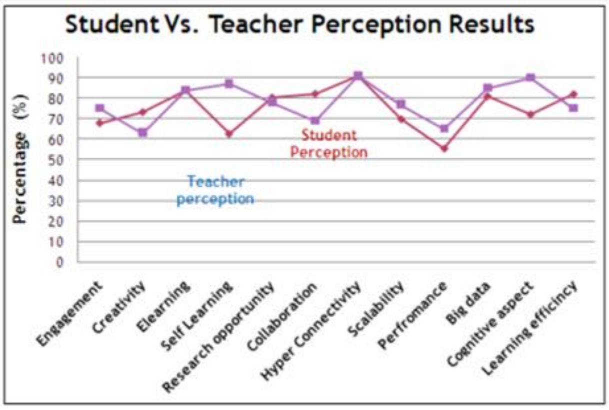

Fig. 10. Comparison of the teacher-based and student versions' forecasts.

Figure 10 displays the findings of a graphic comparison. According to Fig. 10, the three components of e-learning, research opportunities, and hyperconnectivity overlap in both scenarios. Both groups think that those elements in the higher education IoT ecosystem are significantly impacted by the IoT. The key distinction is that learners rated cognitive learning factors as having the greatest impact on their learning in the questionnaire. Also, the student's perspective on the self-learning component is crucial, although the teacher's perspective does not place the same weight on it. Another distinction between the two viewpoints is the role that IoT employment plays in better education about the collaboration problem. Students don't place the same value on collaboration and teamwork as teachers do, despite instructors' claims to the contrary. Finally, while teachers place a little lower priority on the same element than students do, both groups of students have a weak belief that the application of IoT can foster innovation in higher education.

4.1 Agility

The complexity of traditional education, the advancing capabilities of artificial intelligence, augmented reality, virtual reality, blockchain, and the best of 5G performance, as well as learning management systems and applications, all affect how quickly and easily smart education technologies can operate.

4.2 Adaptability and Comparison of Smart Education Innovative Technologies.

The ability of traditional education to adjust to changing circumstances is complex, and it is only moderately controlled for augmented reality, artificial intelligence, and virtual reality. Table 1 demonstrates the stark gap between modern smart education and conventional education.

Technology/ Features & Challenges	Agility	Adaptability	Integration	Interoperability	Reuse	Reliability	Quality	Learning Expe.	Cost	Safety	Proof Of Work	Op. Efficiency
Traditional Education	C	C	C	C	C	C	C	C	C	C	C	C
AI	I	M	I	M	M	M	I	I	R	-	N	R
AR and VR	I	M	I	M	M	M	I	I	R	-	-	-
Big Data	-	I	I	I	I	I	I	I	R	R	-	-
Blockchain	I	I	I	I	I	I	I	I	R	I	B	B
Cloud Computing	-	I	I	-	I	I	I	I	R	I	-	I
Data Science	-	-	I	-	-	M	I	I	R	-	-	M
IoT	-	I	I	C	R	I	I	B	R	R	-	S
ML and DL	-	I	-	-	I	-	I	I	R	I	-	-
5G	B	B	B	-	-	B	-	-	R	-	-	-
LMS &App.	B	B	B	B	B	B	I	I	R	-	B	I
STEM	Experiment, Discover, Thinking, Collaboration, etc.											
C-Complexity, I-Increased, R-Reduced, B-Better, M-Moderate, S-Support												

Table 1. A comparison of smart education innovative technologies [27]

Big data, blockchain, cloud computing, the internet of things, machine learning, and deep learning are all becoming more popular in terms of reacting to new advancements, while 5G performance, learning management systems, and applications are advancing.

4.3 Integration

While augmented reality, virtual reality, artificial intelligence, big data, cloud computing, blockchain technologies, the internet of things, and data science are all being moderately integrated, traditional education is still lagging behind in its ability to adapt to new or emerging technology. As 5G networks, learning management systems, and applications combine with current and upcoming technology, their performance improves.

4.4 Comparison of Smart and Traditional Educations

In terms of the students' overall development, connection and reaction, cognition, attention, teaching methods, persistence, comprehensibility, and accomplishment. A feature-by-feature comparison of traditional and modern schooling is provided in Table 2. A scalable and affordable smart education system is produced through successful technology adoption, which takes advantage of its advantages. Modern classroom usage of new technologies, as well as examples of these technologies' employment in entrepreneurial solutions, should be known to educational authorities and end users [28].

S/N	Parameter(s)	Traditional Education	Smart Education
1	Academic Independence	Classroom only	Through technology
2	Attainment Capability	Lower	Higher
3	Attention span	Very short	Fairly Large
4	Cognitive Ability	Limited	Enhanced
5	Evaluation	Prefixed	Continuous
6	Feedback	No provision	Evaluation with a feedback mechanism
7	Interaction	Limited	Enhanced
8	Learning Time	Fixed	Anytime & anywhere
9	Delivery	Teacher	Learner centric
10	Motivation	Teachers	self-motivated
11	Retention	Lower	Higher
12	Study type	Not promote	Promote. Group/ Collaborative
13	Understanding the ability	Limited	Much better

Table 2. Feature wise comparison of smart and traditional educations [27] [28].

University students, instructors, and administrators will all benefit greatly from the planned IoT-enhanced smart education's numerous new features and opportunities. By enabling remote participation in lectures and lab sessions, it will provide students greater flexibility in scheduling their time without sacrificing the valuable insights and information gained from in-person attendance. By engaging in simulated activities that are based on facts and behaviours that are realistically evolving, it will also make their learning more realistic. Additionally, it will enable them to use IoT devices easily and effectively to access data resources and save the required data. By utilising IoT devices to forecast the student's pleasure and perception of what he is learning and suggest/apply acceptable learning options, it will also improve the adaptive self-learning process.

Also, it will make it easier for students to cooperate with one another, connect with teachers, and interact with experts or professionals in other sectors. The IoT-enhanced LMS will give instructors the tools they need to oversee the evaluation of students' performance more effectively during lab sessions and assessments. Additionally, by evaluating the data collected by IoT sensors on students' learning strategies and methodologies, the IoT enhanced LMS will enable instructors to improve their teaching experiences and increase their understanding of students' perceptions of knowledge.

With the help of the IoT-enhanced LMS, teachers will be able to share data with both in-class and out-of-classroom students before and during the lecture. By connecting IoT devices and modules from both sides and running them via a shared LMS service, it creates new opportunities for collaboration and partnership with the industrial market and with various types of institutions, which is beneficial for university administrators. Additionally, the classroom monitoring tool will give the university management insight into what occurs during lectures without invading students' privacy or jeopardising instructors' confidence. Finally, the technology under consideration assists the administration in enhancing security at various campus areas and throughout activities.

Generally speaking, we anticipate that the suggested IoT-enhanced LMS will usher in a new era of learning management systems and pave the way for fresh areas of study. The initial version's starting point is defined by the eight applications that are suggested in this paper. Future developments in smart environments, apps, strategies, and inventions will further alter the LMS's form and appearance.

V. CONCLUSION

People's interactions on a virtual playing field have an impact on behavior and the learning process. The IOT has proven to be the finest technology now available for achieving the goal of effective and proficient remote learning, i.e., from anywhere to everyone. IOT tools can be used to evaluate and assess students' tendency, learning style, talents, and needs. Learning modules can be developed, adjusted, and executed in simple capsules in smart classrooms with the clear goal of meeting the needs of each student. IOT applications have also successfully and profitably addressed issues with cost-effectiveness, security precautions, management control, physical presence of teachers and students, studying exclusively in physical classrooms, etc. IoT technology removes the need for physical presence and provides access to all educational resources, including teachers, tools, and locations, effectively promoting online learning. IoT promises to have a substantial impact on the learning process in higher education by giving students and professors access to global resources and opportunities. As a result, one of the key effects of IoT-based smart learning environments is that they can significantly alter the jobs that students and instructors currently perform.

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