-Submitters should use the Conference President e-mail addresses

-All submissions will undergo a double-blind peer review by at least three external scholars› reviewers.

## 5. Important Dates:

- Abstracts Submission:
- Research Reports Final Submission Deadline:
- Final Notification of Acceptance/ Rejection:

## 6.Conference Participants Fees

All conference participants, including presenters of papers and attendees must register for the conference, and are urged to pay the appropriate voluntary registration fee as follows:

- Interested individuals 200 Egyptian pounds for each Egyptian participant and 200 US $ for non-Egyptian citizens.
- Faculty staff and trainers 100 Egyptian pounds for each person.
- ESISACT and other Egyptian non-governmental organization members are to pay 100 Egyptian pound for each.
- University and higher institution students only 50 Egyptian pounds each.
- Presenters and submitters of research papers and presentation reports are to pay 500 Egyptian pounds for each paper or report for Egyptians, and 200 US $ for foreigners.
- Organizations, institutions, companies and banks membership in ESISACT are free without charge for only 3 persons; otherwise, 300 Egyptian pounds for each organization when they are not members of ESISACT.
- Organizations, institutions, companies and banks sponsoring the conference 5000 Egyptian pounds for each.

## 7. CORESPONDENCES

ESISACT: http://www.esisact.com.eg/

Chairman of the Conference: Prof. Alaa Mohamed El Ghazali

Coordinator of the Conference: Dr. Hossam Ibrahim Elsobky

- The impact of Generative AI on the practices, policies and research directions in education or healthcare
- Education or healthcare in the era of generative Ai and its models
- Generative AI implications and considerations for Egyptian Higher Education.
- Revolutionizing education unleashing the power of ChatGPT/AI to empower educators and educational reform.
- Shaping the future of education or healthcare: Exploring the potential and consequences of generative AI and models.
- The emergence role of generative AI in medical education, research and practices.
- Opportunities, challenges, and future directions of generative AI in medical education.
- Generative AI in medicine and healthcare: Opportunities and challenges.

## 4. PAPER SUBMISSIONS

The paper submissions for the 27th Scientific Conference are to be in the following categories:

- **Full-length submissions:** Interested experts and researchers may submit a full-length original and previously un-published conceptual or empirical research manuscript for review and decision. Accepted papers will be published in the conference proceedings.
- • **Research-in-progress submissions:** Interested individual researchers who are engaged in post graduate studies or occupied in research projects for certain enterprises are urged to submit their research plans or projects in progress outcomes.
- **Abstracts**: All the above submitters of papers should provide and present abstracts of their papers of no more than 100 words indicating the key words to be utilized in the intended papers.
- **Paper manuscript Guidelines:**

- Manuscripts of full length and in-progress papers should not exceed 15 A4 pages, with a maximum of five figures / tables.

- Papers must be accompanied by a separate cover letter with every author (s) names, address, phone and fax numbers, e-mail, full affiliation, the track or theme to which it is submitted. All correspondences will be sent to the first author unless otherwise specified.

- Submitters must provide their e-mail address where the acknowledgement will be forwarded.

- The paper manuscript must contain, in its first page, the paper title, the author (names, an abstract and a list of keywords.

- All submitted papers must be electronically in MS Word and submitted electronically.

-The submitted papers must be carefully checked for correct grammar, and spelling.

technology. If you are still not sure how to introduce it in your company to transform your business operations, Plain Concepts, can help you.

Therefore, join us in exploring the cutting-edge world of Generative Artificial Intelligence in Education and Healthcare Conference

This 27th Scientific Conference is to focus on the future applications of Generative AI and models on both topics:

- **Generative AI in education:** The use of AI in the classroom may at first be met with some reluctance, but it is something we have been witnessing ever since it was proposed to introduce intelligent calculators in mathematics classes. Teachers will gradually introduce generative AI to generate notes, reports, lesson plans, summaries, and so on. It will also transform education by creating personalized learning experiences. Examples exist, such as Character.ai, a chat room allowing users to chat with AI-generated characters and historical figures.
- **Generative AI and Healthcare:** Thanks to this technology, The healthcare sector will also be one of the most beneficial and at the forefront. Historically, it is one of the most receptive to technological innovations, and this will be no exception. From the generation of synthetic medical images for training models to the creation of personalized treatment plans, generative AI will play a key role in advancing healthcare technologies, diagnostics, and patient care.

## 2. Conference Main Objectives

Whether you are an educator, researcher, teacher, student or industry professional, this conference is your gateway to understanding how generative AI is revolutionising the way we learn, teach and assess as well as the healthcare of the people. You will learn about cutting-edge technologies and large language models such as ChatGPT, Bard and Claude 2.

Understand how these tools and natural language processing capabilities enable personalized and interactive learning experiences through a series of keynotes, talks, discussion panels and hands on workshops, demonstrations and networking events with leading academics, researchers and industry experts in this area.

## 3. Conference Main Themes

The conference is to be organized to cover the following main themes:

- Future education and framework for the adoption of generative AI models.
- Future healthcare and the adoption of generative AI.
- Generative AI regulations on Education and Healthcare.
- Generative AI Revolutionizes Software Engineering.

Egyptian Society for Information
Systems and Computer Technology

# 27th Scientific Conference on Generative AI and Models Exploring in Future Education and Healthcare for Egyptian Institutions

## 1. Introduction

Generative AI is becoming an integral part of many people's personal and working lives for activities traditionally thought exclusive to the human mind, such as generating content and brainstorming. In our latest Capgemini Research Institute report, Why consumers love generative AI, we explore the potential of generative AI as well as its reception by consumers and their hopes around it.

But first, what is generative AI? Fundamentally, generative AI models have the capability to learn the properties and patterns of data for a wide range of applications - from creating text, images, and videos in different styles to generating personalized content, enabling machines to perform creative tasks that could previously only be completed by people. The different types of generative AI have a range of use cases across text, image and video, audio, chatbots, and search.

But, even with generative AI's huge transformative potential, there are areas of concern that organizations, consumers, and regulators will need to work together to navigate. These include a high level of consumer trust in generative AI, which can sometimes be misplaced and leave consumers vulnerable to threats in areas such as security, privacy, and misinformation.

Despite these potential downsides, it is clear that the impact of generative AI will be enormous. Its mass adoption by consumers in an unprecedented time frame is an indicator of the technology's usefulness in many areas. At the same time, protective mechanisms will be important, in addition to reasonable caution. As consumers continue their journey with generative AI, it will be up to all of us, including organizations and regulators, to ensure that its full potential is utilized in a positive way.

Generative AI is such a versatile tool with so much potential that it is set to become a mainstream

# Will the Next Version of GPTLike GPT-5 be the AGI?

OpenAI is actively working on GPT-5 (at least not publicly). Most industry experts believe that OpenAI would milk GPT-4 for a range of workflow automations. That is where the next 2-3 years of focus in AI industry would be – to make these cool toys used for day-to-day business.

Part of me is scared that a "good enough" AGI capability can be built on top of existing GPT-4 with advances in robotics, vector databases, visual languages and automation tools to connect all these in a workflow. The move from public datasets to private, industry datasets can make them freakishly smart – better than human experts in that industry. While they don't have sentience, I periodically forget that I'm talking to a machine already. I don't know of very many jobs that GPT4 cannot do, if we parallelly fix issues in robotic hardware and navigation.

Aso we could thinks that technology progress doesn't go linearly. We hit limits on many of these techs fairly quickly. For instance, in 1968 when Boeing 747 was introduced, the industry thought that better planes would come quite soon and the 747 would last only about half decade. 55 years later, it is still the key standard in airlines. While we could break sound barrier, the other parts of airline tech didn't grow linearly to make supersonic flights commercially feasible and comfortable.

Same happened in the moon landing. People thought if in 10 years we could launch a sound rocket to actually put man on moon, we would be landing on Mars in 1970s. Tech and financial limits hit quickly and we are not substantially more advanced in space tech compared to the 1960s.

In our own lifetime, we saw how a cool Google search of circa 2000 became ugly POS by 2023, ran over by SEO companies. For 25 years search was stagnant. OpenAI could get as complacent as the Google management and not push for more.

And we might hit GPU and energy limits soon, and 50 years later our grandkids might still be using GPT4 just as we are using our grandfather tech

generative adversarial models or GANs. There are close to 500+ papers on this topic, and almost 3 dozen variants of GANs with more appearing every week. However, there are barely any papers that show 1) whether GANs will converge reliably when trained (the original GANs do not!) 2) what the sample complexity of GANs are (no one knows) 3) what GANs can and cannot do. There's as far as I know 1-2 papers that attempt to give a theory of GANs, a particularly nice paper by Sanjeev Arora and colleagues, which is largely a negative result. It shows that the original GAN model does not converge, but that a modified multiple generator/ multiple discriminator model might converge, in a very weak sense. Yet, this has not dampened any of the excitement about this model, far from it.

There's also a collective sense of loss of reality when folks get excited about models like GANs. These models taken thousands and thousands of iterations to converge (when they do, and often, they don't), and each iteration requires many many passes through the data. At the end of the day, you burn through millions of CPU cycles, and you have to wonder whether after burning all that energy: is the game worth the candle? Where's all this energy getting us? is it leading us to a solid scientifically based theory of how to build a theory of unsupervised learning? The vast majority of GAN papers are largely empirical, showing cute pictures of what a variant of GAN can do, but the metrics are often either non-existent or somewhat artificial.

So, many of us in the field indeed do look forward to a life beyond deep learning, where we can not only build impressive empirically substantiated learning systems, but also have a solid theory underlying it.

If you want an example of a truly "deep" science, look no further than this year's Nobel prize for the design of LIGO detectors, capping a 100 years of effort to detect gravitational waves from Einstein's general relativity theory. We can now detect collisions among black holes 2 billion light years away releasing more energy in one collision than all the energy from all the stars in the observable universe. And there's a very substantial amount of nontrivial mathematics that went into the building of the LIGO detectors and in advances in general relativity theory.

That's what a true "deep" learning theory should look like. I am confident that one day, machine learning will get there, but it will take many years of effort, and physicists provide us with an inspiration of what can be achieved

# What is Next After Deep Learning

The first, and most important thing, to realize about deep learning is that it is not a "deep" subject, meaning that it is a very "shallow" topic with almost no theory underlying it. There are no guarantees of convergence (since we are after all talking about nonlinear optimization in high-dimensional spaces), and no performance guarantees of any kind (say, compared to what you get with other areas of machine learning, like kernel methods, sparse linear models etc.). It's essentially like woodworking without physics. If you mix this type of polish with that kind of wood, you get this sort of effect. The reason that there invariably has to be a future beyond deep learning is that one cannot build a solid engineering science of machine learning with bricks built out of hay. As Vladimir Vapnik once said, "The most practical thing in the world is good theory", and that's currently not available in deep learning. If deep learning is the best solution the machine learning community can do, as a card carrying member of this research community for over 30+ years, I'd have to say we are in serious trouble!

Let's just take one example, the current rage over

course not. We like to see automation as a one-to-one replacement, with the manager grabbing the back of the person's wheely chair and rolling them out to the sidewalk, then rolling a robot into their place. What normally happens is a much slower and subtle change; sometimes so slow and subtle that nobody notices. These automations become tools used by the people they're supposedly replacing. In this case, an artist might be tasked with presenting a variety of designs for a character. The artist is still using their artistic training to make decisions, but the slow drawing process is accelerated, although sometimes "tweeks" will still need to be made.

This often leads to a phenomenon known as elasticity in the market. Because artists are more efficient (and therefore cheaper for a give amount of work) more artistic projects get approved, and more passion projects get off the ground.

So we have two competing forces. One the one hand, a manager doesn't need to hire as many artists to get the same amount of artwork done. On the other, new ways and new projects become possible thanks to the increase in efficiency. It's very hard to tell which one will be the dominant force going forward. I predict we're going to see example of both, with large firms slowing hiring or laying off artists, and smaller firms or independent creators suddenly finding a voice.

Will there be more or fewer artists in the future? I don't think that number going to change a lot. People have always wanted to make art going back to long before we had money to pay them for it. The fact that AI can help us make it isn't going to stop us.

Oh yeah. The same argument applies to the "but AI can't do hands" argument. The memes being posted in other answers are 3 Midjourney releases old.This is what Midjourney hands look like as of September 2023. Even the hobbyist-made Stable Diffusion models (that can be run at home) are doing a pretty decent job at hands. They're within the range of quality that you get from paid artists

# Is Artificial Intelligence Making Artists Obsolete?

Not yet. You'll see other answers which show how bad AI art is. "Hey look, it got the number of legs wrong!"

Here's the thing. It's really really new. It's improving every day, and not all AI art generators are the same. You can cherry pick a particular bad generation, from a particular underdeveloped AI model all you want. You're basically doing the same thing as holding up a 3 year old's crayon drawing as a representation of how bad human artists are. Give the 3 year old 20 years of practice. Give the AI 2 years. Six months ago, the favorite whipping boy was how badly AI could do hands. You'll noticed that those making that gleeful observation have gone strangely quiet lately

The most highly voted answer (e.g. the one that strokes are human ego the most) used a unicorn to demonstrate how bad AI can be. Let's do the same.

This was done on a home system with a model created by hobbyists. You can nitpick details, but you can do that with any painting, and at least some of them will be the result of concious decisions made by the person running the generation (aka artistic vision). This is V5 of the model. V1 came out a year ago. Now let's see what a professionally trained system (Midjourney V5.1) can do.

It's not exactly the laughable straw man (horse) that we see in other posts. While you can absolutely make AI generate bad images, or cherry pick bad ones (there's no shortage right now), the fact is that it can also create perfectly usable images for a variety of applications that you would normally hire an artist for. Will this mean that artists will become obsolete? Of

This is the challenge before business leaders right now; and it's a hard one. The answer starts with integrating AI into your organization and iterating from there. Because while AI will enable people and organizations to achieve more, we're at the very beginning of defining what "more" looks like. But to move ahead, we need to put in place the conditions that we help us discover what comes next.

One of the really exciting things about using AI to be more efficient – whether that's using generative AI to get ideas or to conduct research – is that it allows you to think more deeply about a concept or a problem you're trying to solve. It's not a far leap to imagine how this level of concentrated effort is going to enable companies to develop truly new and innovative solutions faster; and then take advantage of the snowball effect of that speed.

**Throughout: Prioritize Security & Responsible AI**

Alongside all of AI's promise, one thing is certain. We will not realize AI's full potential without safeguards. Technology has always been an accelerator and an enabler. AI is no different, but it does present potential risks that have to be managed.

For any company, the success of Responsible AI initiatives depends on at least three things. First, it takes committed and involved leadership. (Microsoft's Vice Chair and President, Brad Smith, and our Chief Technology Officer, Kevin Scott, chair our Responsible AI Council.) Second, companies must build inclusive governance models and actionable guidelines, as we have done. Finally, they must also invest in responsible AI in the form of new engineering systems, incubations that are research-led, and in the people who will ensure that responsible AI principles are put into practice. At Microsoft, we have hundreds of people working on this, and for many of them, it's their full-time job. Beyond that, we've adopted the mindset that using AI responsibly is a responsibility we all share, no matter your role.

The **AI roadmap** will be different for every organization, and it looks different depending on whether you're a tech company or not. Tech companies are more likely to have already implemented some form of intelligent agent into their software experiences, for example. But for everyone, the potential is massive, and the time to start is now.

Just like ride-sharing needed smartphones, there are as-yet conceived industries that will need AI to get off the ground. Most of us recognize that AI will be completely game-changing. We see the practical applications – not only for the tech landscape but for humanity, and that's what's truly profound about this. The AI market is moving quickly, and the cycles in and around AI are faster than we've ever seen. Right now, there is tremendous opportunity for business leaders to embrace AI and adapt to the profound changes that are coming. There is exponentially greater opportunity for the businesses that use AI to lead and drive that change.

tain tasks. Less than two years since its launch, GitHub's Copilot is already writing 46% of the code on its repository and helps developers code up to 55% faster. Imagine what developers are doing with that extra time. Three out of four users say it helps them conserve mental energy and focus on more satisfying work. Said another way: Creating new things and solving new problems.

Consider the workflows and process-driven activities in your business: things like payroll, on-boarding, or IT help desk support. These are all repeatable, rules-based processes that can be streamlined with AI. This is the driver behind an entire new category of AI software that can handle manual tasks and reshape scores of business processes.

There's another way to think about AI for productivity: time. If you're in fraud detection, or you're a security analyst, time can be your biggest asset or your biggest challenge. If you can shorten the amount of time it takes to comb through lots of data-rich, time-sensitive information, you're already better and more effective at your job.

**Transform Experiences**

Today, AI is already impacting how businesses deliver experiences that are better, faster, more efficient, or entirely new, from predictive text on your phone to chatbots on websites to suggested searches when you open a browser.

As an example, PwC is using Azure OpenAI Service to expand and scale its own AI offerings while also helping clients in industries like insurance or healthcare reimagine their businesses by leveraging the power of generative AI. CarMax is using it to analyze hundreds of thousands of customer reviews and surface key takeaways for buyers about every make, model, and year of vehicle in its inventory.

Even in its early stages, AI is making employee experiences better too. A recent Microsoft survey found that 89% of employees and business decision makers with access to automation and AI-powered tools feel more fulfilled. They say it's because they can spend time on work that truly matters. Nine out of 10 said they want the opportunity to apply AI solutions to even more tasks and activities.

I see that happening already in some of the organizations I work with. They're pursuing more advanced AI in use cases like customer support, writing assistance, or data extraction and classification. The common thread in each of these involves using AI to leverage resources or information you already have to transform experiences for people.

**Build New Things**

The above steps are versions of using the "new thing" to do old things better, to borrow my colleague's turn of phrase. But how can you use the new thing to actually do new things? What can you do that's completely different? How can you delight customers and create new lines of business and, with them, new revenue?

you use the new thing to … do new things. He's right. Consider an example from health care. Paige is a software company using AI to change the way doctors identify, diagnose, and treat cancers. With properly trained and tuned models, AI can look at thousands of digital pathology images, pixel by pixel, and detect abnormalities faster and with more accuracy. Imagine what these tools can unlock not only for pathologists and doctors, but for patients, too. It means earlier disease detection, healthier lives, and more time with loved ones.

Right now, every company, no matter the size or industry, should be thinking about AI. AI is moving from its auto-pilot phase, which was all about narrow, purpose-built tools that use machine learning models to make predictions, recommendations, and automate, to its copilot phase, where there's tremendous opportunity to revolutionize how just about everything gets done. Leaders who embrace AI now and take action to understand it, experiment with it, and envision how it can solve hard problems are going to run companies that thrive in an AI world.

But where should they start? Nearly every day, we talk with business leaders who ask important questions about AI's potential. No matter where you are in your AI journey, it's incumbent upon every leader to embrace this unique time and take advantage of this powerful technology. If you feel unsure how to start, or how to move forward, you're not alone. Like any business-planning exercise, think about your AI strategy in phases. Embrace agility and change, and keep a continuous learning mindset, calibrating and adjusting your gameplan as you go.

### Start by Experimenting

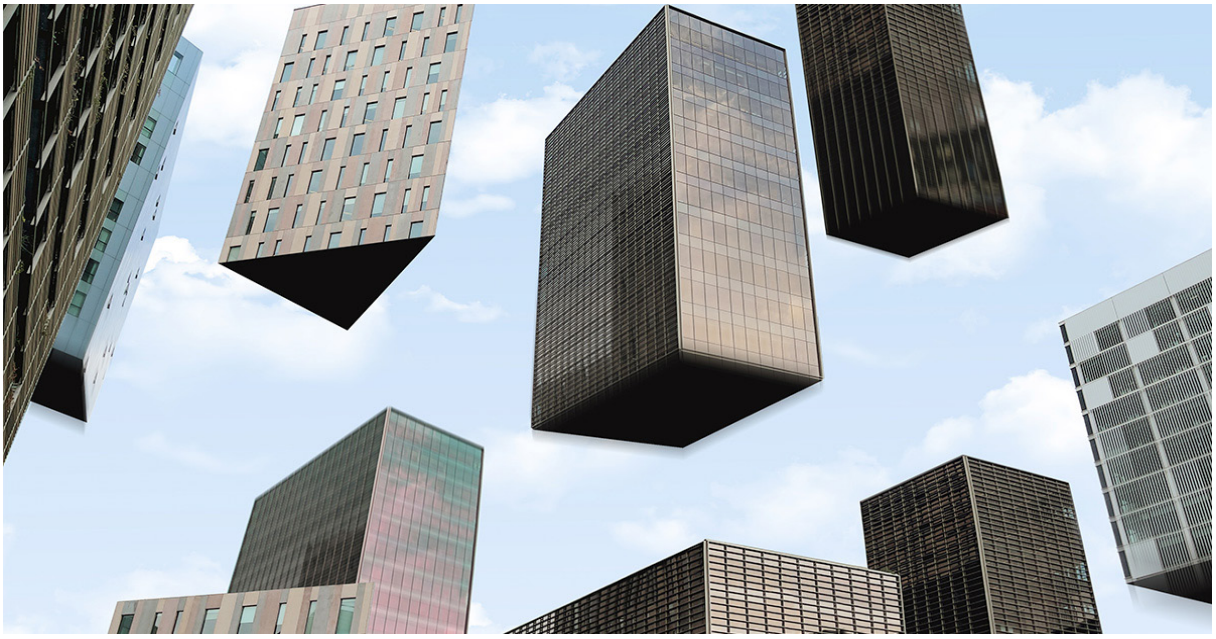
The best way to learn about AI is to use it. It's rare for new and disruptive technology to be immediately accessible. This is. Most of the leaders I talk with have tried popular AI applications like ChatGPT or the new Bing. There are many other options out there, but the point is to get curious.

Try applying it to whatever task is in front of you and see what it's good at and what it's not. Use it to generate interview questions, write a memo, research and summarize a topic you want to learn more about, or get thought starters for a document. I used Bing and ChatGPT to help me get ideas for a speech. I've used Microsoft 365 Copilot, the AI integration across Microsoft apps to generate slides, to find and summarize documents that share a topic, and to recap email exchanges with colleagues. By using and experimenting with AI, you'll be in a better position to imagine how it could be used in your organization – and you likely know better than anyone where opportunities and potential exist.

### Deploy for Productivity

When it comes to productivity, AI copilots – from Microsoft and from others – can be deployed or embedded in applications to assist or simplify cer-

# Build a Winning AI Strategy for Your Business



Artificial intelligence is a kind of catalyst; it's the next wave of truly transformative technology with potential we cannot yet fully envision or appreciate. Companies will start by using this new technology to do "old things" before discovering the new opportunities it...more

Recently, like millions of people, we are using a ride-sharing app on our smartphone. It was pretty uneventful and not something I gave much thought. Ride-sharing is simple and convenient, and it's now an $80+ billion industry. But we weren't that long ago that it didn't even exist. We had cars, we had riders, and we had drivers; but to work, ride-sharing needed smartphones. When they arrived, so did an enormous variety of conveniences and new experiences – some that became entire industries – that we never could have imagined.

Artificial intelligence is a similar kind of catalyst; it's the next wave of truly transformative technology with potential we cannot yet fully envision or appreciate. It is the defining technology of our time, changing the way we live and work. In my entire career in tech, I've never been more excited and optimistic than I am now. I have a colleague at Microsoft who talks about AI like this: You've got to use the "new thing" to do old things better. Then,

quires either giving their proprietary LLM provider access to their data or allowing the provider to deploy the proprietary model within the customer organization. This becomes a privacy issue because private and sensitive data will be accessible to people outside of the internal organization, leaving room for data breaches.

**Is this a problem that involves all company data -- for example, should a company be worried about ChatGPT using the results of that company's publicly distributed survey -- or is the concern only about confidential data (such as PII or internal data such as sales figures)?**

The main concern is around confidential data (such as PII) or internal data (such as sales figures). However, in the example of a company's publicly distributed survey, despite that survey being public, the data being input into the survey might be private or sensitive -- for example, email addresses. Although respondents are typically required to agree to a privacy statement before filling out a survey, this likely does not give the company permission to use PII for model training and inference.

**Are companies aware of the problem or the security measures that are needed to protect data in this emerging age of generative AI?**

Companies have a general awareness of possible privacy and security concerns, but because generative AI is still in the emerging stages and people are learning as they go, many have gaps in their understanding of the risks and how to mitigate them. That's why we're releasing our Confidential AI solution while it's still in the testing stages so that people can start understanding the possible solutions for remedying these concerns.

**What, to your knowledge, is happening at generative AI companies, such as OpenAI, to address security and privacy issues?**

Generally, companies seem to be more concerned about bringing their own models to the market to remain competitive. However, those who are trying to address these issues, such as OpenAI, are leaning heavily on lobbying for regulation and guidelines to help people use this technology safely and ethically.

**Until these issues are solved, what best practices do you recommend for enhancing security and privacy?**

Lacking a proven privacy and security solution, LLM users must exercise caution. Organizations should set and enforce usage guidelines and educate employees about the potential pitfalls. Case in point: Alphabet, Google's parent company, recently warned employees about using confidential information on AI chatbots. A full ban is not practical given the proliferation of tools, with more AI models and applications becoming available every day. Education remains the most effective way to reduce the risk until solutions such as Opaque's become widely available.

# Generative AI Poses Security Risks

Generative AI can be a great productivity booster, but concerns over protecting the data used to train LLMs -- even the public-facing data -- are driving enterprises to carefully consider how the technology is used. Opaque Systems' VP of product, Jay Harel, explains.

**Upside: Generative AI seems to have taken the world by storm, but many issues remain, among them security and privacy**.

Jay Harel: There are three main issues when it comes to generative AI and privacy, especially in terms of large language models (LLMs). The first issue surrounds queries. Any LLM provider can have visibility into the queries entered by their users, which may include sensitive information such as proprietary code or personal identifiable information (PII). This may lead to information loss or privacy-regulation infringements.

The second issue comes with learning and training AI models. To train AI models, the provider must use fresh training data. This data is retained by the AI model, increasing the chances of sensitive information leaking or landing in the wrong hands.

Finally, there are IP issues for organizations with proprietary models. Organizations want to fine-tune their models on company data, but this re-

The Influence of Leadership and Work Motivation on Employee Performance in the Non-Medical Section of Buah Hati Hospital, Ciputat, South Tangerang. International Journal of Social and Management Studies, 3(3), 163-175.

[29] Mubarok, K., & Suparmi, S. (2023). The Effect of Work Environment and Work Responsibility on Employee Performance at Demak Agung Mosque. In Proceeding of the International Conference on Business and Economics (Vol. 1, No. 1, pp. 86-98).

[30] Kristiadi, A. A., Debataraja, R. U., & Silitonga, P. (2022). Employee Performance Improvement at the Grand Mercure Hotel Jakarta Kemayoran through Talent Development Initiatives. International Journal of Science and Society, 4(1), 102-125.

[31] Azar, A. T. (2012). Overview of Type-2 Fuzzy Logic Systems. International Journal of Fuzzy System Applications (IJFSA), 2(4), 1-28.

[32] Comas, D. S., Pastore, J. I., Bouchet, A., Ballarin, V. L., & Meschino, G. J. (2014). Type-2 fuzzy logic in decision support systems. Soft Computing for Business Intelligence, 267-280.

[33] Ren, Q., Balazinski, M., & Baron, L. (2011). Type-2 TSK fuzzy logic system and its type-1 counterpart. International Journal of Computer Applications, 20(6), 8-13.

[34] Runkler, T., Coupland, S., & John, R. (2017). Interval Type-2 Fuzzy Decision Making. International Journal of Approximate Reasoning, 80, 217-224.

[35] Minutolo, A., Esposito, M., & De Pietro, G. (2016). A Fuzzy Framework for Encoding Uncertainty In Clinical Decision-Making. Knowledge-Based Systems, 98, 95-116.

[36] Gupta, S., Modgil, S., Bhattacharyya, S., & Bose, I. (2022). Artificial intelligence for decision support systems in the field of operations research: review and future scope of research. Annals of Operations Research, 1-60.

[37] Jiskani, I. M., Cai, Q., Zhou, W., Lu, X., & Shah, S. A. A. (2022). An Integrated Fuzzy Decision Support System for Analyzing Challenges and Pathways to Promote Green and Climate Smart Mining. Expert Systems with Applications, 188, 116062.

[38] Nascimento, D., & Notargiacomo, P. (2023). Proposal for an Expert System for Knowledge Evaluation And Corporate Training Suggestions. In Inted2023 Proceedings (Pp. 6250-6257). Iated.

[39] http://juzzy.wagnerweb.net/

[40] Knauf, R., Gonzalez, A. J., & Abel, T. (2002). A Framework for Validation of Rule-Based Systems. IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics), 32(3), 281-295.

[41] Bartoš, J., & Walek, B. (2013, July). A Methodology for Testing of Information System under Uncertainty. In 2013 36th International Conference on Telecommunications and Signal Processing (TSP) (pp. 20-22). IEEE.

[42] Batarseh, F. A., & Gonzalez, A. J. (2015). Validation of Knowledge-Based Systems: A Reassessment of the Field. Artificial Intelligence Review, 43, 485-500.

Journal of Economics, Business and Accounting, 1-9.

[14] Michalopoulos, D., Karras, A., Karras, C., Sioutas, S., & Giotopoulos, K. (2022). Neuro-Fuzzy Employee Ranking System in the Public Sector. Volume 358: Fuzzy Systems and Data Mining VIII, 325-333.

[15] Amihai, and Philippe Smets, eds. (2012). «Uncertainty Management In Information Systems: From Needs to Solutions». Springer Science & Business Media.

[16] Maitra, S., & Gupta, N. (2013). A Hybrid Approach for Handling Uncertainty-Probabilistic Theory, Certainty Factor and Fuzzy Logic. International Journal of Computer Science and Mobile Computing, 2(11), 70-78.

[17] Dubey, S., Pandey, R. K., & Gautam, S. S. (2014). Dealing with Uncertainty in Expert Systems. International Journal of Soft Computing and Engineering, 4(3), 105-111.

[18] Moftah, K., Abdelmawgoud, M., Abd, M. A. E. M. E., & Salam, E. (2023). Measuring the Level of Employees Performance in Cairo›s Hotel Chains: An Analytic Study. Journal of the Faculty of Tourism and Hotels-University of Sadat City, 7(1/1).

[19] Alfandi, A. M. (2020). Hotel-Related Factors and Employee Performance» The Case of Jordanian Four Star Hotels. International business research, 13(3), 68-78.

[20] Zebua, S., & Chakim, M. H. R. (2023). Effect of Human Resources Quality, Performance Evaluation, and Incentives on Employee Productivity at Raharja High School. APTISI Transactions on Management (ATM), 7(1), 1-7.

[21] Alhabib, R., & Alsultan, M. (2021). The Impact of the Dimensions of Strategic Intelligence on the Performance of Workers: A Field Study in the Ministry of Human Resources and Social Development in the Qassim Res Militaris. The Arab Journal for Scientific Publishing (AJSP), 13(1).

[22] Sugiyanta, Y., Suyono, J., Elisabeth, D. R., Chikmawati, Z., & Zulkifli, C. Z. (2021). The Mediating Role of Work Environment in Relationship between Leadership and Job Promotion on Employee Performance. In Proceedings of the Annual International Conference on Industrial Engineering and Operations Management Singapore (pp. 1-17)

[23] Li, G., Zong, Q., Chen, X., & Song, M. (2023). Intergovernmental Environmental Affairs Division and Environmental Public Services Supply: Evidence from 289 Cities in China. Energy & Environment, 0958305X231201974.

[24] Reklitis, P., Sakas, D. P., Trivellas, P., & Tsoulfas, G. T. (2021). Performance Implications of Aligning Supply Chain Practices with Competitive Advantage: Empirical Evidence from the Agri-Food Sector. Sustainability, 13(16), 8734.

[25] Zadeh, Lotfi A. (1965).Fuzzy Sets. Information and control 8.3, 338-353.

[26] Zadeh, Lotfi Asker. (1975). The Concept of a Linguistic Variable and Its Application to Approximate Reasoning–I. Information sciences 8.3, 199-249.

[27] Mendel, J. M. (2003). Type-2 Fuzzy Sets: Some Questions and Answers. IEEE Connections, Newsletter of the IEEE Neural Networks Society, 1, 10-13.

[28] Farida, S. I., Zulkarnaen, I., & Hidayat, A. (2022).

was carried out. Since the hotel segment primarily depends on its employees, employee performance in hotels is a more significant success component than in any other industry. This approach has produced rational and more accurate compression results as compared to the type 1-fuzzy system. Future research can employ more systems with diverse applications to assess the type-2 fuzzy-based system that has been suggested.

## REFERENCES


[1] Derebew, B., Thota, S., Shanmugasundaram, P., & Asfetsami, T. (2021). Fuzzy Logic Decision Support System for Hospital Employee Performance Evaluation with Maple Implementation. Arab Journal of Basic and Applied Sciences, 28(1), 73-79.

[2] Giotopoulos, K. C., Michalopoulos, D., Karras, A., Karras, C., & Sioutas, S. (2023). Modelling and Analysis of Neuro Fuzzy Employee Ranking System In the Public Sector. Algorithms, 16(3), 151.

[3] Harl, M. I., Saeed, M., Saeed, M. H., Alballa, T., & Khalifa, H. A. E. W. (2023). Human Intuitionistic Data-Based Employee Performance Evaluation with Similarity Measure Using Lattice Ordered Picture Fuzzy Hypersoft Sets. IEEE Access.

[4] Nikmanesh, M., Feili, A., & Sorooshian, S. (2023). Employee Productivity Assessment Using Fuzzy Inference System. Information, 14(7), 423.

[5] De, A. K., Chakraborty, D., & Biswas, A. (2022). Literature Review on Type-2 Fuzzy Set Theory. Soft Computing, 26(18), 9049-9068.

[6] Madi, E. N., Zakaria, Z. A., Sambas, A., & Sukono. (2023). Toward Effective Uncertainty Management in Decision-Making Models Based on Type-2 Fuzzy TOPSIS. Mathematics, 11(16), 3512.

[7] Ramirez, M., & Melin, P. (2023). A New Perspective for Multivariate Time Series Decision Making through a Nested Computational Approach Using Type-2 Fuzzy Integration. Axioms, 12(4), 385.

[8] Khorami, M., & Ehsani, R. (2015). Application Of Multi Criteria Decision Making Approaches For Personnel Selection Problem: A Survey. International journal of engineering research and applications, 5(5), 14-29.

[9] Mikuli, I., Lisjak, D., & Štefani, N. (2021). A Rule-Based System for Human Performance Evaluation: A Case Study. Applied Sciences, 11(7), 2904.

[10] Kochenderfer, M. J. (2015). Decision Making Under Uncertainty: Theory and Application. MIT press.

[11] Rezaee Kelidbari, H. (2019). Presentation of the Human Resource Performance Assessment Model using Fuzzy Inference System (FIS). Journal of Operational Research In Its Applications (Applied Mathematics)-Lahijan Azad University, 15(4), 79-95.

[12] Ojokoh, B., Asogbon, M. G., Samuel, O. W., & Adeniyi, B. S. (2020). Fuzzy Driven Decision Support System for Enhanced Employee Performance Appraisal. International Journal of Human Capital and Information Technology Professionals (IJHCITP), 11(1), 17-30.

[13] Pathirana, G. Y., Kuruppu, C. L., & Rodrigo, J. A. H. N. (2022). The Impact Of Job Satisfaction On Employee Performance: A Case At ABC Manufacturing Company. Asian

The final objective of this study was to present DSS to evaluate employee performance in Cairo›s hotel chains. The main novelties of this research are shown in the following points:

• Obtaining Cairo›s hotel chains experts' knowledge to evaluate employee performance.

• Handle vague and imprecise of experts› responses by utilizing the type-2 fuzzy set.

• Presenting a DSS to determine the employee performance in hotel industry as fair, good, very good and excellent based on type-2 fuzzy sets.

• Discovering the importance of type-2 fuzzy set by introducing a comparison between the type-1 fuzzy system and the proposed system based on type-2 fuzzy set.

Table 1 shows the comparison of sample results obtained by type-1 fuzzy DSS and the proposed type-2 fuzzy DSS. The results shows that type 1-fuzzy system is limited as it cannot represent impreciseness as a feature of human thinking. The results shows that a slight difference between the proposed system and type-1 fuzzy system but by comparing the results within the experts, it is concluded that the results of the proposed system based on type-2 set is near to expert answers. Also, it is concluded that the level of commitment and, adaptability and are among the most important factors that affect employee performance evaluation.

Table 1. A comparison between type-1 and type-2 fuzzy DSS results

| No. | Inputs | | | | | | Output | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | LC | PS | A&F | TW | LTC | S | Type -١fuzzy system | | Type٢- fuzzy system (Proposed System) | |
| 1. | 5 | 4 | 4 | 4 | 5 | 5 | 4.3 | Good | 4.4 | Good |
| 2. | 6 | 5 | 6 | 7 | 5 | 6 | 6.2 | V. Good | 6.3 | V. Good |
| 3. | 6 | 7 | 5 | 5 | 5 | 7 | 6.2 | V. Good | 6.3 | V. Good |
| 4. | 7 | 9 | 5 | 6 | 8 | 7 | 6.2 | V. Good | 6.3 | V. Good |
| 5. | 5 | 6 | 7 | 7 | 5 | 6 | 6.2 | V. Good | 6.3 | V. Good |
| 6. | 6 | 6 | 6 | 6 | 6 | 6 | 7 | Excellent | 6.7 | V. Good |
| 7. | 7 | 6 | 6 | 6 | 6 | 6 | 7 | Excellent | 6.7 | V. Good |
| 8. | 6 | 8 | 8 | 8 | 6 | 7 | 7.4 | Excellent | 7.7 | Excellent |
| 9. | 6 | 8 | 7 | 8 | 6 | 7 | 7.4 | Excellent | 7.8 | Excellent |
| 10. | 7 | 7 | 7 | 7 | 7 | 7 | 8.3 | Excellent | 8.2 | Excellent |
| 11. | 8 | 8 | 6 | 7 | 8 | 5 | 8.3 | Excellent | 8.2 | Excellent |
| 12. | 8 | 6 | 6 | 7 | 7 | 6 | 8.3 | Excellent | 8.2 | Excellent |
| 13. | 9 | 7 | 7 | 7 | 9 | 7 | 8.3 | Excellent | 8.2 | Excellent |

## 5. CONCLUSION

Expert systems and DSSs are examples of artificial intelligence fields that rely not only just on true information, but also on knowledge that is ambiguous. For instance, when questioned about a certain statement, an expert›s view might be vague and imprecise. Degrees of uncertainty that are challenging to represent using type-1 fuzzy sets can be described using type-2 fuzzy sets. When comparing a type-2 fuzzy set to a type-1 fuzzy set, the extra dimension offers more degrees of freedom, which improves the uncertainty representation. Because of this, type-2 fuzzy sets can manage higher degrees of uncertainty, which has hindered the effective use of fuzzy systems in decision-making.

This paper presents a type-2 fuzzy set-based decision support system for evaluating employee performance in the hotel business. The ambiguity of concepts connected to human expert assessments has been mitigated through the use of type-2 fuzzy sets. To enhance the knowledge base, the system validation

that of human experts. Several tests are prepared to assess whether the system is compatible with predefined criteria, where the test does not involve the subjective opinions of the tester. These methods involve the following steps: identifying criteria for testing that cover the domain and generating a set of questions to validate knowledge base. The results from the system are then compared to those from experts. The experts› answers provide suggestions while also acknowledging the lack of certainty in the ratings. Next, in order to enhance the knowledge base, mistakes are found and corrected using the outcomes of the experimental processes as shown in Figure 9 [40, 41].

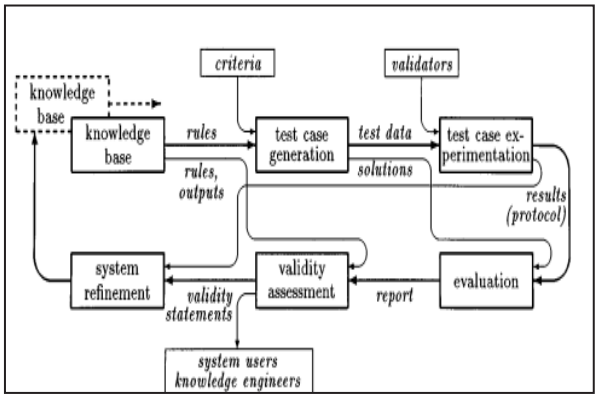



Figure 9. Validation Process [40]

Various validation strategies result in varying demands on the development team and specialists. Both the knowledge engineer and the expert are burdened by such validation. Adhering to a specified procedure aimed at enhancing system coverage is crucial. Managers in a software development environment are very interested in the testing coverage levels and final findings. The most widely accepted method for achieving quantifiable characteristics to support managers in their planning is to use a lifecycle model. Planning and scheduling are crucial to the software development process from a management perspective. As a result, validation techniques ought to be customized to support management in adhering to the procedure and assessing performance in relation to deadlines [40-42].

## 4. DISCUSSION AND RESULTS

In type-1 fuzzy, the degree to which the object›s features are achieved should be ascertained by an expert. For example, there are three red balls. The first is 75% red, the second is 85% red, and the third is 95% red. In type-2 fuzzy, experts are unable to pinpoint the precise level of obtaining the feature. For instance, suppose that there are three red balls. The first one is red by 70%-80%, the second by 85%-90%, and the third by 93%-100%. It therefore displays an interval fuzzy set. Expert knowledge modelling has made extensive use of DSSs. Determining the system›s output through the evaluation of fuzzy predicates and fuzzy sets is one known implementation strategy. Despite the widespread usage of type-1 fuzzy sets in this kind of implementation, some sources of uncertainty cannot be sufficiently described through the application of expert knowledge, limiting their impact on the output of the system, particularly when the information is derived from disparate expert viewpoints.

An expansion of type-1 fuzzy sets are type-2 fuzzy sets. A type-1 fuzzy sets determines the membership value, often known as the degree of truth. These sets minimize the impact of uncertainties by allowing for better models of uncertainty in DSSs based on the knowledge of experts. Even if various viewpoints could result in various membership functions, a unique model can still be created using type-2 fuzzy sets.

level of commitment (LC), aptitude for problem-solving (PS), level of adaptability and flexibility (A&F), aptitude for teamwork (TW), level of time commitment (LTC), and level of steadiness under stress (S), knowledge base of the system, and the output membership of the system quality as shown in Figure 5 and Figure 6.

3. The proper type-2 fuzzy set membership functions are given inputs. This process is known as the fuzzification process.

4. The defined type-2 fuzzy sets are used as inputs by the inference engine to create the rules, which are subsequently saved in the knowledge base, shown in Figure 7.

5. The type-2 fuzzy sets are then reduced to a single value in the cycle›s last phase. Defuzzification is the term used for this procedure.

6. Creating and putting into use the DSS utilizing the earlier established inputs, rules, and output to display the outcomes as shown in Figure 8.

7. Validating the suggested DSS to make sure that, when given the same inputs, the output of the intelligent system is equal to that of experts. The knowledge base is then improved by using the outcomes of the validation stages to identify and correct faults.

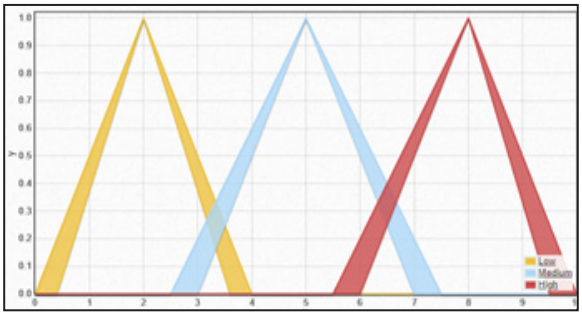



Figure 5. Commitment Level Input Membership

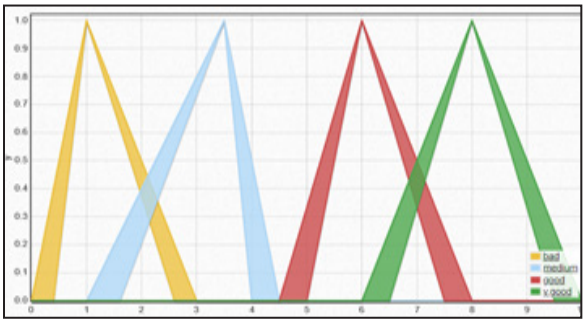



Figure 6. Aptitude of Problem-solving Input membership

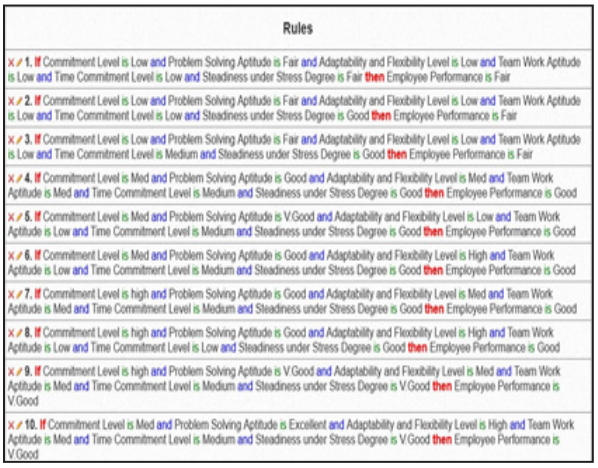



Figure 7. Employee Performance System Knowledge Base

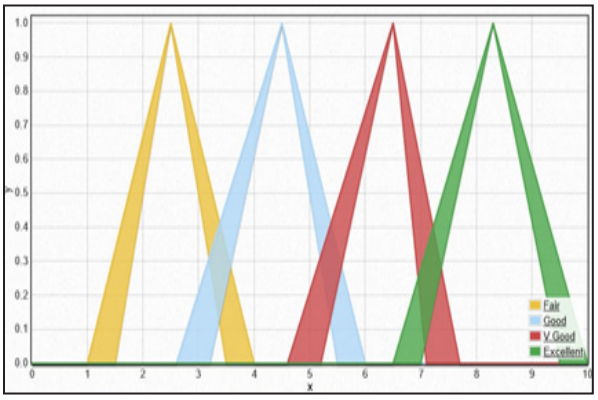



Figure 8. Employee Performance Output Membership

The validation process verifies that, given identical inputs, the expert system›s output is equivalent to

decisions in a given subject [35]. Traditional DSS could only support decision-making through numerical computations and data modelling. With artificial intelligence, the system can imitate almost human intellect [36]. DSSs try to simulate the issue of knowledge uncertainty so that they may reach conclusions as accurately as a human expert [37].

The key players in the design of an expert system are an expert who has knowledge and can solve problems, a knowledge engineer who records the expert›s knowledge in an inference engine and knowledge base, and a user who uses the system to access the required guidance and information [38].

In this section, a decision-support system is proposed for evaluating employee performance in the hotel industry while taking into account the following key variables: commitment level, problem-solving aptitude, adaptability and flexibility level, teamwork aptitude, time commitment level, and steadiness under stress degree. These contributions were gathered from several domain experts› questionnaires. As they outline the membership function for inputs, knowledge base, and membership of output in this work, three experts assist us in developing the suggested system. The researcher performed two surveys: one to gather the information required to develop the system rules (as shown in Figure 3), and the other to validate the system›s rules and outcomes following its development. As there is no need to create a new system from scratch, Juzzy software has been used to simulate the suggested DSS. The ability to simulate type-2 fuzzy inference systems with two membership values is now available through Juzzy [39]. Figures 4 present the employee performance system which consists of the system inputs (level of commitment, aptitude for problem-solving, level of adaptability and flexibility, aptitude for teamwork, level of time commitment, and level of steadiness under stress), the knowledge base.

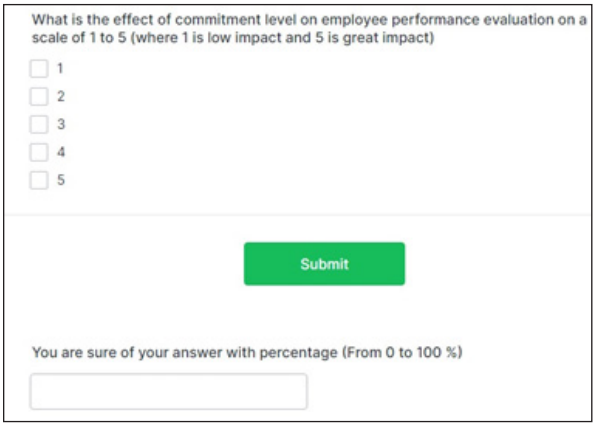



Figure 3. Sample of survey to collect knowledge for the proposed DSS

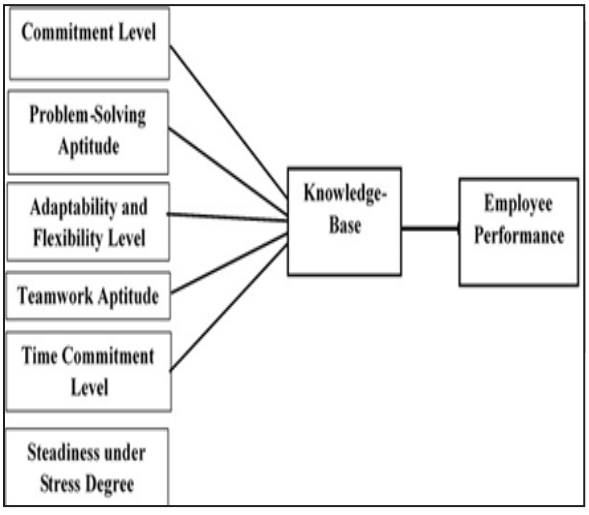



Figure 4. Employee Performance Evaluation System

Algorithm of the proposed DSS is stated as below:

1. Define the system requirements reflected in the inputs, rules, and outputs.

2. Professionals define the memberships of the input variables of the system, which are the

that have prevented the successful adoption of fuzzy systems in decision-making [27, 31].

## 3. THE PROPOSED TYPE2-FUZZY DECISION SUPPORT SYSTEM FOR EVALUATING EMPLOYEE PERFORMANCE

Type-2 fuzzy set is used to enhance uncertainty and imprecision modelling. These type-2 fuzzy set, which essentially consists of «fuzzy fuzzy» sets where the fuzzy, were initially presented by Zadeh in 1975. The membership value for each element of a type-2 fuzzy set is a fuzzy set between 0 and 1, in contrast to the membership grade of a type-1 fuzzy set, which is a crisp value between 0 and 1. A type-2 fuzzy set denoted by A', is characterized by a type-2 membership function $uA(x, u)$, where $x \in X$ and $u \in Jx \subseteq [0, 1]$ and $0 \leq uA(x, u) \leq 1$ [26, 31]. The difference between type-1 fuzzy set and type-2 fuzzy set is shown in Figure 1.

One intriguing method of putting a DSS into practice is to express knowledge as a collection of fuzzy predicates which use logical connectives to establish relationships between input variables. By assessing these relationships, the DSS produces its output. According to this paradigm, the suggested model›s suitability given the body of information is what determines the system›s quality and usability. A DSS is a logical implementation of knowledge; once designed, it cannot find any knowledge [32].

The type-2 fuzzy DSS›s fuzzification unit accepts input in the form of precise data. It assigns two membership values, a defuzzification unit that converts type-2 fuzzy values to crisp, in contrast to type-1 fuzzy DSSs, which only assign one membership value, and an inference system that converts input to output variable based on expert-created rules. Type-2 fuzzy set may handle imprecise information when an expert is questioned about a particular claim to offer a degree of membership [31, 33].

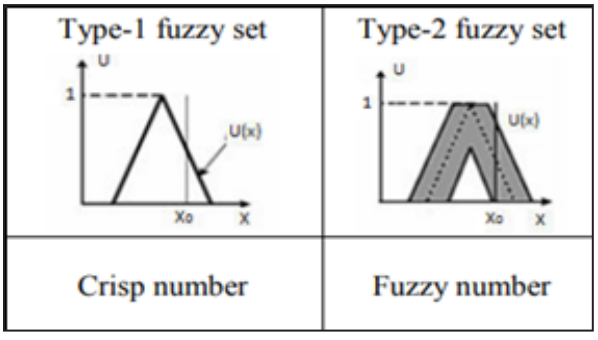



Figure 1. Type-1 fuzzy set vs. Type-2 fuzzy set [33]

To illustrate type-2 fuzzy decision making approach, an application example is discussed: Assume that there are two guests A and B and it is needed to set the room temperature. The information that is collected is that A will be comfortable when the temperature is 17 degrees, and will be annoyed when it is either less than 16 or more than 19 degrees. Furthermore, B will be perfectly content around 20 degrees, and will be uncomfortable at either the temperature is less than 18 or more than 22 degrees. In this case, decision-maker will adjust the temperature between 18 and 19 degrees, as no guest will be less than satisfied at that point; this gives an additional tool to simulate more complicated decision-making, such as the capability to balance different preferences and risk-taking approaches [34].

DSS, which primarily consists of the user interface, knowledge base, and inference engine, replicate expert thinking to solve problems and make

making difficulties regularly appearing in human resource management, they presented decision making approaches based on sophisticated computations that require a long time to measure employee performance for each.

Therefore, it is needed to build a DSS to calculate employee performance directly from the system in a suitable execution time.

Other studies proposes a ranking model for staff selection based on specific criteria using neural network and fuzzy logic methodologies [2, 14]. The study provided explanations for the factors that have a proportional impact on the productivity of government personnel. The results was beneficial to any employee selection system and helpful to management of public sector. The study considers academic skills, professional experience, responsibility, and age as variables in selecting the best employee. A larger data sample is required for more exact time-factor forecasting. More aspects, such as soft-skill factors, should be considered.

Another investigation offered in a study was to offer an alternate technique for analysing employee productivity through the use of a fuzzy inference system. The findings show that situational factors can have a significant influence on an employee›s productivity. The fuzzy inference system model›s use of linguistic variables and fuzzy rules enabled a more thorough evaluation [4]. Employee performance is evaluated using a fuzzy inference system comprised of two dimensions of field performance and a duty function in [11]. The criteria were analysed using the Fuzzy Delphi approach and expert opinion. The correctness of the model was finally tested and verified with the use of the limit test. The outcomes demonstrate how effective the proposed technique is in measuring employee performance.

To forecast the state of employee performance at Babcock University in Nigeria, a smart fuzzy DSS was developed. The study has used Henri Fayol›s management concepts for employee performance evaluation to realistically illustrate the efficacy of fuzzy inference idea. According to experimental findings, the suggested approach could anticipate an employee›s assessment status with more accuracy than the traditional technique [12]. The previous systems presented in [4, 11, 12] have trouble in expressing words with ambiguity.

Previous work clearly shows a research gap since DSSs for evaluating employee performance are conducted under conditions of comprehensive knowledge. Therefore, it is needed to present a DSS that can handle imprecise nature of the required input data. The vagueness in complex systems has been modelled using fuzzy set theory. Typically, type-1 fuzzy set is used in fuzzy systems to present membership degree values between 0 and 1. In cases when experts are reluctant to specify membership, type 1-fuzzy set has no answer. Type-2 fuzzy set provides a way to describe degrees of uncertainty that are difficult to model using type-1 fuzzy set. Comparing type-2 fuzzy set to type-1 fuzzy set, the additional dimension provides more degrees of freedom for a better representation of uncertainty. As a result, type-2 fuzzy set has the capability to handle larger levels of uncertainty

In the hotel industry, the employee performance is an important success factor than in any other sector since the hotel segment mainly depends on its employees. The hotel employees' are in immediate connect with the customers. Therefore, the hotel industry relies on human interaction to maintain the level of service customers are expected to have [18].The most significant issue in hospitality and tourism sector is evaluating and managing employee performance, as it affects hotel›s productivity and profits. Hence, hotel›s success is mostly depend on the employees' quality work [19]. So, hotels seek to achieve continuous development by considering employees as a top priority as they are the customers' first point of contact during a service interaction [20].

Employee performance is an indicator of organization's success in producing results with value that allowing both to maintain a competitive edge [21]. This explains why senior management as a whole cares about the accomplishment of their employees especially in the hospitability sector [18, 22]. Any evaluation system includes input, processing, and results. Employee performance must be measured in terms of objectivity and quality, be substantial and valuable, be adaptive to changes in implementation, and be effective or efficient [20]. The majority of evaluation process are based on information derived from human intuition that describes performance attributes for a thorough review [3].

The employee performance information includes subjective assessments, expert opinions, and linguistic evaluations from managers, and colleagues to give a thorough picture of an employee's attitude, and interpersonal skills [23]. Organizations can measure qualitative information, which are frequently difficult to quantify using conventional methods by including information that is based on human intuition in the evaluation process [24]. Consequently, a substantial amount of information is frequently vague and imprecise [3]. Zadeh›s developed type1-fuzzy set in 1965 which is a major contribution to tackling these issues by converting human intuitionistic-based knowledge into a more computational structure [25]. Type-2 fuzzy sets was presented in 1975 that results in more accurate estimation of uncertainties where conventional type-1 fuzzy set fail to produce satisfactory results [26]. It is scientifically incorrect to utilize type-1 fuzzy set to model words, as type -2 fuzzy sets allow modelling the inherent uncertainties in words [27]. Previous studies emphasized the importance of measuring employee performance represented in the quality of work, amount of work, and level of commitment [2830-].

A multi-criteria decision making algorithm was presented in [1] to evaluate hospital employee performance taking in account vagueness and imprecision found in decision making process based on interval valued fuzzy weighted distance. Another study [3] presented a lattice-ordered picture fuzzy hypersoft set for employee performance evaluation to provide more beneficial results problems where uncertainty associated with the problem. Although these researches [1, 3] offer tremendous flexibility in resolving decision-

etc. [1,2]. These factors are qualitative data which is a type of data that is associated with description of an attribute, for example: «The employee flexibility level is high". The employee performance evaluation process can be made by handling qualitative data in the uncertain environment. Dealing with such uncertainties in real world is an application of type-2 fuzzy set as it has higher capability for capturing uncertainties than type-1 fuzzy set. In addition, decision makers feel more convenient while providing vague judgments instead of certain values due to the fact that they deal with inexplicit preferences during evaluation process [57-].

In 1970s, Edward Albert presented the decision support system (DSS) as a branch of applied artificial intelligence [8]. DSS is a software application that is capable of gathering and analysing data as human experts do to make decisions in different areas, such as engineering, healthcare, education, and others. DSS represents knowledge about particular area to create information that is useful for both structured and unstructured decisions [9]. Designing DSSs under uncertainty is essential issue, as it is significant to take in account different sources of uncertainty when recommending decisions. The process of balancing multiple uncertain factors to build DSS is challenging [10].

Various DSS to evaluate employee performance was presented in previous studies [114-11][4-]. A research gap is clear in previous work, as DSSs for employee evaluation is implemented under complete information, while the real life situations has uncertainty aspects. Handling uncertainty to solve real life problems is one of the significant issue of artificial intelligence [15]. Vague information implies a lack of clear information, for example: the car colour is nearly yellow. Imprecise information implies that information is not determined, for example:The machine temperature is between 8086- °C. Fuzzy set can handle vague information, while type-2 fuzzy logic set handle vague and imprecise information [16, 17].

In this paper, Type-2 fuzzy set is presented as a better option to evaluate employee performance than type-1 fuzzy set as it is able to handle vagueness and impreciseness of information. Therefore, the main contribution of this paper is to present DSS that can handle vagueness and impreciseness to evaluate employee's performance in Cairo›s hotel chains. Moreover, as there is no research investigated the combination of commitment level, problem solving capability degree, adaptability and flexibility level, teamwork capability level, time schedule commitment degree, and steadiness under pressure degree to evaluate employee performance in Cairo›s hotel chains.

The paper is organized in the following way: Section 1 provides an introduction to the paper; Section 2 presents literature review; Section 3 discusses the developing of proposed type2-fuzzy decision support system for evaluating employee performance; Section 4 discusses the results of the proposed system; and finally, the conclusion presented in section 5.

## 2. LITERATURE REVIEW

# A Decision Support System for Employee Performance Evaluation under Uncertainty in Hotel Industry

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## ABSTRACT

An employee›s performance in any firm is greatly influenced by their knowledge and skills. For instance, an employee›s performance is mostly evaluated on a qualitative basis in tourism sector. The evaluator›s ability for making decisions depends on how he could determine different factors that includes vagueness, and imprecision. Any employee should get effective and efficient performance evaluations with the right ratings in order to be considered for growth, and development. As a result, the purpose of this work is to build a decision support evaluation system for hotel staff members who want to advance their careers. In this research, type-2 fuzzy set is suggested to extract expert thinking as it is able to handle vague and imprecise information. The suggested approach is demonstrated with a case study using an example. The results showed that the proposed type-2 fuzzy decision support system achieves better results than the type-1 fuzzy system.

**Keywords**: Type-1 fuzzy set, Type 2-fuzzy set, decision support system, employee evaluation, employee performance. .

## 1.INTRODUCTION

Employees are one of the essential origins to maintain the competitive advantages in organizations by utilizing their knowledge and skills. Therefore, employee performance evaluation is a critical process as it is a key indicator of the organization's competitiveness [1]. Identifying employee's skills and capabilities level is a complex process, which in many cases leads to argument results [2]. Many studies in employee performance evaluation are implemented under complete information, while the real environment has uncertainty aspects. As evaluation performance are described by vague and imprecise terms that is why traditional evaluation methods may not be efficient [3, 4].

The employee performance is measured based on various factors, such as commitment level, responsibility degree, discipline level, flexibility Level, teamwork capability level, time schedule commitment degree, and stress control degree,

proliferation of education-specific generative AI products can potentially improve research, knowledge development, tutoring, and productivity across institutions. To deliver on this potential, however, faculty, staff, and IT departments need to become aware of the challenges and longer-term opportunities of generative AI to improve the effectiveness of their administrative tasks, teaching, and research. Moving forward, institutions must nurture the development of skills and judgment among students, staff, and faculty to ensure they learn how to do the following things:

- Ask the right questions
- Evaluate, validate, and refine AI outputs
- Build interdisciplinary links across knowledge domains
- Generate new insights rather than creating replicas of existing views

The environmental impacts of generative AI will also be significant–particularly as many products rely on generative AI models that must be trained on massive datasets–a process that uses considerable electricity. Focusing on the evaluation of clear use cases, data-driven insights, and small-scale pilots to inform broader institutional AI strategies will likely remain the typical approach across the sector in the near term.

Institutions should take a number of key actions as they prepare for the future:

- **Prepare**–The rapid evolution of AI authoring and venture capital investments means widespread institutional use is likely. Retain and continuously refine policies to share with students and staff and encourage internal exploration of how to leverage generative AI in a positive way.
- **Monitor this evolving** trend–Generative AI technology is in the early stage and is widely hyped, but widespread access and exploration of generative AI models by students and faculty may challenge many traditional education practices and assessment approaches.
- **Explore effective use cases**–Evaluate potential educational uses that align with institutional strategy, particularly those impacting the curriculum management and academic administration space. Distill opportunities and threats into a discussion on longer-term strategic responses.
- **Look to the future**–Accept that faculty and institutions will continue to look beyond the control and restricted use of AI toward effective practices that leverage the best of human inputs and machine outputs. Monitor and follow the market and technology as they rapidly evolve and explore how AI can help improve educational practices.

## References

1. Gartner (2023) «Generative AI,» Information Technology Glossary, Gartner Glossary,

2. OpenAI (March 14, 123)»GPT-4,» I (website), March 14, 2023.

3. Charles Hodges & Ceren Ocak (August 30, 2023)

4.«Integrating Generative AI into Higher Education,» EDUCAUSE Review

Despite the real and potential promise of generative AI applications in higher education, several risks remain.

- **"Hallucinations"—False** answers are sometimes generated as a result of models using «statistics» to pick the next word with no actual «understanding» of content.
- **Subpar training data**–Data could be insufficient, obsolete, or contain sensitive information and biases, leading to biased, prohibited, or incorrect responses.
- **Copyright violations**–Some models have been accused of using copyrighted data for training purposes, which is then reused without appropriate permission.
- **Deepfakes**–Outputs generated by ChatGPT could appear realistic but may actually be fake content.
- **Fraud and abuse**–Bad actors are already exploiting ChatGPT by writing fake reviews, spamming, and phishing.

The quality of generative AI outputs depends on the combination of model selection, the knowledge base used, prompts, individual questions, and refinements. Therefore, institutions are ramping up efforts to teach staff, students, and faculty about the risks of generative AI and its appropriate use through the creation of relevant prompts and the evaluation of generative AI models.

## 3. Generative Ai in the Future: Practices, Products, and the Paradox of Choice

As machines become more «intelligent,» educational institutions must define and refine ways of working that increasingly reflect a world of «you and AI.» Generative AI solutions rely on people to shape the quality of the model and its output. However, retaining a focus on higher-level critical thinking is essential for individuals and institutions in the academic sector (figure 1).

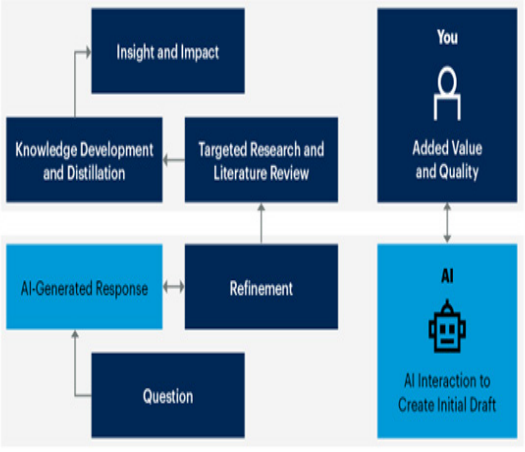


Figure 1. The Future of Knowledge Development: Between You and AI Source: (Source: Gartner)

Academic assessment approaches must evolve beyond isolated assignments toward more continuous, data-driven views. Combining multiple formative and summative approaches continues to offer an enduring path forward. In parallel, leveraging generative AI tools to streamline productivity and create credible first drafts of content or enhance conversational user interfaces to better support students will likely combine to support improved educational experiences.

In the face of continued growth and choice of generative AI solutions, the ability of students and faculty to evaluate when and how to use generative AI effectively will become more significant. The

alongside search and have incorporated generative AI into writing, presentation, and communication tools. Institutional policies are evolving to reflect this–moving from banning ChatGPT to cautiously encouraging the appropriate use of generative AI tools within academic activities.

Faculty recognize that anti-plagiarism tools still play a role in student codes of practice. Notifying students of the consequences of cheating is now often used as an approach within institutional policies to nudge students away from widespread ChatGPT use. For many institutions, however, the need to evolve assessment practices is recognized as the most realistic way forward, and task forces and committees abound to evaluate how best to make this happen. Institutions are starting to ask questions about the following issues:

- **Student assessment**–What are students learning? What processes are they adopting, and are they relevant for future careers?
- **Teaching and learning**–How can institutions teach appropriate prompt design and output evaluation skills? How can they build digital literacy and faculty acceptance of the potential for AI tutors?
- **Research**–How can new knowledge best be developed, validated, and applied? How is research best carried out?
- **Quality**–How and where is it appropriate to trust generative AI solutions to enhance teaching, administration, or research productivity?

These issues are shaping change as educational institutions focus on strategic exploration and targeted investments in generative AI. Common potential use cases being explored include the following:

- **Productivity** to accelerate report authoring, coding, meeting planning, and decision support. Interest in chatbots with improved conversational interfaces has intensified, with the goal of freeing up the capacity of student support services to target those most in need
- **Teaching support** to accelerate the creation of lesson plans, teaching videos, images, presentations, lecture notes, and study support materials
- **Research assistance** to summarize content, analyze data, identify patterns, select appropriate research methodologies, peer-review papers, connect knowledge domains, design research projects, generate hypotheses, and accelerate literature review
- **Student engagement** to enhance course-selection guidance, bill and fee payments, course registration, study skills, time management, and conversational AI generated messaging to nudge at-risk students toward actions that improve performance

The education sector›s interest in generative AI is creating opportunities for new and existing technology vendors that incorporate generative AI approaches (e.g., LMS, CRM, and SIS solutions), as well as vendors with products that are not generative AI but that outperform or supplement generative AI in specific use cases (e.g., chatbot providers).

1) A model (such as the generative pre-trained transformer model behind ChatGPT, although many more are now available) and the data used to train it,

2) A question (or prompt) from an individual, and

3) A refinement of that question until an acceptable output is achieved

These machine-learning neural network models can now leverage billions of learning parameters and are additionally trained on large datasets. ChatGPT›s research release was trained on over 570 GB of data (from books and the internet) and was refined by human feedback. That said, the timing of that training (up to 2021) and the veracity of the data were factors to take into account when evaluating ChatGPT›s outputs.

Three factors caused the accelerated use of generative AI in education:

1) Widespread access at no or low cost,

2) Engagement through text- and image-based user interfaces that accelerate written, visual, or code output generation, and

3) The perceived quality and scale of training of large language models, allowing outputs to improve to a credible level

Widespread student use in 2023 inevitably raised questions about academic integrity. Anxieties around the ability of generative AI to create (in some contexts) quality essays and test results expanded with the release of GPT-4, which started to demonstrate «human-level performance on various professional and academic benchmarks (2) Anti-plagiarism software targeting AI-generated content continues to evolve in response to results, faculty feedback, and student behaviors. In parallel, those students seeking to use generative AI for disreputable purposes continue to challenge assessment models through various tools and products designed to deliberately disguise or mask the embedded patterns of generative AI.

By the fall, as it became evident that all major technology vendors and education technology products would soon have some element of generative AI, acceptance of its use became more common. As two higher education faculty members recently asked, «Shouldn›t higher education institutions be preparing graduates to work in a world where generative AI is becoming ubiquitous?

## Present Generative AI: Evaluating the risks and realities

The education sector has rapidly evolved from generative AI denial to anxiety, fear, and partial acceptance. Generative AI continues to polarize the sector. However, many institutions now have policies to control and restrict inappropriate student and staff use and faculty members who encourage appropriate student exploration and evaluation. IT departments are struggling to balance increasing demands for new generative-AI products and are evaluating whether to purchase or take a custom-build approach.

Across the world, faculty and institutions acknowledge that banning generative AI is a transient response to change. Generative AI is being embedded into the tools of everyday work. Major technology vendors have integrated AI interfaces

# Perspective of Generative AI in Higher Education Historical Background

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## 1. Introduction

The increased adoption of generative AI tools creates opportunities for its use in academic research, knowledge development, and AI-assisted authoring. This paper highlights this trend, discussing the implications of generative AI use in education and actions higher education. Chief Information Officers can take to prepare for the future.

In less than a year, ChatGPT and generative AI have moved from peripheral awareness to priority focus for many higher education institutions across the country. These tools involve a loop of human-generated questions and AI-generated responses, catalyzing the consideration of multiple potential uses in higher education:

- Students› use for research, content development, and academic assignments
- Administrative staff use for report writing, data analysis, and enhanced student support
- Faculty use to accelerate lesson planning and teaching material development

So, is generative AI a fad or a critical enabler of future institutional success? This article will examine the past, present, and future of generative AI in education.

## 2.The Potential Background of generative AI in the Past

Generative AI can be defined as follows: «AI techniques that learn a representation of artifacts from data and use it to generate unique content (including images, video, music, speech, and text) that preserves a likeness to original data. (1)

OpenAI›s ChatGPT, a specific implementation of generative AI that creates conversational content, reached over one million users less than one week after it was made available as a research release in November 2022. It quickly became one of the most novel experiences and successful software releases in history, driving significant educational interest, large investments, product development, and generative AI solution evolution.

Generative AI output is created through a combination of three key elements:

manual procedures. Moreover, it introduces a streamlined mechanism for employers to effortlessly access and authenticate certificates during the hiring process through a singular application, eliminating the need to engage the issuing institution separately.

## 8. List of Abbreviations

| | |
|---|---|
| DPoS | Delegated Proof of Stake |
| GPA | Grade Point Average |
| IoT | Internet of Things |
| PoS | Proof-of-Stake |
| PoW | Proof-of-Work |
| WISE Network | Worldwide Integrated Scholarly Environment |

## 9. References


[1] Monrat, Ahmed Afif, Olov Schelén, and Karl Andersson. «A survey of blockchain from the perspectives of applications, challenges, and opportunities.» (2019) IEEE Access 7: 117134-117151.

[2] Lykidis, Ioannis, George Drosatos, and Konstantinos Rantos. «The use of blockchain technology in e-government services.» (2021) Computers 10.12: 168.

[3] Crosby, Michael, et al. «Blockchain technology: Beyond bitcoin.» (2016) Applied Innovation 2.671 :10-.

[4] Nakamoto, Satoshi. «Bitcoin: A peer-to-peer electronic cash system.» (2008) Decentralized business review.

[5] Zheng, Zibin, et al. «Blockchain challenges and opportunities: A survey.» (2018) International journal of web and grid services 14.4: 352375-.

[6] Bhutta, Muhammad Nasir Mumtaz, et al. «A survey on blockchain technology: Evolution, architecture and security.» (2021) Ieee Access 9: 6104861073-.

[7] Azbeg, Kebira, et al. «An overview of blockchain consensus algorithms: Comparison, challenges and future directions.» (2021) Advances on Smart and Soft Computing: Proceedings of ICACIn 2020: 357369-.

[8] Bodkhe, Umesh, et al. «Blockchain for industry 4.0: A comprehensive review.» (2020) IEEE Access 8: 7976479800-.

[9] Baiod, Wajde, Janet Light, and Aniket Mahanti. «Blockchain technology and its applications across multiple domains: A survey.» (2021) Journal of International Technology and Information Management 29.4: 78119-.

[10] Damoska Sekuloska, J., and A. Erceg. «Blockchain Technology toward Creating a Smart Local Food Supply Chain.» (2022) Computers 2022, 11(6), 95.

[11] Ali, Omar, et al. «A comparative study: Blockchain technology utilization benefits, challenges and functionalities.» (2021) Ieee Access 9: 1273012749-.

[12] Yumna, Hafiza, et al. «Use of blockchain in education: a systematic literature review.» (2019) Intelligent Information and Database Systems: 11th Asian Conference, ACIIDS 2019, Yogyakarta, Indonesia, April 8-11, 2019, Proceedings, Part II 11. Springer International Publishing.

[13] Turcu, Cristina, Cornel Turcu, and Iuliana Chiuchisan. «Blockchain and its Potential in Education.» (2019) arXiv preprint arXiv:1903.09300.

[14] Raimundo, Ricardo, and Albérico Rosário. «Blockchain system in the higher education.» (2021) European Journal of Investigation in Health, Psychology and Education 11.1: 276293-.

[15] Saleh, Omar S., Osman Ghazali, and Muhammad Ehsan Rana. «Blockchain based framework for educational certificates verification.» (2020) Journal of critical reviews 7.3: 7984-.

[16] Ullah, Nazir, et al. «Blockchain technology adoption in smart learning environments.» (2021) Sustainability 13.4: 1801.

transfer to another institution, the latter can verify the student›s data from the blockchain.

**Partition 2:**

The operational process of the second partition is outlined below:

1. Per semester, a higher education institution solicits a transaction encompassing graduates› certificate.
2. A block symbolizing the transaction is formulated and shared across all nodes.
3. Validation of the transaction block remains the role of the unit within the higher education ministry.
4. Upon validation, the block is integrated into the blockchain.

Each educational institution follows these steps to append their graduates› certificates. Subsequently, any organization›s recruiters can access a candidate›s certificate for job assessments.

Figure 1 shows the model›s different entities and the flow of data, since the issuing of the transactions› requests, for students and graduates updated data, to the validation of the higher ministry of education and finally having all the data available to all educational institutions and organizations› recruiters.

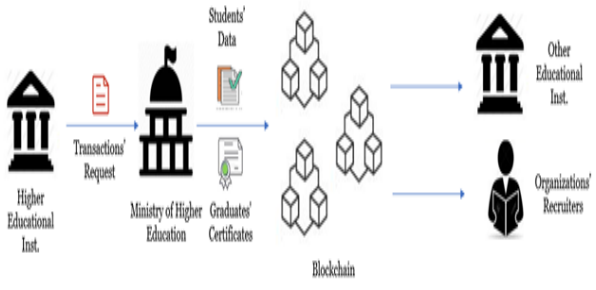


Figure 1. Proposed Model showing the data flow between the different entities

### 6.2 Proposed Model Advantages

Blockchain technology offers an array of potential solutions that could play a pivotal role within educational systems. In the proposed model, implementing blockchain technology yields several advantages:

- Decentralization: Distributing data across numerous entities effectively eliminates central failure points and bottlenecks.
- Scalability: Avoiding scenarios where one or a few entities control the storage and processing of information for multiple individuals.
- Reliability: Information remains unaltered, immutable, and spread across time within the blockchain. Any participant can verify data authenticity and confirm its lack of alteration.
- Security: Treating information and communications as blockchain transactions can reinforce security.

Ultimately, this framework reduces administrative costs, time, labor, and simplifies bureaucracy.

## 7. Conclusion and Prospects for the Future

Blockchain technology stands as a groundbreaking avenue for enhancing the interaction between public services and educational systems, fostering transparency. Its novelty lies in its skilled combination of transparency, integrity, confidentiality, and accountability when carefully implemented.

The integration of blockchain technology within the educational sector bears the potential to improve administrative burdens in diverse scenarios, such as verification and migration processes. Furthermore, it holds the promise of reducing the expenses and exertions linked to conventional

integrity.

• Learning Economy, a blockchain-powered platform, envisions a decentralized marketplace for educational resources, credentials, and services. It grants learners access to diverse educational content and services, all while preserving transparency, traceability, and equitable compensation for content creators.

• BitDegree, an online learning platform, harnessing blockchain for learning motivation. It provides token rewards and scholarships to learners who complete courses and achieve learning milestones. This blockchain-based system guarantees transparency and trust throughout the reward distribution process.

• WISE Network (Worldwide Integrated Scholarly Environment), a blockchain-infused platform, seeks to revolutionize scholarly publishing and peer review. It creates a decentralized, transparent infrastructure for academic researchers to publish, share, and assess scholarly content.

These examples offer just a glimpse into the array of blockchain models and frameworks employed or proposed for integration into educational systems. It›s important to recognize that blockchain›s integration into education is still evolving, with diverse organizations and initiatives actively exploring and cultivating inventive applications of blockchain technology in the educational field.

## 6. Blockchain Proposed Model for Educational Students› Data

The proposed model advocates for the establishment of a unit within the higher education ministry that employs blockchain models for safeguarding educational data and records of students and graduates, thereby facilitating verification procedures for various organizations› recruiters.

### 6.1 Proposed Model

The proposed model suggests the creation of a new unit in the higher ministry of education, that comprises two partitions:

• The initial partition stores undergraduates› data, encompassing grade records and GPAs (Grade Point Average) at each educational level. This aids students during transitions between institutions.

• The second one, stores graduates› certificates, offering benefits to graduates and prospective employers by enabling the verification of candidates› information.

Outlined below are the models for those partitions, which employ blockchains to preserve either students or graduates› data for situations such as students› transfer or certificates› validation.

**Partition 1:**

The operational process of the first partition is illustrated in the following steps:

1. A higher education institution initiates a transaction containing student data.

2. A block representing the transaction is generated and disseminated to all participants, including the higher education ministry and other higher education institutions.

3. Validation of the transaction block is exclusive to the unit within the higher education ministry.

4. Upon validation, the block is incorporated into the blockchain. Whenever a student seeks to

while facilitating verification of credential legitimacy.

• Interoperability and Standardization: Blockchain can promote interoperability and standardization of credential authentication across diverse educational institutions and organizations. Through the adoption of shared standards and protocols, institutions can easily exchange and authenticate credentials, simplifying the process and limiting redundant verification efforts.

• Cost and Efficiency Gains: Integrating blockchain for credential validation can yield cost savings for educational institutions and employers alike. It diminishes the administrative burden associated with manual verification procedures, like contacting issuing institutions or relying on third-party validation services. This produces improved efficiency and decreases operational expenses.

• Global Acceptance: Blockchain-based credential validation can amplify the recognition of educational qualifications on a global scale. As the blockchain functions as a decentralized network, it allows for cross-border validation without complex and time-intensive procedures. This particularly benefits international students or professionals seeking overseas employment or further education.

Although blockchain›s potential for credential validation in education is promising, challenges such as interoperability, scalability, and the need for widespread adoption must be acknowledged. Nonetheless, multiple initiatives and projects are exploring blockchain›s application for this purpose, indicative of a growing interest in leveraging this technology to streamline and enhance the credential verification process.

### 5.3 Blockchain Models and Frameworks for Educational Systems

Numerous blockchain models and frameworks tailored for educational systems have emerged [15, 16], including:

• Blockcerts, an open standard and framework devised by Learning Machine and MIT Media Lab, serves to generate, distribute, and validate blockchain-based educational credentials. It enables educational institutions to issue secure digital certificates to students, easily verifiable by employers and other institutions.

• Open Badges, an open standard by the Mozilla Foundation, facilitates the creation and issuance of digital badges signifying learning accomplishments. Although not exclusively reliant on blockchain, Open Badges can be integrated with blockchain platforms to heighten badge security and authentication.

• Learning Machine›s Federated Issuing System, a blockchain-driven credentialing platform, provides a Federated Issuing System that permits educational institutions to create and validate digital credentials utilizing blockchain technology. This establishes a secure and interoperable framework for credential management across multiple institutions.

• Sony Global Education›s Blockchain-based Platform pioneers a blockchain-centered solution for educational data management. This platform ensures secure storage and sharing of educational records, encompassing academic transcripts and certificates, all while maintaining data privacy and

other stakeholders.

• Lifelong Learning and Micro-credentials: Blockchain can facilitate the recognition and management of micro-credentials and lifelong learning achievements. Students can accumulate a variety of credentials, including short courses, certifications, and badges, and store them on the blockchain. This promotes a more comprehensive and holistic representation of an individual›s skills and competencies, beyond traditional degree programs.

• Fraud Prevention and Academic Integrity: By utilizing blockchain, educational institutions can combat credential fraud and enhance academic integrity. The transparent and immutable nature of blockchain records makes it easier to identify and prevent cases of credential misrepresentation or plagiarism. This helps maintain the credibility and reputation of educational institutions.

It›s worth noting that the implementation of blockchain in the education sector for academic records and transcripts is still in its early stages. However, several pilot projects and initiatives are exploring its potential benefits, and it is expected that the adoption of blockchain technology in this area will increase in the coming years.

### 5.2 Credential Verification

Blockchain technology offers the potential to transform the authentication of credentials within the education sector, presenting mass of advantages [15]. Here›s a look at how blockchain can be employed in this context:

• Decentralized Validation: Blockchain furnishes a decentralized framework for confirming educational credentials. In place of relying on a central entity or third-party authentication services, blockchain functions as a distributed ledger where educational institutions can record and validate credentials. This obviates the necessity for manual verification processes and limits the risk of counterfeit qualifications.

• Immutable Records: Credentials stored on the blockchain are immutable and resistant to tampering. Once a credential is incorporated into the blockchain, any alteration or deletion necessitates consensus across the network. This upholds the credentials› integrity and authenticity, rendering them difficult to forge or manipulate.

• Instantaneous Confirmation: Blockchain-driven credential verification enables real-time confirmation of educational achievements. Employers, educational institutions, or other relevant entities can directly access the blockchain to verify a credential, bypassing time-consuming manual procedures. This accelerates the verification process and minimizes delays in confirmation.

• Elevated Trust and Transparency: Blockchain offers a transparent and auditable system for confirming credentials. The decentralized nature of blockchain guarantees that all transactions and credential updates are visible to relevant parties. Such transparency nurtures trust among stakeholders, as they can autonomously verify credential authenticity without relying on a central authority.

• Privacy and Data Protection: While blockchain offers transparency, it also accommodates personal data protection. This ensures privacy

time and effort burden on both the student and the institution. Thus, a centralized entity possessing comprehensive data about students and graduates could streamline and simplify administrative procedures that necessitate validation. Employing blockchain technology in this context emerges as a viable solution, as it ensures the integrity of all student data, preserving it in an unaltered state and allowing for retrieval as needed.

### 5.1 Academic Records Management

Blockchain technology has the potential to significantly impact the management of academic records and transcripts in the educational sector [14]. Here›s how blockchain can be used in this context:

• Immutable Records: Blockchain provides a secure and tamper-proof way to store academic records. Each academic achievement, such as degrees, diplomas, and certificates, can be recorded as a transaction on the blockchain, creating an immutable and transparent record. This ensures the integrity and authenticity of the credentials, making it difficult for them to be forged or manipulated.

• Verification and Authentication: Employers, educational institutions, and other relevant parties can easily verify the authenticity of academic records stored on the blockchain. By accessing the decentralized ledger, they can independently verify the records without relying on a central authority. This streamlines the verification process, reduces administrative burdens, and mitigates the risk of fraudulent credentials.

• Ownership and Control: With blockchain, individuals can have ownership and control over their academic records. Students can maintain a digital wallet containing their verified credentials and share them with prospective employers or other institutions as needed. This eliminates the need for intermediaries and gives individuals greater control over their educational data.

• Credential Transparency and Transferability: Blockchain enables transparent and auditable records of educational achievements. Students can track their progress, view completed courses, and monitor their achievements in a secure and decentralized manner. Additionally, the transferability of credentials becomes easier as blockchain allows for seamless sharing and transfer of records between educational institutions or employers, facilitating a smoother transition for students.

• Enhanced Data Security and Privacy: Blockchain employs cryptographic techniques to protect sensitive data, ensuring its security and privacy. Personally identifiable information can be stored off-chain, while the blockchain ledger maintains a reference to the data, preserving privacy while still allowing for verification. This helps address concerns related to data breaches and unauthorized access to personal information.

• Streamlined Processes and Reduced Costs: Adopting blockchain for academic records and transcripts can streamline administrative processes, reducing paperwork, manual verification efforts, and the need for physical document handling. This can result in cost savings for educational institutions and faster, more efficient credential verification for employers and

the hash of the preceding block, forming part of its own hash. Consequently, attempting to alter any new or old block becomes exceptionally challenging. The interlinking of blocks through their hashes creates a tamper-resistant chain, as modifying a single block necessitates rewriting the entire blockchain. This linkage mechanism substantially fortifies security against tampering.

Despite its array of advantages, blockchain technology encounters certain barriers [10].

• Scalability poses a notable issue due to escalating transaction volumes and the continuous storage of data across all network nodes.

• The complexity of blockchain programming and its alignment with global laws and regulations present additional challenges.

• Concerns encompassing consensus algorithms like proof-of-work (PoW) and proof-of-stake (PoS), relate to issues such as energy consumption for PoW and the potential concentration of wealth for PoS.

## 5. Blockchain in Education

Blockchain technology possesses the capacity to revolutionize multiple industries through its offerings of transparency, security, immutability, and decentralized governance. Its influence spans sectors such as finance, healthcare, government services, education, and the Internet of Things (IoT) [11].

In traditional education, the storage and exchange of physical records and documents play a crucial role and continue to be extensively utilized in educational institutions such as universities, institutes, schools, as well as within ministries of education [12, 13].

However, this reliance on physical records gives rise to various issues. One such concern is the vulnerability associated with having records stored in a single location, leading to a scenario where unexpected events could result in severe loss. Should these physical records be damaged or destroyed due to unforeseen circumstances, recovery becomes a difficult challenge.

Furthermore, difficulties emerge when attempting to exchange records between different institutions, particularly in cases involving student transfers between institutions. The process of exchanging records is complicated and time intensive. For instance, if a student desires to switch from one institution to another, the task of transferring their records becomes cumbersome. Students also encounter challenges during admission applications as they are required to furnish their entire educational history. There exists no universally accepted standard system capable of delivering such services to all institutions.

Additionally, institutions engage in numerous repetitive transactions involving students, employees, suppliers, vendors, and government bodies. Instances of corruption at higher levels of authority are conceivable. The integration of decentralized auditing into the financial systems of institutions presents a potential remedy to mitigate such corruption.

In the context of organizations needing to recruit graduates, extensive documentation is often demanded to confirm a candidate›s suitability for the offered positions. This process places a significant

Proof of Stake (PoS) stands as an alternate consensus algorithm initially introduced through the Peercoin cryptocurrency, by King and Nadal in 2012. In contrast to the competitive process hinging on energy usage, PoS adopts a selection mechanism that factors in the stakes held by validators. These validators, like miners in a Proof of Work (PoW) setup, are chosen through a selection process that permits the network to choose the node responsible for authenticating the new block. This authentication is proved by demonstrating ownership of a specific coin amount, measured using the «coin age» parameter, which essentially represents the product of the currency quantity and its duration of possession.

Upon the selection of a validator, they validate the block by placing a wager on it and subsequently receive a reward corresponding to the wager they staked. The likelihood of being chosen as a validator is proportional to the volume of cryptocurrency held by an individual. PoS mandates participants to immobilize a designated quantity of their cryptocurrency as collateral. This approach diminishes the necessity for resource-intensive computational power and controls energy consumption.

### 3.3 Delegated Proof of Stake

Delegated Proof of Stake (DPoS) represents a modified version of the PoS mechanism, incorporating a voting system based on participants› reputations. In contrast to involving all individuals as potential block creators, DPoS hinges on a select group of elected delegates who rotate in generating blocks. These delegates are chosen through a voting process by stakeholders within the network, and their responsibilities encompass transaction validation and blockchain upkeep. The primary objective of DPoS is to enhance scalability and transaction processing capacity by limiting the count of validators involved.

## 4. Blockchain Advantages and Disadvantages

Blockchain technology possesses several benefits that render it appealing across diverse domains. [8, 9]. Firstly, its decentralized nature ensures robustness against singular vulnerabilities and network attacks, given the absence of a susceptible central server. Furthermore, the transparency and traceability inherent in blockchain facilitate straightforward validation and tracking of transactions, fostering trust and accountability.

Moreover, blockchain delivers heightened security and privacy through the application of cryptographic methods. Participants can engage with the blockchain network using generated addresses, preserving their anonymity, and diminishing the need for centralized entities to verify identities. The utilization of hashing algorithms and consensus mechanisms contributes layers of security to safeguard the integrity of stored data within the blockchain.

Hashing constitutes a pivotal cornerstone of blockchain›s expertise. Each block holds data to be stored, and every subsequent block incorporated into the chain is encoded with a «hash» - a code produced through arithmetic manipulation of the block›s data. This hash serves as a form of digital fingerprint and is often used to secure passwords. Additionally, each newly added block incorporates

| | | | |
|---|---|---|---|
| Infrastructure | Decentralized | Centralized as it is controlled by one node | Semi-centralized as it is controlled by many nodes |
| Efficiency | - Low; many nodes, making transaction processing quite long | - High<br>- Restricted, with few nodes, so fast transaction processing, and high latency | |

## 3. Consensus algorithms of Blockchain

Blockchain systems operate in a decentralized manner, negating the necessity for a third-party that is considered trustworthy. To effectively address disputes between nodes, counteract security breaches, and guarantee the dependability and consistency of data and transactions, blockchain employs a decentralized consensus protocol. This protocol mandates a shared agreement among all nodes regarding the method of content updating. Furthermore, it requires that blocks can only be incorporated into the ledger when a majority agrees, thus maintaining a constant state. This consensus mechanism forms the foundation for generating and appending blocks to the ledger.

Consensus algorithms, in the blockchain field, are specific protocols adopted by distributed networks to attain concurrence regarding the state of the blockchain [7]. These algorithms ensure common validation and sequencing of transactions among all network participants, thus preventing double-spending and maintaining the integrity of the blockchain. These algorithms involve distinct mechanisms employed to achieve consensus and strengthen security in a distributed system.

Prominent consensus algorithms [5] utilized in blockchain technology, include proof-of-work (PoW) and proof-of-stake (PoS). For example, PoW is notorious for its substantial energy consumption due to the competitive nature of miners striving to create blocks by solving complex mathematical puzzles. Miners, in this context, are specific nodes that engage in the process of verifying blocks before appending them to the blockchain structure. Conversely, in PoS, individuals with larger stakes gradually gather more influence, as their likelihood of obtaining a block is dependent on their stake size.

### 3.1 Proof of Works

The concept of Proof of Work (PoW) was initially introduced by Dwork and Naor, in 1993, with the aim of stopping unsolicited emails and regulating access to shared resources. In 2008, Bitcoin incorporated this concept into its protocol as a consensus algorithm, serving the purpose of achieving agreement on transactions and avoiding the occurrence of double spending attacks.

Consequently, PoW stands as the earliest and pioneering consensus algorithm employed in the context of Blockchain technology. The fundamental notion revolves around motivating miners to employ their computational ability to solve a sophisticated puzzle grounded in a mathematical problem. Once the puzzle is successfully solved, the miner spreads the resulting block across the network for validation by other miners, who assess the correctness of the solution. Upon verification, the block becomes an addition to the Blockchain. Although PoW requires substantial computational capacity and energy usage, its security and reliability have been demonstrated over the passage of time.

### 3.2 Proof of Stake

| | |
|---|---|
| Security | Digital signatures are used to verify and authenticate transactions, and consensus algorithms ensure that transactions are valid before they are added to the blockchain. Additionally, blockchain is more resistant to attacks than centralized systems, due to its decentralized nature. |
| Trust and Consensus | Blockchain permits participants to arrive at an agreement on the condition of the record without depending on a central authority. Consensus algorithms, such as proof-of-work (PoW) or proof-of-stake (PoS), empower understanding among nodes and prevent malicious exercises by requiring a larger part or partners' agreement. |
| Traceability and Auditability | An audit trail of the entire transaction history can be created by following every transaction that is recorded on the blockchain. This feature makes it easier to find and investigate fraudulent activities in addition to increasing accountability. |
| Efficiency and Speed | While traditional monetary frameworks might include middle people and tedious cycles, blockchain can smooth out exchanges by empowering shared moves without the requirement for intermediaries. Particularly, regarding supply chain management and cross-border payments, this may result in faster and more effective transactions. |

### 2.3 Blockchain Types

Based on its intended use and distinctive characteristics, blockchains are divided into various categories [6]:

• Public Blockchains: Anybody can join the network, take part in the process of reaching consensus, and confirm transactions. Several instances of public blockchains include Bitcoin and Ethereum. They are often decentralized, offer security and transparency, but they could not be scalable.

• Private Blockchains: Sometimes referred to as permissioned blockchains, limiting the access to a select group of users who have been given authorization to join the network. These players are frequently reputable and well-known organizations, including consortium members or commercial partners. In contexts where privacy, control, and scalability are crucial, they are frequently utilized in businesses.

• Consortium blockchains: are a half breed between open and private blockchains, where many organizations come together to create a network, whereas agreement is accomplished by a limited number of nodes. They offer more security and flexibility than public blockchains whereas permitting controlled enrollment.

Table 2 shows the differences between the three types of Blockchain [6].

| Property | Public | Private | Consortium |
|---|---|---|---|
| Consensus determination | - All nodes | - One centralized node | - Predefined list of nodes |
| Consensus process | - Permissionless, everyone can join the consensus process | Permissioned, pre-authorization is required | |
| Identity anonymity | - Nodes are (pseudo) anonymous | - Nodes are known | |
| Read permission | - Public data are shared | - Restricted but can be shared | |
| Immutability | - Altering is almost impossible because transactions are shared with different nodes in the distributed network | - Altering is possible if the pre-authorized nodes want to | |

without the requirement for a centralized authority›s approval. A complete copy of the ledger is stored on each node in the network. Each transaction is verified using a consensus mechanism, which involves asynchronous messaging between multiple network nodes. Examples of this messaging include the announcement of a transaction that represents an event in the system, or the creation and broadcasting of a block containing the transaction›s details. Each node should then validate by examining the new block›s transaction sequence to ensure consistency. The Proof-of-Work and Proof-of-Stake consensus techniques are few examples for the used consensus algorithms [2].

## 2. Bitcoin and Blockchain

### 2.1 Bitcoin

Blockchain is the technology that enables bitcoin transactions to be recorded and stored, however bitcoin and blockchain are not the same thing [3].

A paper titled «Bitcoin: A Peer-To-Peer Electronic Cash System» was published in 2008 by a person or a group, written under the name Satoshi Nakamoto [4]. The peer-to-peer electronic cash presented in this study would enable internet payments to be sent directly between parties without going through a banking institution. The first application of this idea was with Bitcoin. The term «cryptocurrencies» is now used to refer to all networks and mediums of exchange that safeguard transactions using cryptography as opposed to those systems where transactions are routed through a centralized, reliable institution.

### 2.2 Blockchain Characteristics

The most important feature of blockchain is its decentralized nature. Each node in a blockchain network keeps an exact duplicate of the ledger, ensuring data redundancy and transparency [1]. On the blockchain, transactions are organized into blocks that are then cryptographically connected to form a chain. Because of the chaining method, it is impossible to change or tamper with previously recorded data, ensuring the immutability of the data. Table 1 lists the major aspects of blockchain technology.

Table 1. Aspects of Blockchain Technology

| Characteristic | Description |
|---|---|
| Decentralization | There is no central authority or third party controlling the network. Instead, the blockchain is maintained and validated by multiple nodes, ensuring transparency, and eliminating the requirement for a reliable third party. |
| Transparency | The blockchain's transparency and auditability make it possible for everyone to see every transaction and data entry. The ledger is accessible to all network members in the same version. |
| Immutability | When a transaction is recorded on the blockchain, it turns out to be incredibly hard to change or mess with. The data's integrity is guaranteed by the chaining of blocks with cryptographic hashes, making it extremely resistant to change. |

# A Model for using Blockchain Technology in Educational Systems

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## Abstract

Blockchain are transparent, tamper-resistant, digital ledgers, implemented in a distributed network of peer-to-peer nodes, in which transactions are made securely and usually without the approval of a central and trusted authority. Thus, blockchains allow peer-to-peer nodes that do not have a trust relationship to exchange data without third parties or intermediaries. This data could correspond to money, contracts, land titles, medical and educational records, certificates, purchase and sale of goods/services, or any other transactions or assets that could be digitized. Blockchain offers lots of advantages, in finance, healthcare, government services, educational sectors, and the Internet of Things. Applying blockchain technology in educational systems will take the management of academic records and the issuing of graduates› certificates to a higher level of trust, in addition to minimizing lots of work and costs. The proposed model calls for a unit within the Ministry of Higher Education using blockchain technology, that will offer a potential solution for student's data storage, students' exchange between institutions and certificates issuing and verification. This will lead to multiple advantages in decentralization, scalability, reliability, and security.

**Keywords**: Blockchain, Educational Systems, Academic Records, Credential Verification, Certificate Validation.

## 1. Introduction

Due to the introduction of a safe and decentralized method for storing and verifying transactions, the blockchain technology concept has transformed many industries. Blockchain was first introduced as the underlying technology for the cryptocurrency Bitcoin, but it has since grown into a powerful tool with many uses outside of virtual currencies.

A blockchain is fundamentally a distributed network of peer-to-peer nodes that implements an open and resistant digital ledger [1]. Blockchain works without a central hub or middleman, in contrast to conventional centralized systems. As a substitute, it enables many parties to securely communicate with one another and carry out transactions without the need of intermediaries or third parties.

It is considered as a peer-to-peer network in which transactions are safely carried out between nodes

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