

AI-powered learning: revolutionizing technical higher education institutions through advanced power supply fundamentals

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Abstract. The burgeoning technological education landscape mandates a reevaluation of educational methodologies, especially in pivotal domains such as power supply fundamentals within technical higher education institutions. This scientific article explores the imperative role of integrating Artificial Intelligence (AI) in teaching the fundamentals of power supply to students in technical higher education institutions. Acknowledging power supply's fundamental significance and the evolving educational challenges, we advocate for the utilization of AI-powered platforms, simulations, and adaptive learning systems. Through a comprehensive analysis, we highlight the potential benefits and contextualize the implementation of AI in Uzbekistan's technical education scenario. By embracing AI-driven educational approaches, Uzbekistan can cultivate a skilled workforce adept in power supply, fostering innovation and propelling the nation towards a technologically advanced future.

1 Introduction

The power supply fundamentals subject stands as a foundational pillar within technical education, playing a pivotal role in shaping the understanding and competency of students in various engineering disciplines. In a world increasingly dependent on technology, power supply forms the bedrock upon which modern electronic devices, communication systems, and industrial equipment operate. This subject encompasses critical concepts such as electrical circuits, voltage regulation, power distribution, and energy conversion, providing the necessary knowledge to design, analyze, and troubleshoot electrical systems.

2 Literature Review

2.1 Integration of AI in Education

Somyürek and Özyer demonstrated the effectiveness of AI algorithms in adapting learning materials and styles to individual student needs, promoting a more tailored and efficient learning process [1]. Additionally, its role in providing real-time feedback has been emphasized by Van den Heuvel et al. showing significant improvements in student engagement and comprehension [2].

2.2 Importance of Power Supply Fundamentals Subject

Understanding the importance of power supply fundamentals is crucial in establishing the need for innovative teaching methodologies. Research by Hu et al. emphasizes the vital role of power supply fundamentals in shaping the careers of electrical engineers. They stress how a strong foundation in power supply fundamentals enables professionals to design efficient and reliable electrical systems [3].

2.3 Modernizing Education in Uzbekistan

In the context of Uzbekistan, modernizing education is a priority to align with global advancements. Research by World Bank sheds light on the need for reforms in Uzbekistan's education system to meet the demands of a rapidly evolving job market [4]. The integration of AI in education is seen as a strategic approach to address this need, enhancing the quality of technical education.

2.4 Bridging Educational Gaps with AI

AI-powered educational platforms have shown promise in bridging educational gaps. Research by Baker discusses how AI can augment traditional classroom teaching, making education more interactive and engaging [5]. This augmentation is particularly critical in

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addressing the shortage of specialized faculty and limited resources faced by educational institutions in Uzbekistan.

2.5 Enhanced Learning through AI Simulations

AI-powered simulations have demonstrated effectiveness in providing an interactive learning experience. Research by Anderson et al. showcases how simulations can significantly enhance understanding and retention of complex technical concepts [6]. By integrating such simulations into power supply education, students can gain practical insights and improve their problem-solving skills [9-20].

3 Importance of Power Supply Fundamentals Subject

Understanding the importance of the power supply fundamentals subject begins with acknowledging its pervasive influence on diverse technical domains. The subject equips students with basic principles, enabling them to comprehend the flow of electrical energy, the function of power sources, and the significance of efficient power utilization. Without a solid grasp of power supply fundamentals, professionals in fields like electrical engineering, electronics, and computer science would be ill-prepared to address the evolving challenges of a rapidly advancing technological landscape [21-30].

In the realm of electrical engineering, for instance, an inadequate understanding of power supply fundamentals can result in inefficient designs, power wastage, and compromised system reliability. Conversely, a strong foundation in power supply fundamentals principles empowers engineers to create energy-efficient systems, minimize losses, and optimize performance—a crucial aspect in our energy-conscious world. Moreover, power supply fundamentals knowledge is essential for navigating emerging technologies such as renewable energy systems, electric vehicles, and smart grids.

By emphasizing the critical role of power supply fundamentals in technical education, students can grasp the importance of mastering this subject as a precursor to their professional success. A comprehensive understanding of power supply fundamentals principles equips students with the necessary skills to contribute effectively to various industries, fostering innovation and sustainable technological growth.

4 Teaching Methods and Challenges

4.1 Traditional Teaching Methods

Traditionally, power supply fundamentals have been taught using conventional classroom lectures, textbooks, and laboratory experiments. While these methods offer a structured approach, they often face limitations that hinder optimal learning experiences. Lecture-based teaching, for example, may not adequately engage students, limiting their comprehension and retention of complex theoretical concepts. Additionally, practical laboratory sessions, though valuable, may have resource

constraints, making it difficult for all students to have hands-on experiences [31-35].

4.2 Survey Insights

To gather firsthand insights about the existing resources and teaching methods, we conducted a survey among 135 students from Tashkent State Technical University. The results are as follows:

1. Labs at the University:

- * Poor: 42%
- * Bad: 14%
- * Satisfied: 27%
- * Good: 11%
- * Top: 6%

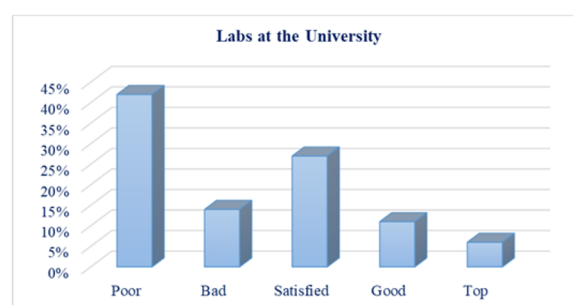


Fig. 1. Quality of Labs at the University

42% of students rated the labs as poor, with 14% marking them as bad. This illuminates a pronounced need for improvement in lab facilities, necessitating enhanced equipment availability and quality, to facilitate hands-on learning and application of theoretical concepts.

2. Status of Study Guides or Materials:

- * Poor: 30%
- * Bad: 16%
- * Satisfactory: 24%
- * Good: 24%

STATUS OF STUDY GUIDES OR MATERIALS

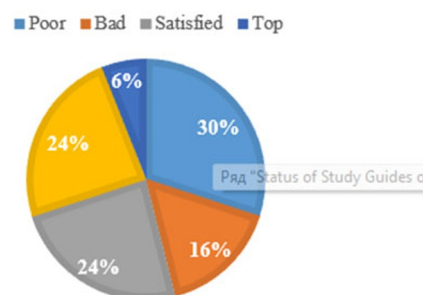


Fig. 2. Status of Study Guides or Materials

The survey reveals 46% of respondents are dissatisfied with study materials, citing them as either poor or bad. This significant percentage underscores the pressing need for updated relevant, and comprehensive study materials that align with the dynamic nature of power supply topics.

3. Professional Skills of Professors and Teachers:

- * Poor: 14%
- * Bad: 5%
- * Satisfied: 29%

- * Good: 35%
- * Top: 17%

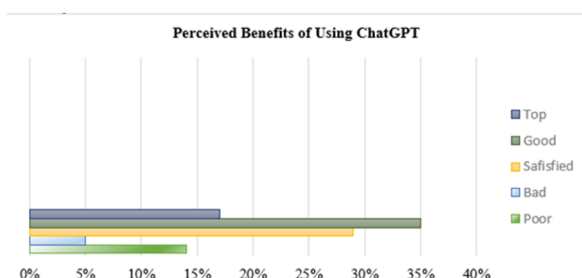


Fig. 3. Professional Skills of Professors and Teachers

The survey results, in this case, were more favourable, with 52% rating their professors and teachers as good or top. However, ongoing professional development and continuous learning opportunities are crucial to maintain high teaching standards and adapt to evolving educational needs.

4. Level of Interactivity of the Lessons:

- * Poor: 36%
- * Bad: 8%
- * Satisfactory: 23%
- * Good: 20%
- * Top: 13%



Fig. 4. Level of Interactivity of the Lessons

36% of students rated the lesson interactivity as poor. This underscores the need for innovative, engaging teaching methods that cater to diverse learning preferences and paces, fostering an inclusive learning environment.

These survey results emphasize some of the prevalent challenges within the institution, including concerns related to laboratory facilities, study materials, and the interactivity of lessons. The feedback on the professional skills of professors and teachers, however, appears relatively positive.

4.3 Challenges

1. Limited Practical Exposure: The survey reflects that a significant proportion of students find the labs either 'Poor' (42%) or 'Bad' (14%), suggesting challenges in providing extensive hands-on training due to limited laboratory resources and equipment. This restricts students' ability to apply theoretical knowledge in practical scenarios.

2. Outdated Learning Resources: The dynamic nature of power supply means that outdated textbooks and learning materials can lag behind. The survey highlights that 30% of students rated study materials as 'Poor',

while 16% rated them as 'Bad', suggesting a lack of up-to-date educational resources.

3. Faculty Shortage: While the professional skills of professors and teachers were rated positively by the majority, there is still room for improvement.

4. Diverse Learning Needs and Lack of Interactivity: Students often have different learning paces and preferences. The survey suggests that 36% of students found the lessons 'Poor' in terms of interactivity, indicating a need for more engaging and diverse teaching methods [36-41].

5 Introduction of AI in Teaching

5.1 Advantages of AI in Education

The integration of Artificial Intelligence (AI) in education offers transformative benefits. AI algorithms can personalize learning experiences, adapt content to individual student needs, provide immediate feedback, and create interactive and immersive learning environments. These advantages align well with addressing the challenges faced in teaching power supply fundamentals.

5.2 Utilizing AI for Teaching Power Supply Fundamentals

1. Adaptive Learning Platforms: AI can personalize the learning journey for each student based on their progress, learning style, and understanding. It can adapt the curriculum to suit individual needs, ensuring a more efficient and effective learning process.

2. Simulations and Virtual Labs: AI-powered simulations can replicate real-world scenarios, providing a safe and dynamic environment for students to experiment with and apply power supply fundamentals concepts without the need for extensive physical resources.

3. Real-time Feedback and Assessment: AI algorithms can instantly assess student performance and provide detailed feedback. This immediate feedback loop helps students identify and rectify misconceptions and errors promptly.

The integration of AI in teaching power supply fundamentals can address traditional teaching challenges and elevate the quality of education, enabling students to comprehend and apply the subject effectively. This approach is particularly relevant for technical higher education institutions in Uzbekistan, where overcoming resource limitations and enhancing educational quality are paramount.

6 Implementation in Uzbekistan's Technical Higher Education Institutions

6.1 Current Educational Landscape

In Uzbekistan, technical education plays a critical role in fostering technological advancements and economic growth.[7] However, the educational landscape faces challenges in keeping up with rapid technological changes and providing students with the most up-to-date knowledge and skills. The conventional

teaching methods may fall short in fully preparing students to meet industry demands, particularly in domains like power supply fundamentals.

6.2 Need for Modernization

To bridge the gap between traditional teaching methodologies and the current technological landscape, incorporating AI into teaching the fundamentals of power supply is imperative. Modernization is essential to equip students with the practical skills and knowledge necessary to thrive in a technology-driven job market.[8]

6.3 Benefits of AI in Uzbekistan's Context

1. Accessible Learning Resources: AI-powered educational platforms can provide students with access to high-quality educational materials, even in remote or poor areas, promoting inclusivity and equal educational opportunities.[8]

2. Addressing Faculty Shortage: AI can supplement the role of educators by offering personalized guidance and support. This is particularly significant in Uzbekistan, where there might be a shortage of specialized faculty in certain technical areas.[8]

3. Enhanced Student Engagement: AI-driven interactive tools and simulations can make learning more engaging and enjoyable for students. This engagement can lead to improved understanding and retention of power supply fundamentals.[8]

4. Global Competitiveness: By adopting AI in education, Uzbekistan's technical higher education institutions can align their programs with international standards, enhancing the competitiveness of graduates on a global scale.[8]

7 Prospects

The integration of AI into teaching the fundamentals of power supply in Uzbekistan's technical higher education institutions presents a promising avenue for enhancing the quality and effectiveness of technical education. It enables students to be adequately prepared for the evolving landscape of power supply technologies and related industries.

Empowering students with a strong foundation in power supply fundamentals through AI-driven educational approaches will not only benefit their careers but also contribute to the growth and development of Uzbekistan's technological sector.[8] As the nation moves towards a more digitally driven future, a technologically adept workforce is crucial, making AI-integrated education an imperative investment for the nation.[8]

Through this marriage of traditional academic rigor and cutting-edge technology, Uzbekistan's technical higher education institutions can play a crucial role in shaping a generation of adept professionals capable of driving progress and prosperity in the dynamic world of power supply.[8]

Conclusion

The rapid evolution of technology mandates an innovative and responsive approach to education, particularly within technical domains like power supply fundamentals—a foundational subject pivotal to multiple engineering disciplines. Considering the survey conducted amongst the students at Tashkent State Technical University, it is evident that there is a palpable demand for modernized, effective teaching methodologies that can adequately equip students with the essential skills and knowledge pivotal to this discipline.

The integration of Artificial Intelligence (AI) into the teaching frameworks holds colossal potential in bringing about an educational renaissance in Uzbekistan. AI-powered platforms, adaptive learning systems, and simulations emerge as transformative tools, with the capabilities to offer students personalized and immersive learning experiences. These systems can meticulously simulate real-world scenarios, allowing students to delve deep into the practical aspects of power supply fundamentals and to grasp intricate concepts more effectively. Immediate feedback and tailored study plans derived from AI can elevate student engagement and catalyze efficient learning trajectories.

Within the confines of Uzbekistan's educational milieu, where the quandaries of resource constraints and faculty shortages are prevalent, AI stands out as a promising beacon, poised to ameliorate the quality and accessibility of education. The survey findings underscore the necessity of such innovations, highlighting substantial dissatisfaction with current labs and study materials, while accentuating the relative contentment with the professorial staff. This demonstrates fertile ground and a willing audience for AI-integrated methodologies.

AI can forge pathways to equal learning opportunities, fostering an environment where students are not just recipients but active contributors to the knowledge ecosystem, and preparing them to be globally competitive in the progressively evolving field of power supply. As Uzbekistan charts its journey toward a technologically driven future, actualizing AI in teaching becomes an imperative, rather than a mere alternative. This embracement is fundamental to nurturing innovation, addressing the prevalent discontent regarding learning resources and laboratories, and propelling the national technical landscape to new heights.

In conclusion, through the astute integration of AI in the realm of power supply education, and in addressing the concerns and needs highlighted by the students' perspectives gathered in the survey, Uzbekistan can usher in a generation of technically adept individuals. These individuals will be the harbingers of a future where sustainable and sophisticated power supply systems form the bedrock of national progress and development, marking a significant stride in realizing the nation's vision for a technologically advanced and educationally enriched future.

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