ARTIFICIAL INTELLIGENCE IN VOCATIONAL EDUCATION AND TRAINING: A CRITICAL ANALYSIS

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Artificial Intelligence (AI) has revolutionised the way we live and work, and its impact is felt across many sectors. In recent years, the application of AI in Vocational Education and Training (VET) has garnered significant attention. This paper aims to critically analyse the role of AI in VET, highlighting its potential benefits and drawbacks. It explores how AI can enhance the learning experience of students by providing personalised and adaptive training. However, the paper also argues that the integration of AI in VET must be done with caution, as it could result in job losses and exacerbate existing inequalities in the labour market. Ultimately, the paper concludes that AI in VET should be used as a complementary tool to support human learning, rather than replace it.

Keywords: Artificial Intelligence, Vocational Education, Training, Teaching and Learning

Introduction

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines that are designed to think and act like humans. Vocational education is a form of education that prepares individuals for specific trades, crafts, or careers. It is often focused on practical and technical skills, rather than theoretical knowledge. The integration of Artificial Intelligence (AI) into the field of Vocational Education and Training (VET) has been a topic of growing interest in recent years (Biswas, 2022). As technology continues to advance, the potential for AI to revolutionise the way VET is delivered is gaining more attention. However, while the advantages of AI in VET are numerous, there are also a number of critical issues that must be considered (Li, Li and Wang, 2019). This paper aims to critically analyse the use of AI in VET, exploring both its potential benefits and the challenges that must be addressed in order to realise its full potential. Through this analysis, we will gain a deeper understanding of the role that AI can play in improving the quality and accessibility of VET programmes and the implications for stakeholders, such as educators, students and employers.

National Education Policy (NEP 2020)

The National Education Policy (NEP 2020) focuses on integrating vocational education into the school system, offering hands-on learning and practical skills development (National Education Policy 2020). It aims to make vocational education accessible to all students, starting from an early age. The policy suggests incorporating vocational education into the regular curriculum at the secondary

level to expose students to various vocational skills and enable informed career decisions. It also proposes establishing vocational education and training centres in every district, along with a network of vocational institutions for quality education. Collaboration between academic institutions and industries is emphasised to ensure relevant skills for the job market. The NEP 2020 aims to provide a technology-enabled, comprehensive approach to vocational education, empowering students to build successful careers and contribute to the economy.

Artificial Intelligence

Artificial Intelligence (AI) is increasingly used in vocational education to enhance learning experiences. AI algorithms analyse student performance and learning styles, providing personalised feedback and support, improving motivation and engagement (Kim and Kim, 2019). AI also facilitates skill development through simulations and virtual training environments, offering practical experience in fields like healthcare, retail and manufacturing. Moreover, AI automates administrative tasks like grading, enabling instructors to focus on individualised guidance (Kim and Kim, 2019). However, challenges exist. Job displacement is a concern as AI may replace human workers (Chen and Tu, 2017). Cost limitations may restrict access to AI technology in schools. Implementing AI responsibly and ethically is crucial to maximise its benefits in vocational education.

Virtual Lab and Vocational Education

The popularity of virtual labs in vocational education has grown due to their safe and convenient platform for learning. These labs provide students with realistic environments to experiment and develop skills (Argyriou and Kalyvianaki, 2020). By accessing interactive simulations and tools, students can perform experiments, control variables and observe results, gaining hands-on experience in a controlled setting. For example, an automotive virtual lab allows students to troubleshoot and repair engines and transmissions.

Virtual labs offer broader resources than traditional classrooms, as students can access them from anywhere with an internet connection. This is beneficial, especially for students in rural areas with limited resources. Collaboration with students worldwide enables knowledge sharing and relationship building. Virtual labs also foster the development of soft skills like presentation, decision-making, problem-solving, critical thinking and customer service.

Cost-effectiveness is another advantage of virtual labs, as they eliminate the need for physical space, equipment and staff (Chen and Huang, 2019). This makes them ideal for vocational education programmes with limited resources and budget constraints. By gradually introducing virtual labs, schools can effectively develop both vocational and soft skills in students.

Augmented Reality (AR) and Virtual Reality (VR)

Augmented Reality and Virtual Reality technologies have greatly impacted the field of vocational education (Zhang and Yang, 2020). Here are some of the ways AR and VR are used in vocational education:

Hands-on Training: AR and VR technologies allow students to practise and learn skills in a safe and controlled environment. For example, a student learning welding could practise using virtual welding tools and get immediate feedback on their technique, without the risk of injury or damaging equipment.

Job Simulation: Students can experience various jobs and careers through VR simulations, allowing them to explore different career paths and make informed decisions about their future.

Visual Learning: AR and VR technologies provide a visual representation of complex concepts and ideas, making it easier for students to understand and retain information.

Access to Real-world Experiences: Students can use AR and VR technologies to experience real-world scenarios, such as construction sites or medical procedures from the comfort of their classroom.

Collaborative Learning: AR and VR technologies can also be used for group activities and projects, allowing students to collaborate and work together in a virtual environment.

AI in Teaching and Learning

AI-powered educational tools and platforms can help to reduce the workload of teachers and is not meant to replace teachers, but rather to support and enhance the learning experience for both students and teachers. AI tools can have several applications as given below.

Personalised Learning: AI-powered learning tools can analyse student data and tailor learning experiences to individual needs and abilities.

Intelligent Tutoring Systems: AI tutors can provide real-time feedback, answer questions and guide students through learning activities.

Language Translation and Learning Tools: AI can be used to translate learning materials into multiple languages, making education more accessible for students who are not native speakers.

Intelligent Content Creation and Recommendation: AI can help teachers create personalised lesson plans and suggest relevant learning materials based on student performance and interests.

Chatbots and Virtual Assistants: AI-powered chatbots and virtual assistants can provide quick and accurate responses to student questions, reducing the workload of teachers and improving the learning experience for students.

To deploy AI-driven educational applications for teaching and learning goals, teachers may not be digitally prepared (e.g., Ally, 2019; Seo *et al.,* 2021). They might not have the technological know-how to set up rules for AI-driven systems that automatically produce assignments and feedback for students or to do data analysis (Seo *et al.,* 2021; Ng *et al.,* 2023). Four new categories of competency for teachers and trainers were developed based on the literature and the interviews that were conducted by Attwell *et al.* (2020) which are: Category 1: Knowledge of the effects of AI on society and the workplace Category 2: Design and development of VET curricula Category 3: Vocational training that takes place in schools and in places of employment Category 4: Teacher and trainer competency

improvement. Being able to deal with new technologies and use them in a focused and pedagogically beneficial way requires the development of digital competencies, which is unquestionably a vital first step (Attwell *et al.*, 2020).

AI Technologies in Training

The following are the common AI Technologies used in Training (Perini, Tommasi and Sartori, 2021):

Machine Learning: Machine learning algorithms can be used to personalise training for individual learners, analyse data to determine the effectiveness of training programmes and improve course material.

Natural Language Processing: Natural language processing can be used to analyse learner behaviour and to provide instant feedback on responses. This technology also allows for virtual learning assistants to answer questions in real-time and provide personalised recommendations.

Virtual Reality: Virtual reality technology is increasingly being used to provide immersive training experiences that simulate real-world scenarios. This allows learners to practise decision-making and problem-solving skills in a safe environment before applying them in real life.

Robotics: Robotics technology can be used to create realistic simulations for training in areas, such as industrial automation and surgical procedures. These simulations allow learners to practice complex tasks and make mistakes in a low-risk environment.

Intelligent Tutoring Systems: Intelligent tutoring systems use machine learning algorithms to adapt to the learning pace and style of each individual learner. This technology can provide personalised feedback and support, and help learners stay motivated and engaged throughout the training process.

Chatbots: Chatbots can be used to answer frequently asked questions and provide support to learners. This technology can help reduce the workload of trainers and instructors, allowing them to focus on more complex tasks.

Big Data Analytics: Big data analytics can be used to analyse large amounts of data related to learner behaviour and performance. This technology can be used to identify areas of weakness and to develop targeted training programmes that address these areas.

AI and Unemployment

Artificial Intelligence (AI) has sparked concerns about job loss due to automation (European Commission, 2020). While some jobs may be automated as AI advances, new job opportunities will also arise in fields like data analysis and AI programming. AI can enhance productivity and efficiency, fostering economic growth and job creation. Goldman Sachs estimates that 46 per cent of tasks in administrative and 44 per cent in legal professions could be automated, compared to lower percentages in construction and maintenance (Briggs and Kodnani, 2023). However, a recent report by the UN DESA's Development Policy and Analysis Division (DPAD) suggests that predictions of widespread job automation are unrealistic. Technological advancements excel in limited job ranges and rarely replace entire professions that require adaptability and versatility. Moreover, new

technologies both create and destroy jobs, as seen throughout history. A study revealed that only the job of a lift operator had been automated out of 270 professions from the 1950 US Census by 2016. Policymakers and businesses should proactively address these challenges, ensuring equitable distribution of benefits of AI.

Role of 5G Technologies

In terms of the role of 5G in this area, it is expected to bring even more advanced AI technology to the field of vocational education and training (Carter and Egliston, 2021). 5G is expected to offer much faster speeds, lower latency and greater capacity compared to 5G, enabling the development of more advanced AI systems. For instance, 5G can help to create more personalised learning experiences for students, through the use of AI-powered tutoring systems. This technology can also help to assess student learning outcomes more accurately and provide real-time feedback to help students improve their skills. On the other hand, there are also potential downsides to the integration of 5G in vocational education and training. There may be a need for workers to constantly reskill and upskill as the technology advances, which could prove to be challenging for some individuals. While AI and 5G technology have the potential to transform vocational education and training, it is important to consider the potential impacts on the workforce and ensure that workers are adequately prepared for the changes ahead. A critical analysis of the integration of AI and 5G in vocational education and training is necessary to ensure that this technology is used in a responsible and ethical manner.

The Future of Vocational Education

Artificial Intelligence (AI) has the potential to revolutionise vocational education, making it more accessible, personalised and effective (Ho and Wong, 2018). AI can provide personalised and adaptive learning experiences, improving outcomes and student interest while assisting teachers. It enables immediate responses to student queries and determines their knowledge levels, offering specialised learning resources. AI also addresses the shortage of vocational teachers by providing quality education. Machine learning algorithms help understand strengths and weaknesses of students, offering tailored recommendations for improvement. AI automates administrative tasks like grading and attendance, freeing up time for educators to engage with students. Real-time feedback helps students identify areas for improvement and adjust their strategies. AI improves accessibility by offering 24/7 access to educational resources, reducing barriers for remote or disadvantaged students (Zhang and Wang, 2019; Li and Tan, 2017). However, AI is not a substitute for human teachers but a tool to enhance teaching and learning. States should analyse skill gaps and introduce future-oriented job roles in schools, making students future-ready.

AI and Ethics

AI and ethics are increasingly important as AI advances (Tommasi, Perini and Sartori, 2021). The ethical implications of AI involve ensuring its alignment with principles and values. Bias perpetuation is a major concern, as biased training data can lead to discriminatory outcomes in areas like criminal justice,

healthcare and hiring. Lack of accountability is also problematic, as it's challenging to assign responsibility when AI decisions cause harm. Privacy is another concern, as AI's collection and analysis of personal data may be exploited for malicious purposes. Additionally, AI can reinforce existing biases and discrimination. To address these issues, ethical AI development requires transparency, accountability, fairness, non-discrimination and privacy protection (Becker, Spöttl and Windelband, 2021; Tūtlys and Spöttl, 2021).

Conclusion

Artificial Intelligence (AI) has been making waves in the field of vocational education and training. This technology has the potential to revolutionise the way vocational education is delivered, making it more accessible and effective by offering new and innovative ways of learning, teaching and assessment. However, there are also concerns about the impact of AI on the workforce, such as the potential loss of jobs and the need for reskilling. However, it is essential to critically analyse the impact of AI on VET in terms of its limitations, biases and ethical considerations. Additionally, there is a need to ensure that VET institutions have the necessary resources and infrastructure to effectively implement AI technologies. As AI continues to shape the future of work, it is crucial to consider its role in VET and to proactively address its challenges in order to provide learners with the skills and knowledge needed to succeed in a rapidly changing world.

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