Big Data and Blockchain synergy in Digital Transformative Tourism Education

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Abstract

Current tourism learning in higher education system often lacks a focus on the recent technologies necessary for tourism growth, competitiveness, and adaptability. Hence, the alignment of tourism transformative education with the changing needs of the practical tourism context is pivotal to prepare students to be responsible, informed and technologically qualified learners for a best future of the industry. This research highlights the crucial role of the transformative education and strives to bridge the gap in the existing tourism literature. Through meticulous analysis, this paper aims to improve the quality and effectiveness of tourism education and its interaction with the industry by evaluating and implementing a distinctive potential of big data and blockchain synergy.

Key Words:

Transformative Education, Tourism, Big Data, Blockchain.

Introduction

In light of recent and emerging challenges such as climate change, violent and hateful ideologies, conflicts, and the potential hazards of global pandemics, education must teach young people the knowledge, skills, values, and attitudes required to live cooperatively, be flexible, think critically, respect diversity, care for the environment, and enthusiastically participate in finding solutions both locally and globally. Accordingly, Transformative Education is critical in assisting individuals to develop these competencies. (UNESCO, 2022)

Transformative Learning was first presented in 1978 by Jack Mezirow. It presents a wide-range approach to adult education that includes identity changes and considers numerous perspectives and experiences, (Mezirow, 2008). Transformative Education can also be defined as "an approach to teaching based on promoting change, where educators challenge learners to critically question and assess the integrity of their deeply held assumptions about how they relate to the world around them". (Eschenbacher, 2020)

Transitioning to digital transformative education, new digital technologies have rapidly transformed societal functions and have created a continuous need for the acquiring and mastering of new skills. The education sector has witnessed a series of paradigm shifts in its system of delivery influenced by technology. In the past two decades, distance education and e-learning have become an important means of delivering knowledge and skills in the education sector (Daniel, 1996, Altbach, 2005). This trend has filtered down to tertiary level education in travel and tourism, where there has been a significant push towards digital delivery of unit materials as a way to adequately prepare students for the digital workforce that awaits them.

As the tourism industry undergoes rapid transformation, the integration of cutting-edge technologies such as big data, blockchain, and emerging technologies presents new opportunities for revolutionizing tourism education (EU Commission, 2020). Integration these technologies enable tourism educators to analyse vast amounts of data, including travellers' preferences, booking patterns, and market trends, to inform curriculum development and strategic decision-making (Li et al., 2021).

This article explores the potential of these technologies to enhance experiential learning, foster global collaboration, and prepare students for the dynamic landscape of the tourism sector. This study is structured into four parts: the first part entails the potential opportunities of adopting Bigdata in both realms of learning analytics and tourism industry. The second part examine the role of Blockchain in creating a transparent and secure academic and industrial environment. The third part is dedicated to illuminate the authors' proposed scheme presenting the transformative potential of integrating big data and blockchain synergy. Then, the analysis of the combined impacts of these technologies paves the way for advanced solutions that fill the gap between education and industry. Finally, challenges and future directions are discussed to open the doors for further research.

Big Data in Transformative Education

Applying big data in education using learning analytics plays a crucial role in measuring students' learning outcomes and implementing efficient teaching process. This can facilitate the determination of the best teaching strategies and contribute to track the level of students' engagement in the learning process.

The immense potential of big data in organising, interpreting, and analysing massive amount of data, will enable educational institutions to analyse students' learning behaviour and design a personalized learning experience and informed decision-making process (Dishon, 2017).

Table 1 illustrates Big Data learning analytics, highlighting their critical role in developing educational experience.

Table 1: Big data learning analytics

Significance	Description
Data-Driven Decision Making (DDDM)	Implementing Data-driven decision-making assist in improving teaching and students learning experience. As well as enhancing accountability and transparency and promoting innovation and collaboration in the educational institution. Moreover, DDDM help educators to evaluate students' behaviour and preferences and provide personalised instructions and feedback. (Estrellado, 2020)
Data Privacy and Security	Ethical considerations surrounding data privacy and security are crucial when implementing big data initiatives in education. Ensuring the protection of student data is essential for maintaining trust and compliance with legal regulations (Reidenberg, 1995).
Integration of Analytics	The integration of predictive modelling and learning analytics into educational institutions can lead to more effective student support mechanisms and improved educational outcomes. This integration optimises resources and enhances decision-making processes (Baker, 2009).
Personalised Learning	When compared with more technical subjects such as IT, students of tourism often have problems in seeing the direct benefits of computerised systems and the potential cost savings involved. Personalized learning opportunities give students the chance to practice and improve their weak points in knowledge. This is a direct improvement over traditional teaching through a fixed curriculum and is made possible through utilizing Intelligent Learning Environments (Cheung et al.2021)
Predictive Analytics for Student Success	Predictive analytics powered by big data can forecast student success and identify potential areas of concern. This proactive approach allows for early intervention strategies to be implemented, thereby supporting students in achieving their academic goals (Fahd and Miah, 2023).

Big data in the transformative Tourism sector and Educational Empowerment

By incorporating big data in the tourism industry, it is expected to expand more efficiently and effectively in determining the future patterns of the industry. Big data can be gathered from private and public sources. The ability to gather and evaluate customer data and other forms of information has transformed tourism marketing and pricing strategies (Tong-On et al.2021). In fact, data in the travel industry is being used to better comprehend business and leisure travellers, develop customer service, offer the right pricing on the product, and more effectively promote and distribute their services. With the incremented availability of data, such technology will also enhance operational efficiency within tourism industry. This can be seen by utilizing data to find out patterns and make quick decisions (Naqvi et al.2021). Through carefully maintained business processes, data can help avoid making decisions out of habit or from emotional incentives. This makes the industry more methodical, and operators will be able to embrace well-informed changes that are beneficial to their company and clients.

The significance of big data analytics in tourism is exceedingly critical. It has numerous implications and could change the whole perspective of how the tourism industry works. Utilising big data tools can help tourism organisations to expand their productivity and enhance their offers to potential travellers, by analysing data from social platforms, commerce websites as well as review sites, to find out what travellers think about specific destinations and what can be developed. This is becoming increasingly important in the tourism industry where there

is an overabundance of data and where it is often difficult to determine the information that will provide the most valuable insight. This necessitate improving training and education requirements for the industry (Lim et al.2023)

The integration of big data in tourism education would create innumerable benefits for the students as well as the educators. In the case of students, it would create opportunities for engaging in real-life work environment (Fettes et al., 2020). Students will be able to engage in experiential learning, allowing them to apply what they are learning in the classroom to a real work environment. This can be achieved through the use of simulations and case studies using the big data sets from the business environment. Real-life examples can foster a greater understanding of concepts and data analysis that will stay with them throughout their career. Big data will create opportunities for more internships with tourism businesses (Ivkovic & McRae, 2021).

For educators, the use of big data in tourism education can help measure student learning and teacher effectiveness. This can be done using learning analytics to track how students are engaging in the learning process and determine what teaching strategies are effective. Big data sets can also be used to evaluate curriculum effectiveness through measuring the knowledge and skills gained by students as they progress through the program. This can ultimately lead to program improvement. The increase in data analysis skills required in the tourism industry can also create more research opportunities for educators in their respective fields. Table 2 presents the role of Big Data in tourism education.

Table 2: Leveraging Big Data in Tourism for Enhanced Education

Importance	Description	Education Awareness Benefits
Understanding Traveler Behaviour	Big data facilitates the analysis of massive dataset to identify travellers' preferences, motivations and booking matters (Zhao et al.,2019).	The incorporation of big data analytics in educational curriculums will result in raising students' awareness on the critical role of data-driven decision making and the advanced industry practices (Manyika et al., 2011).
Enhancing Destination Management	Enabling destination managers to track tourists flows, evaluate carrying capacity and enhance resource allocation (Emmer and Holešinská 2020).	Enhancing students' comprehension about the critical role of sustainable tourism practices and responsible resources management in tourism industry.
Facilitating Market Research	Big data analytics allow to identify the emerging markets and recognising the business opportunity as well as designing creative and customised marketing campaigns to enhance tourists' experiences in the industry (Xiang & Gretzel, 2010).	Through the analysis of big data, students will be able to identify the recent market trends and create effective marketing strategies.

Enabling Personalised Experiences	Big data assist tourism organisations to personalise tourists' experiences through information gained from their preferences and interactions (Yoo & Gretzel, 2011).	Students will recognise the importance of customer-centric approaches and will learn to personalise consumers' experiences based on their preferences.

Blockchain in Education

Blockchain is a decentralised, distributed ledger technology that securely records transactions across multiple computers in a tamper-resistant and transparent manner (Tapscott & Tapscott, 2016). Each transaction, or block, is linked to the previous one, forming a chain of blocks, hence its named blockchain. This technology utilises cryptographic techniques to ensure the integrity and immutability of data, making it highly secure and resistant to unauthorised alterations. The technological evolution raised the need of digital educational development (Balcerzak et al., 2022). However, the physical presence remains a necessity presenting a restriction for learning advancement (Ghazali & Saleh, 2018; Daraghmi et al.,2019; Islam et al., 2018).

Blockchain learning analytics.

Blockchain offers learning analytics advantages such as secure assessment and certification emerging a pivotal application of this transformative technology. Applying Blockchain within the education sector guarantee a secure credentialing and certification. Indeed, it facilitates the execution of tamper-proof as well as transparent certification systems. This will help these establishment to ensure the authenticity of academic achievements certifications stored on the blockchain ledger (Lam & Dongol, 2022).

This technology presents an essential tool addressing different challenges encountered by educational institutions such the case of Saudi Arabia, undertaking a rapid educational expansion based on the Saudi Vision 2030. Blockchain allows the verification of various obstacles encountered by both students and educators. This will assure safeguarding the education integrity and the rapid advancement of digital transformative education (Savelyeva & Park, 2022).

Similarly, the use of Blockchain within the Indian Higher Education context seeks to combat the propagation of counterfeit degrees by improving transparency and security across the education system (Grech & Camilleri, 2017). India Higher Education presents a successful case of applying blockchain-based ecosystems such as Secure Key Technologies. Higher Educational Institutions in this country strength authentication and identity validation processes, laying a solid basis for an efficient digital future (Grech & Camilleri, 2017; Savelyeva & Park, 2022).

Incorporating Blockchain Technology in Assessment Methods

The growing difficulty in remote assessment, remarkably reached unprecedented levels of fraud and plagiarism during the Covid-19 outbreak. In order to combat plagiarism and e-cheating in remote assessments, the use of Blockchain technology, Digital Signature principles, and plagiarism detection tools successfully reduce or remove these difficulties by carefully analysing and classifying these elements. Eventually, the primary goal is to implement and encourage information security and reliability within the assessment system of distance

learning. By incorporating cutting-edge technologies and best practices, higher educational institutions strive to uphold academic integrity and ensure the credibility of remote assessments (Dias et al., 2023).

Furthermore, blockchain-based assessment platforms offer secure and transparent environments for conducting exams and assessments, ensuring the immutability of student performance data (Lam & Dongol, 2022).

The Role of Blockchain in Transformative Tourism Education

Table 3 outlines the benefits of blockchain implementation and underscores the significance of fostering digital awareness within tourism education.

Table 3: The Role of Blockchain in Transformative Tourism Education

Role	Description
Enhancing Transparency& Trust	The exploitation of Blockchain technology in tourism education will assist students to generate advanced solutions for enhancing transparency and accountability in the industry. This may involve process like validating supply chain integrity and certifying travel documents. (Van et al,. 2023).
Exploring Decentralized Applications	Through decentralised applications, students and teachers can collaborate and interact directly and smoothly by relying on innovative approaches to deliver the content of their tourism study. Exposing student to this technology will motivate them to understand its potential in reforming the business models and tourists' experiences (Ozdemir and Erol, 2020).
Promoting Innovation and Collaboration	Blockchain technology fosters the concepts of innovation and collaboration by allowing stakeholders to share data securely and transparently. Hence, students need to be encouraged to participate in blockchain and industry research projects to strengthen the industrial partnership (Ivanov and Webster, 2024).
Facilitating sustainable Tourism	Educators can reinforce students' knowledge on how blockchains are promoting sustainable tourism practices and responsible consumption and production. (Park and Kim, 2023).
Enabling Financial Inclusion	Tourism industry can financially benefit from blockchain technology through presenting secure and low-cost payment systems. Therefore, teachers can discuss with students the critical role of blockchain in facilitating access to financial services and its role in empowering communities in tourism industry (Zheng and Law, 2022).
Decentralized Identity Verification	Decentralised Blockchain system offers secure techniques to verify travellers' identities and decreasing the dependence on centralised agencies. Hence, educators should encourage students to learn about blockchain-based identity solutions to create a secure tourism experience (Zheng and Li, 2023).
Transparent Supply Chain Management	Blockchain provides another advantage of enabling transparent supply chain management. Educators can engage students in comprehending the pivotal role of blockchain in encouraging supply chain transparency in the tourism field, while encouraging reliable sourcing and sustainable practices. (Ivanov and Webster, 2020).
Facilitating Smart Contracts	Smart contracts are usually used to automate the implementation of an agreement so that all participants can be instantly certain of the outcome, without involving any intermediaries or time loss. these are written contracts which will be converted

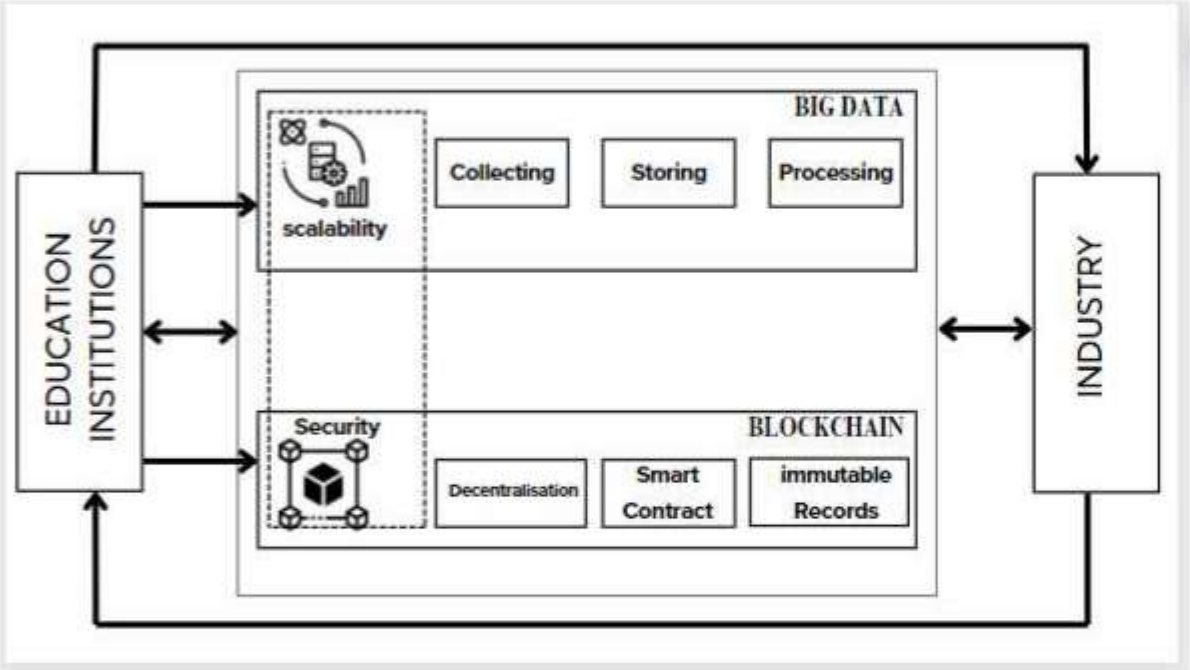
	into lines of code. Smart contracts in the tourism industry can revolutionise the need for contracting services. It helps to connect travellers directly with the service providers through smart contracts (Luo and Hu, 2023).

Big data and Blockchain synergy

The marriage of Blockchain and Big Data illustrates a perfect union of innovation within the digital transformative education. This dynamic partnership offers a new era of data-driven learning transformation.

The below scheme (Figure. 1) illustrates the role of Big Data and Blockchain synergy in bridging the gap between academia and the industry.

Figure. 1: Big Data & Blockchain Synergy



Source: Authors

This scheme isn't only a theoretical construct. It demonstrates a blueprint for enhancing tangible, transformative change within the educational environment. This will create a better future involving effective cooperation, innovation, and progress. The approach combines systematic steps of Big Data as well as Blockchain decentralised system.

Through a series of efficient phases, Big Data enables educational institutions gain actionable insights, update teaching strategies, and improve students' experiences. The collection of data can be gathered from private datasets including learning outcomes, students' performance, and administrative processes. As well as publicly available datasets from various sources such as social media, online reviews, and booking platforms.

However, the characteristic of unstructured nature of big data including an enormous amount of valuable information remains unprocessed. This information could be utilised to

enhance the predictive capabilities of data analytics, and aid in better decision-making within the education sector. However, this is a challenging feat as unearthing this information requires sifting through a vast volume of data, and this requires storage and computation of such big data. Yet, current data analytics platforms implemented within educational institutions may run into scalability issues, given the volume of data involved, and this is where there is a potential for big data analytics on Blockchain. Moreover, within the tourism industry, big data analytics in the realms of fraud detection, consumer behaviour prediction, revenue management, etc. could benefit from a more cost-efficient analytics platform in the form of blockchain.

The interaction between educational institutions and industry can lead to generate numerous benefits and opportunities not only through implementing Big Data Technology but also Blockchain which plays a primordial role across decentralisation, smart contract, and Immutable Records. In fact, the decentralisation system can ensure the authenticity of academic achievements and manage the process of validating credentials for students by verifying academic records and certifications. In turns, employers can easily and securely streamline the recruitment process.

Challenges and Future Directions

Data Privacy and Security Concerns in Educational Innovation

Big data and Blockchain technologies pose a critical challenge of Privacy and Security Concerns (Kerzner et al., 2023). To address such restriction, educators should ensure the implementation of a transparent system ensuring secure data processing practices mitigating the risk of algorithmic bias (Koh et al., 2022).

On one hand, educational data privacy is often relatively under addressed when compared with other domains such as health or business where there are strict regulations on what data can be collected and how it can be used (Reidenberg, J.R. 1995). However, due to the sensitive nature of the student data and changing laws reforms new tools and methods are needed to ensure that educational data can be utilized in manners that preserve student privacy and adhere to emerging regulations. Therefore, the best practices methods for secure data storage and analysis are still in development.

Particularly, the extended database and analysis within the tourism education domain is related to various kind of risks associated to the collection, storage, and usage of personal data like students' academic records and learning behaviours. This is why it must fulfil data protection regulations like GDPR (General Data Protection Regulation) (Park et al., 2023). Moreover, the implementation of clear policies and the Compliance with regulatory frameworks governing data privacy and security is primordial to protect individuals' privacy rights and to mitigate legal risks associated with data processing and storage (Al-Kasasbeh et al., 2021; Faiella et al., 2022).

These challenges may also be addressed by the implementation of a strategic investment in education technology infrastructure, standardized protocols, scalable architectures to encourage learning outcomes and gutting students ready for the dynamic tourism industry (Guo et al., 2022).

Despite of the existence of several blockchain-based initiatives focusing on data integrity and Secure Record Keeping in education (Mitra, Tauz, & Dolecek, 2022; Kan & Kim, 2019; Zhu, Guo, & Zhang, 2021; Guesmi & Farah, 2021), challenges remain in selecting the

appropriate blockchain technology and addressing storage complexities (Xu et al., 2017; Alawida, Samsudin, & Teh, 2019).

Additionally, the integration of blockchain technology into education requires careful consideration to ensure privacy, security, and scalability (Alawida et al., 2019; Farah & Belghith, 2017).

Embracing Continuous Professional Development for Educators

The issue of time has been cited as another factor that inhibits the ability of educators to seek continuous, professional development (CPD). Full-time educators may face a lack of relevant CPD opportunities due to the highly specific nature of their subject. This is a point which could apply to several teaching disciplines.

Due to the demands of teaching innovation and change, CPD remains a significant factor in the success of any educational course. In the field of tourism, it is widely regarded that educators delivering and teaching elements of the product to students must have an up-to-date knowledge and industry experience of their subject. However, this need is often cited as a point of weakness as many educators with valuable industry experience are often part-time or adjunct staff and may not have regular access to CPD opportunities.

Enhancing Collaboration for effective implementation

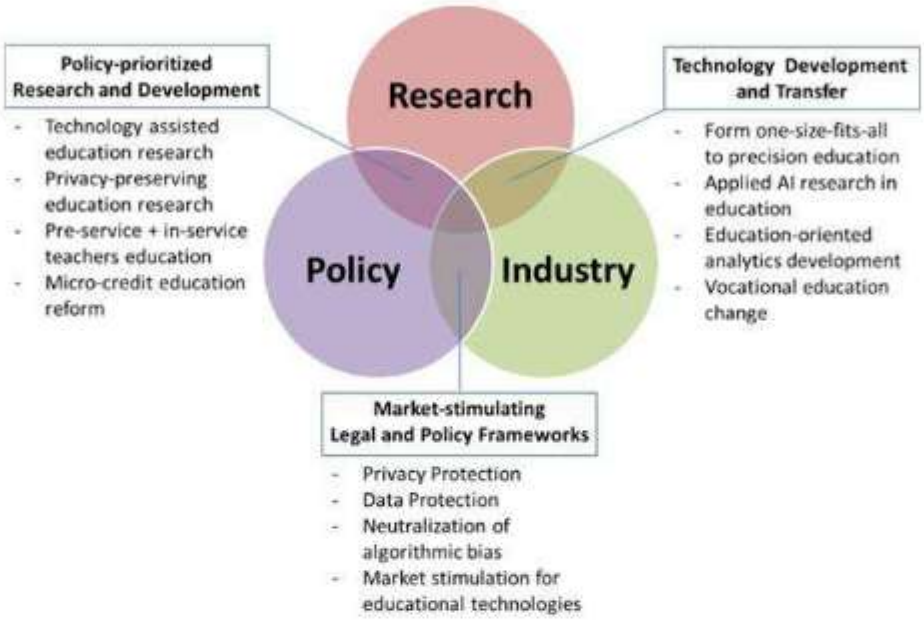
Data scientists, often employed for their expert analysis and interpretation of large data sets, are the leading force behind the big data phenomenon. Their skills and knowledge will be in high demand according to the potential benefits of big data in education. It is essential that education systems and institutions have a strong collaboration between data scientists or professionals, educators policy-makers, and researchers.

Such collaboration is necessary in the development and improvement of assessment and learning analytics tools. Data scientists must consult with educators to identify the needs of educational tools. This will ensure that tools are properly aligned with learning objectives and subject content. Together they must develop the competences and key abilities that students will need for the future workforce (Bereiter, 2002). Educators have a more focused understanding of educational theory and practice and can provide insight to data scientists on the educational context in which tools and data analysis will be applied. It will also be necessary for data scientists to train educators in the use of new tools and data analysis for the purpose of empowering educators to interpret data and ultimately use it toward the improvement of their own teaching and student learning. (Luan et al., 2020).

This collaboration will result in continual improvement and refinement of data analysis, providing more meaningful results and feedback to educators for the betterment of student learning. However, such collaboration may take a lot of work to interconnect across different disciplines and industries. Particularly, when none of the parties have a clear idea of their mutually beneficial interests or the expertise and abilities to make that vision a reality.

Figure 2 shows the latest accomplishments and changing future trends resulting from the use of big data and artificial intelligence (AI) in education, at the intersections of researchers, policymakers, and industry stakeholders.

Figure 2: Contemporary developments and future trends at the intersections between research, policy, and industry driven by big data and AI advances in education.



Source: Luan et al., (2020)

Conclusion

Today, technology has advanced from just facilitating and managing educational systems to becoming the foundation of creating different ways of learning. As technology rapidly grows, digital education is a continuous process that aims to provide the best learning experience among its learners where this enables them to gain knowledge anywhere and anytime. During this process, digital technology offers continuous interaction between learners and their environment, creating more meaningful educational process that result in new knowledge transfer, and changes in learners' behaviour. Through meticulous analysis, this paper aims to improve the quality and effectiveness of tourism education and its interaction with the industry by evaluating and implementing a distinctive potential of big data and blockchain synergy. Using Big Data and Blockchain technologies ensure data-driven insights, transparency and security integrity serves to improve and update curriculum design for better academic and practical future. This will create an educational vision based on flexibility, reactivity, and alignment with continuous change of the digital era, particularly in the tourism sector, creating an environment where advancement, cooperation, and creativity coexist peacefully.

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