A Conceptual Model for Social Media Enabled Intelligent Higher Education in the Era of Industry 4.0: Aligned with Oman Vision 2040

Indu Govinda Pillai, Anju Mathew Cherian, Greeshma Eliyan and Bobby Sathyaseelan
Gulf College, Muscat, Oman

indu@gulfcollege.edu.om
anjuit@gulfcollege.edu.om
greeshmasunil@gulfcollege.edu.om
bobby@gulfcollege.edu.om

Abstract: The Industry 4.0 brings about technological revolutions in the higher education system to create an equitable and digitally enabled higher education system. However, in the case of Oman, several barriers to a fair and technology-driven education system exist, such as geographical barriers. This study proposes a conceptual model for the creation of a social media enabled and equitable and fourth industry revolution-based technology-enabled higher education system in Oman, incorporating Education 4.0. The methodology for the research was qualitative content analysis of academic literature on the technologically driven higher education system based on the triple helix model, Industry 4.0, and Oman Vision 2040. From the data analysis, four main domains were identified, which are training, research, technology, and policy. Moreover, five opportunities for the technologically driven higher education system were identified, which are adaptive personalized remote learning, job creation, global competitiveness, financial sustainability, and digitization of government services. The conceptual model is proposed by mapping domains with opportunities within an intelligent collaborative educational ecosystem grounded in Industry 4.0 capabilities.

Keywords: Social Media in Education; Education 4.0; Industry 4.0; Intelligent Higher Education; Knowledge-Based Economy; Oman Vision 2040; Workforce Development

1. Introduction

The higher education system in the Sultanate of Oman is regulated and supervised by the Ministry of Higher Education, Research and Innovation, (Ministry of Higher Education, Research and Innovation n.d.) which is responsible for ensuring the quality of academic programs, adherence to national and international standards, and alignment with labour market and national development objectives. There are some challenges associated with this mode of instruction, especially for students who are limited due to geographical, environmental, and socio-economic constraints. For example, constant interruptions due to bad weather, transport challenges, and even emergency shifts to virtual learning environments are indicative of the vulnerability of traditional modes of instruction. These are some of the challenges that have contributed to delayed graduation, absenteeism, and dropout rates, thus limiting access to quality education.

Industry 4.0 technologies offer new opportunities for developing flexible, scalable, and intelligent education systems that can address issues of accessibility and equity in education. The study on Education 4.0 (González-Pérez and Ramírez-Montoya 2022) informs the need of models with complex reasoning and auto-systemic thinking. Also, the research shows that faculty are generally ready to adopt Industry 4.0 technologies when they perceive performance benefits (Al-Riyami et al. 2023).

The study aims to align these technologies together the Oman Vision 2040. And designing an such platform can support social and economic diversification. This can help the future workforce to be ready with Industry requirements. The proposed model is rooted in triple helix model of innovation. The following sections describe the theoretical framework, methodology, proposed framework, results and conclusion.

2. Theoretical Framework

2.1 Industry 4.0 Technologies

Industry 4.0 encompasses technologies such as artificial intelligence (AI), cloud computing, Internet of Things (IoT), robotics, and automation, which can be used for data-driven decision making (Bousdekis et al. 2021). These technologies support higher education through immersive content, real-time analytics, interactive simulations, and remote access to laboratories and learning environments (Moraes et al. 2023). It also supports nations seeking to enhance workforce skills and economic competitiveness (Lauder and Mayhew 2020).

Industry 4.0 was formally introduced in Germany in 2011 (Yang, 2021) and has since influenced industries to digitalise and a need of strengthen academia with industry (Bongomin et al. 2020). Despite its benefits, issues of privacy, monitoring, and digital divide must be addressed (Burbules, Fan and Repp 2020)

2.2 Education 4.0

The concept of Education 4.0 highlights the importance of future skills, competency-based education, and AI-based personalization by integrating with Industry 4.0 (Agrawal, Sharma and Bhatnagar 2021). The integration of technologies such as cloud computing, augmented and virtual reality plays an important role in improving learning, engagement and conceptual understanding (Qureshi et al. 2021; Aliyu and Talib, 2020)). The Fourth Industrial Revolution (Industry 4.0) requires higher education institutions to redesign curricula in the direction of technological advancements (Wang et al. 2023; Coşkun et al. 2017) and the need of a strategic framework for equitable access with integration of Industry 4.0 technologies (Pasi and Dhamak 2025).

to integrate develop new education models for collaboration between academia and industry The Fourth Industrial Revolution requires HEIs to redesign curriculum transformation, digital pedagogical practices, and collaboration between educators and institutions. Developing educational models with technology integration is required to promote student-centred learning (Zainuddin et al. 2019).

The personalization of adaptive learning frameworks involves the identification of key aspects, which include learners, progress, individualization, and environments (Peng, Ma and Spector, 2019). AI-based systems play an essential role in facilitating these aspects.

2.3 Digital Learning Platforms and Social Media in Higher Education

Digital learning platforms and social media enhances the access, personalisation, collaboration and knowledge sharing in higher education

Digital platforms enhance higher education with more access, personalisation, flexibility using learning management systems such as Moodle, Blackboard. They provide ubiquitous access to educational resources (Liu, Lomovtseva and Korobeynikova 2020), personalised and flexible learning (Alshammary and Alhalafawy 2023). Additionally, they provide better accessibility timely feedback to improve the student experience, thereby improving sustainable higher education (Gavrus, Petre and Lupșa-Tătaru 2025).

Social media enhances higher education through collaborative learning, increased interaction and sharing of knowledge among peers as well as the teachers (Ansari and Khan 2020). This can lead to better academic performance.

2.4 Triple Helix Model

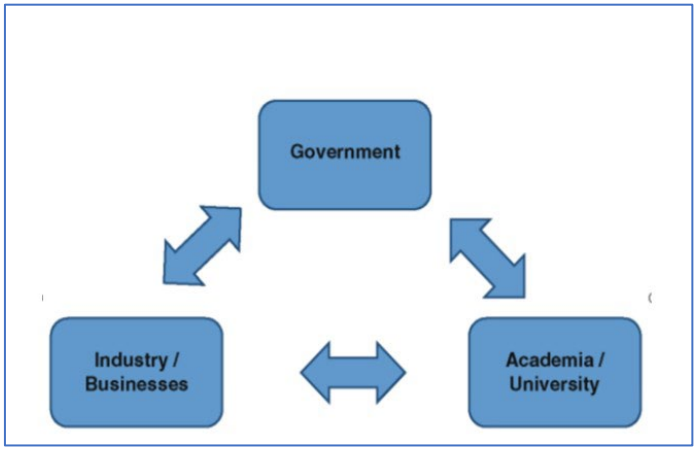

Figure 1: Triple Helix Model

The Triple Helix Model of innovation brings forth the interaction of academia, industries, and government as the source of innovation (Etzkowitz 2008). These three actors contribute to the development of knowledge, societal progress, and technological advancements. Studies highlight the importance of networking, collaborative structures and informed governance in innovation ecosystems (Ranga and Garzik 2015; Galvao et al. 2019).

This model provides the strategic base for the integration of Industry 4.0 technologies and education modernization initiatives, with the support of the informed governance.

2.5 Oman Vision 2040

Oman Vision 2040 focusses the importance of improving human capital, increasing employment opportunities in the private sector, empowering SMEs, and improving the quality of education (Oman Vision 2040 Implementation Follow-up Unit n.d.). Moreover, the vision ensures the importance of matching the quality of education (Al'Abri, Ambusaidi and Alhadi 2022) with the global labour market requirements and the development of research and innovation capabilities.

The alignment of the agents of the Triple Helix with the national priorities will contribute to the development of a technology-enhanced higher education system that addresses the socio-economic needs of Oman.

3. Methodology

Qualitative Content Analysis methodology was employed to investigate academic studies, policy papers, and innovation frameworks on the topics of Industry 4.0, Education 4.0, the Triple Helix Model, and Oman Vision 2040. The stages of the methodology is depicted in figure 2.

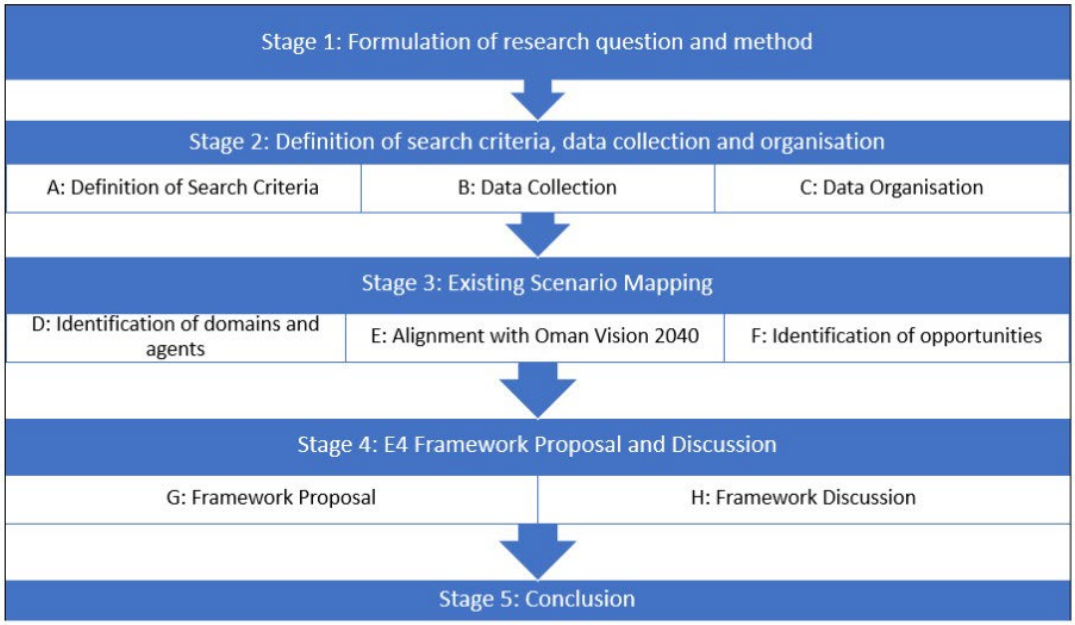

Figure 2: Research Methodology

The research question guiding this analysis was: How can an Industry 4.0–enabled higher education model be designed to enhance accessibility, personalization, and workforce readiness in alignment with Oman Vision 2040?

3.1 Data Sources

The primary sources used in the paper included peer-reviewed articles, Oman Vision 2040 policy documents, and reports from higher education and innovation bodies.

3.2 Data Collection

Key words were used to search for literature: "Industry 4.0 in education," "Education 4.0," "Triple Helix," and "Oman Vision 2040." A coding frame was developed based on previous research and emerging themes from literature.

3.3 Data Analysis

Qualitative content analysis identified recurring themes that represented four domains: training, research, technology, and policy. There were five opportunities identified that were relevant to higher education transformation. Tables 1 and 2 provide a summary of the extraction of domains and opportunities from the literature.

Table 1: Identification of Domains

Data Sources	Training	Research	Technology	Policies / Legislation
(Moraes et al. 2022)	×	×	√	×
(Bongomin et al. 2020)	√	×	×	×
(Agrawal, Sharma and Bhatnagar 2021)	√	×	√	×
(Qureshi et al. 2021)	√	×	√	×
(Mian et al. 2020)	√	√	×	×
(Burbules, Fan and Repp 2020)	√	×	√	×
(Etzkowitz 2008)	√	√	√	√
(Ranga and Garzik 2015)	√	√	√	√
(Cai and Lattu 2022)	×	√	√	√
(Gachie 2019)	×	×	×	√

Table 2: Identification of Opportunities

Data Source	Adaptive Personalised Learning	Generate Job Opportunities	Global Competitiveness	Financial Sustainability	Digitisation of Govt Services
(Bongomin et al. 2020)	×	√	×	×	×
(Peng, Ma and Spector 2019)	√	×	×	×	×
(Oman Vision 2040 Implementation Follow-up Unit n.d.)	×	√	×	√	√
(Al'Abri, Ambusaidi and Alhadi 2022)	×	×	√	×	×

3.4 Identification of Domains

Four domains emerged from content analysis such as training, which is academic skill development, research, that is innovation and knowledge creation, technology, which is basically Industry 4.0 integration, and policy/legislation, that deals with governance and compliance. These domains align with the Triple Helix agents, which are academia, industry, and government.

3.5 Identification of Opportunities

The Five opportunities emerged, which are as follows:

- Adaptive Personalized Remote Learning
- Generation of Job Opportunities
- Global Competitiveness
- Financial Sustainability
- Digitization of Government Services

These opportunities align directly with Oman Vision 2040 objectives.

3.6 Mapping Domains and Opportunities

Table 3 presents the mapping of domains to opportunities using Triple Helix agents.

Table 3: Mapping Domain and Opportunities

Agents	Domains\ Opportunities	Adaptive Personalised Remote Learning	Generate Job Opportunities	Global Competitiveness	Financial Sustainability	Digitisation of Government Services
Academia	A. Training	√	×	√	×	√
	B. Research	×	×	√	×	×
Industry 4.0	C. Technology	√	×	×	×	√
Government	D. Policies/ Legislation	×	√	×	√	×

The mapping indicates technology and training are strong facilitators of adaptive personalized remote learning, research promotes global competitiveness, policy and legislation contribute to job creation and financial sustainability, and technology facilitates digitization in government services.

4. Proposed Conceptual Model

The conceptual model is presented with an overview, the diagrammatic representation of the model, stakeholder roles and the operation of the framework.

4.1 Overview

The conceptual model integrates domains and opportunities within an intelligent educational ecosystem grounded in Industry 4.0 capabilities.

The model consists of agents, domain and opportunities. Agents include academia, industry and government. Domain includes training, research, technology and policy. Opportunities consists of remote learning, jobs, competitiveness, sustainability, digital government. Also, it aligns the social media and digital tools in academia to enhance adaptive personalised learning as well as global competitiveness.

4.2 Conceptual Model

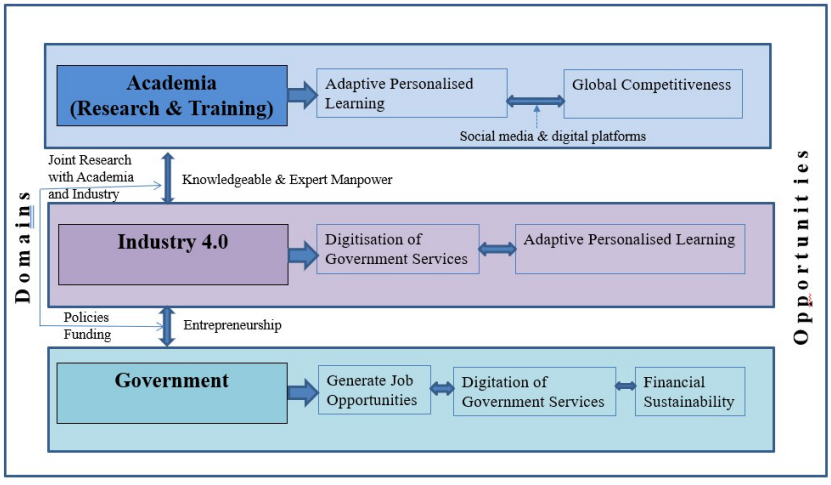

Figure 3: Proposed Conceptual Model for Higher Education

The proposed platform is diagrammed in the figure 3.

The framework leverages IoT, AI, cloud computing, robotics, VR/AR, and smart analytics to provide custom-designed, accessible courses to remote learners (Núñez and Mendoza-Padilla 2020). It enhances interaction, engagement, and assessment through intelligent systems and virtual environments.

4.3 Stakeholder Roles

The model proposes the major stakeholders as academia, industry and government. The academic delivers training, research, and personalised learning. Industry provides technologies, supports innovation and enhances digital services. Government sets legislation ensures quality and funds transformation.

4.4 Framework Operation

The framework enhances real-time learning analytics, SVRE-supported engagement (Mystakidis, Berki and Valtanen 2021), continuous assessment and feedback (Gikandi, Morrow and Davis 2011) and inclusive access to high-quality education. The proposed model presents social media and digital tools in academia to support personalized learning, engagement and global competitiveness.

This model aligns with Oman Vision 2040 by promoting digital transformation, upskilling, and economic diversification.

5. Results and Discussion

The proposed conceptual model combines the higher education reforms with Oman Vision 2040 and Triple Helix actors. The higher education system can be benefitted with personalised training by expanding remote access. Also, the model prepares the graduates with the technological demands of the industry. The technology backed learning management system along with social media improves the learner engagement and interaction in academia.

Moreover, with the equitable access of data among the stakeholders, more transparency, performance tracking, and data informed decision-making are achieved (Jin et al. 2015).

Even though, there are many challenges that may be encountered, such as data privacy and security concerns, digital literacy needs, infrastructure and integration needs and institutional policy changes.

These challenges are to be overcome with the discussion with all the concerned stakeholders especially government, industry, and academia. Even though, these challenges exist, , a tremendous opportunity for transforming higher education and national development is shown by this conceptual model

6. Conclusion

This research proposes a conceptual model for intelligent higher education platform that are based on Industry 4.0 and align with Oman Vision 2040. The model identifies five opportunities in this regard. It incorporates Triple Helix principles for collaboration with training, research, technology, and policy domains, thereby increasing access, equity, and a knowledge-based economy. Also, it presents the usage of technology backed social media and digital tools in enhancing the higher education.

The future research will focus on developing an operational plan for the proposed conceptual model.

Ethics Declaration

The methodology used in this research is qualitative content analysis. Ethical approval was not required in this research.

AI Declaration

AI tools were used for improving language refinement only; no AI system was used to generate scientific content.

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