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Cohesive Online Education Model Using Emergent Technologies to Improve Accessibility and Impact

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Abstract: It is commonly known that the present systems and techniques used in education are outdated. In 1983, UNESCO had already called attention to this, calling present techniques archaic and inefficient. Though a lot of new developments have been achieved and a lot of commendable work has been carried out to remedy particular shortfalls in present systems, no literature was found that develops a concise and complete model for an education approach that maps the use of emergent technologies and techniques to improve on shortfalls in present teaching and learning paradigms. This paper reviews emergent technologies and techniques and their impacts and successes, to propose a combined model for online education to improve the effectiveness, accessibility and impact of teaching and learning activities. This paper concludes by presenting the possible future scope of education and employment structures by examining the possible impacts of the proposed model.

Keywords: online education; blockchain; gamification; machine learning; micro-credentials

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1. Introduction

1.1. Existing Teaching Paradigms

UNESCO [1] published Viewpoints and Controversies in a quarterly review of education in 1983, which outlined education paradigms at the time. Though this publication is 40 years old at the time of this publication, the highlighted shortcomings still exist today. The author outlined viewpoints on education, including the following shortfalls of teaching paradigms:

- An outdated and limiting teacher–pupil structure;
- An excessively long period, often into the student's 30s or 40s, for postgraduate study;
- Inefficiency in conveying information and knowledge that is not targeted or tailored to better suit the student's requirements;
- A focus on reproduction and "drilling" instead of creation and innovation;
- The changing world and technology now requires more innovation and creativity than repetitive and procedural knowledge;
- Assessment is examination-centred, which has been proven not to be effective.

These viewpoints ring true when considering the mismatch in the rate of change in modern society and the rate of change in teaching and learning activities throughout an individual's training experience from basic education to graduate or post-graduate training. The shortcomings are not only on an individual student level, but also on a societal and international level. The United Nations highlighted the importance of accessible education by developing a standalone goal in the Sustainable Development goals. The targets outlined in this Goal 4 include improving access to equitable and high-quality basic education and improving the disparities between genders and regions. It also targets equal access to quality and affordable technical and vocation tertiary training for all [2].

The disruptive impact of the COVID-19 pandemic in 2019 and 2020 on the slow rate of change in this environment has supported the rapid roll-out of technology-enabled educational practices, including expansion into online learning. This effort remained sporadic, globally uncoordinated, and, resultantly, unsustainable.

1.2. Opportunities of Online Learning

Online education tremendously assists learning experiences, with many educators exploring its benefits. This expansion has gained great traction in implementation during- and following the COVID-19 pandemic and the resulting social interaction limitations [3–7]. These trends and growth include the following:

- Collaborative learning: online resources are enabling students and educators to interact, engage with, and share content, despite their physical location [8,9].
- Microlearning: It is becoming more popular to generate shorter and more focused lessons, since they improve retention and are more convenient for a faster-paced way of life. These courses are also most often shared using online platforms, enabling easy access and more customisable content [10,11].
- Personalized learning: using AI-enabled online learning has allowed online platforms to use data analytics to ascertain learning styles, strengths and weaknesses which enable tailored content to be developed and shared, in turn improving the learning experience and success rate [12].
- Virtual and augmented reality: Learners have the opportunity to engage with simulation and virtual experimentation without having to be in the same physical location. Additionally, this improves student understanding, with in-depth engagement instead of simple didactic content [13].
- Blockchain: online credentials and accreditations are secured using blockchain, improving security and reducing falsification of qualifications, allowing online credentials to be as secure, if not more so, than face-to-face engagements [14].
- Artificial intelligence: As mentioned above, AI is very useful in analysing, adapting and customising learning experiences for specific learners. AI has also been used to develop course material and various other applications [15,16].
- Open educational resources: an additional contribution of online education is the provision of cost-free or low-cost educational resources and materials, which also opens education to an international environment and persons who previously could not have had access to quality educational resources [3,5,16].
- Gamification: restructuring educational interaction to form a more game-like and competitive environment better motivates progression, growth and interaction [17–19].
- Mobile learning: deep market penetration of mobile devices such as smartphones and tablets and the expansion and cost-effectiveness of mobile networks have expanded the possible reach of education as presented using online resources [20–22].
- Social learning: the emersion of social media and incorporation of social media-type features into learner management systems or online educational resources has allowed long-distance and interactive involvement between learners and educators, in turn also expanding the possible reach of quality educational resources (including virtual- and augmented reality) [23,24].

These developments have opened education to widespread improvement, including better access and reach and reduced cost. Though these developments have presented great opportunities, the effective combination of these resources has only been studied in sporadic and seemingly non-cohesive ways.

1.3. Problem Identification

A cohesive model for the combination and future map of development is poorly explored. Though the COVID-19 pandemic has provided a catalyst for the fast-tracked roll-out and adoption of online education, it has been reactive to circumstance and poorly united.

A planned and unified approach is required to expand on how these different technologies and techniques can be combined and gain the possible benefit of the various developments. Though various successful online platforms are presented today, most still lack different emerging technologies that have the success and impact of such online platforms.

It is clear that a gap in the literature, and the problem that this study aims to answer, is how these emerging technologies can be combined to remedy the shortcomings of the present educational paradigms.

1.4. Research Aim

The aim of this research is to improve the present education paradigm to align with technological advances. A secondary aim is to develop a method that better solves international shortcomings of reach, cost and access to quality education.

Propose how emerging technologies can be combined in a cohesive model that will improve teaching and learning impact, reach and, effectiveness in a cohesive.

1.5. Research Methodology

This study uses the grounded theory approach to conduct a qualitative analysis of existing literature findings to generate a solution to the identified problem. The grounded theory approach uses a cyclic data analysis and coding approach to generate conclusions from existing information in an inductive way. Grounded theory does not make use of hypotheses or research questions, but uses inductive reasoning to simultaneously analyse data and generate theory based on the findings. The structure of this study, as guided by [25] for the grounded theory approach, is shown in the diagram in Figure 1.

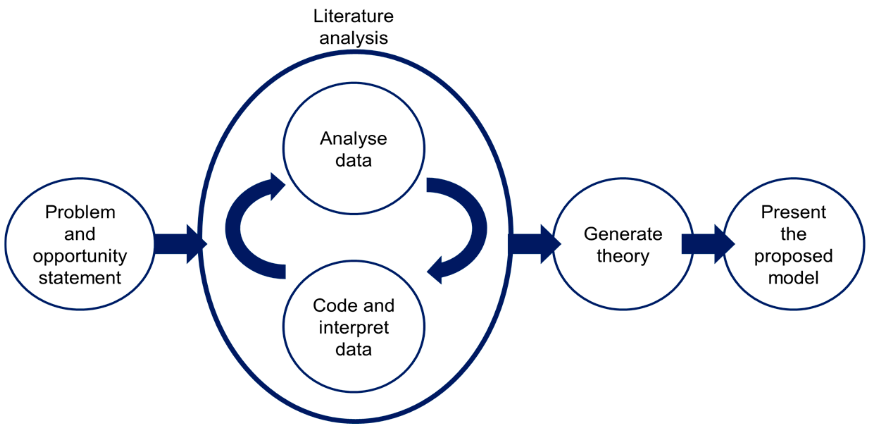

Figure 1. Grounded theory methodology.

From this figure, the step-by-step process in this study and the associated sections is as follows:

- Step 1—Problem and opportunity statement: present the opportunity for improvement and the problem statement using inductive reasoning supported by a short preliminary literature study (Section 1).
- Step 2—Literature analysis: Explore the existing research of emerging technologies and accompanying secondary sources in detail to generate and interpret qualitative data. This process entails reviewing the literature whilst iteratively coding the findings, as outlined with grounded theory methodology (Section 2).
- Step 3—Generate theory: use the results of the iterative literature analysis to propose a theory for the solution to the problem and an opportunity statement (Section 3).
- Step 4—Present a proposed model: Present a practical form of the theory using the explored technologies in a systems model. This will validate the practicality of the study to present a future map for an effective learning model. It will also identify and highlight possibilities for future work (Section 4).

2. Literature Analysis

2.1. Gamification

Gamification is generally defined as using game-like elements such as leaderboards, competitive environments, competency level progression, interactive components and other game design elements in non-game applications like education. It has been proven that gamification is an effective tool to improve learner engagement with the content, and has shown significant development recently [26]. Kalogiannakis, Michail and Papadakis, Stamatios [27] conducted an extensive review of the emerging literature on the implementation and successes of gamification in education. Though some contradicting findings were reported, a clear trend in improvement and increased implementation was shown by this review.

Additional developments include immersive experiences that make use of virtual reality (VR) and augmented reality (AR) when implementing gamification in education. This enables realistic, interactive environments that greatly improve retention and increase the rate of learning, in particular with complex or vague concepts [28,29]. Examples were published by Mehmet [30], who showed an increase in understanding and retention of scientific content through gamification, and Kalogiannakis and Papadakis [27], who, through an extensive review, showed improved retention and a higher volume of content conveyed to learners through different gamification elements.

Adaptive algorithms are also used for gamification in learning. Large sets of user data are gathered and used to personalise the learning experience that better suits the personality profiles and strengths and weaknesses of the learners [31]. Additionally, gamification is used to create a more learner-interactive environment, allowing for improved social and emotional (SEL) skills, which has long been a concern when considering online or distance education. This allows for growth in empathy, decision making and self-awareness in an engaging way [32,33].

Arguably the greatest success of gamification in education is the ability to engage a learner’s intrinsic motivation to participate in the content. This refers to a student’s willingness to engage without the need for external rewards. Tapping into intrinsic motivations greatly improves long-lasting retention, with meaningful experiences for the learners [34,35]. Puspitasari, Ika Arifin, and Shokhibul [36] investigated the impact that gamification has on learner motivation using a meta-analysis. By analysing various published case studies, the authors showed that gamification generates a substantial increase in learner motivation, varying from an 8% to 89% increase, depending on the level of integration.

Apart from the key findings listed, further information regarding the methodology for implementation and the associated efficacy was investigated and listed in Table 1.

Table 1. Gamification in education: published reviews.

Author	Date	Description	Findings	Ref.
Putz, Lisa-maria	2020	Improved knowledge retention and student performance.	Steady increase in learning performance with incorporation of gamified principles.	[37]
Hakak, Saqib	2019	Design of cloud-assisted education gamification.	A cloud-assisted model architecture is proposed.	[38]
Gatti, Lucia	2019	Improved cognitive and critical-thinking skills.	Improved cognitive and affective learning and increased learning outcomes.	[39]
Aguiar-Castillo, Lidia	2021	Higher student satisfaction and deep learning with peers.	Satisfaction increases with an increased level of deep learning.	[40]
Seaborn, Katie	2015	Review of gamification implementation with a multidisciplinary approach.	Empirical studies were identified but broader implementation and testing is required.	[41]
Subhash, Sujit	2018	Review of gamification in higher education for implementation.	Identifying and categorising gamification systems.	[42]
Buckley, Patrick	2017	Learning style and traits: impact of gamification efficacy.	Positive impression, but must be implemented considering learner traits.	[43]

Table 1. *Cont.*

Author	Date	Description	Findings	Ref.
Oliveira, Wilk	2023	Review of gamification efficacy and future research.	Not enough statistical evidence found for efficacy.	[18]
Manzano-León, Ana	2021	Review of literature of student motivation and performance.	Positive reception and marginal improvement in motivation and performance.	[17]
Swacha, Jakub	2021	Review of literature to design interactive content.	Positive reception and marginal improvement in motivation.	[19]
Swacha, Jakub	2019	Literature review of the state of the art in gamification.	Outlined different studies and techniques.	[26]
Kim, Jihoon	2021	Meta-analysis of results of gamification implementation.	Change in behaviours and improved learning outcomes.	[44]
Brouwer, A	2021	A systemic review of gamification in the education of health professionals.	Improved learning outcomes with no negative outcomes reported.	[45]
Naaman, Awaz	2022	Literature review of e-learning applications.	Used as a tool to improve learning experiences, with future study directions outlined.	[46]

2.2. Assessment Procedures

Assessment is a crucial component of the educational process, and recent developments in assessment techniques have shown promising benefits for learners. Traditionally, assessments have been limited to written exams and standardized tests. Technological advancements have led to the development of new assessment techniques, such as formative assessments, digital assessments, and game-based assessments [47].

Continuous assessments, also known as formative assessments, allow for ongoing monitoring of a learner's progress through the different milestones of the learning process. Continuous assessments give students constant feedback on their retention, strengths, and weaknesses, allowing them an informed opportunity to improve or add focus to problem areas before a final, summative assessment is conducted. More recently, making use of digital means to conduct these assessments, with largely automated feedback, increases the frequency at which this feedback can be provided, improving this engagement with learners [48–50].

Game-based assessments have also been used of late. This method of assessment provides a more engaging way to assess learners. These assessments use gaming principles, such as scores, achievements, and leaderboards to motivate learners on the provided continuous feedback. These types of assessments can help learners develop critical thinking and problem-solving skills. This gamification in assessment is also often aligned with project-based or problem-based learning, giving students an interactive engagement with real-world circumstances, which also increases student in-depth engagement and applied understanding of the content [50–52].

New developments in assessment techniques have also led to a more personalized approach to learning, where learners can receive tailored feedback and support based on their individual needs. This can help learners to improve at their own pace and with materials that are relevant to their learning style. Tailoring the feedback and engagement assists in reducing variance between student peers, which improves quality [53].

2.3. Micro-Qualifications

Micro-qualifications, also known as micro-credentials, are short certifications that provide learners with specialised skills learnt over a short period (a short learning programme) [54]. These courses and qualifications are increasing in popularity due to their flexibility, tailored relevance to the job market, and affordability [55–57].

Micro-qualifications are accredited by using online digital badges. Digital badges are visual representations of achievements that can be easily shared and verified online. Digital badges can also be embedded with metadata, which provides detailed traceable information about the training that was undertaken with the micro-qualification [58,59].

Additionally, micro-credentials also present the opportunity to tailor content to employer requirements. Companies are commissioning custom courses to expand and upskill their workforce in required or emerging areas. This is ideal for the industry to adapt quickly to changing and volatile environments. Conversely, these credentials also give employers a more detailed description of employee skill development, increasing employment opportunities for the employees [10,60].

One important characteristic of micro-credentials is their stackable composition, as shown in Figure 2. This entails stacking one short learning programme with another, and in turn, developing a larger knowledge base that can be used as recognition in higher qualifications, or creating higher qualifications through a predetermined combination of micro- credentials. This approach allows learners to build their skills and knowledge gradually over time, and to customize their learning pathway to meet their individual goals and interests [61,62].

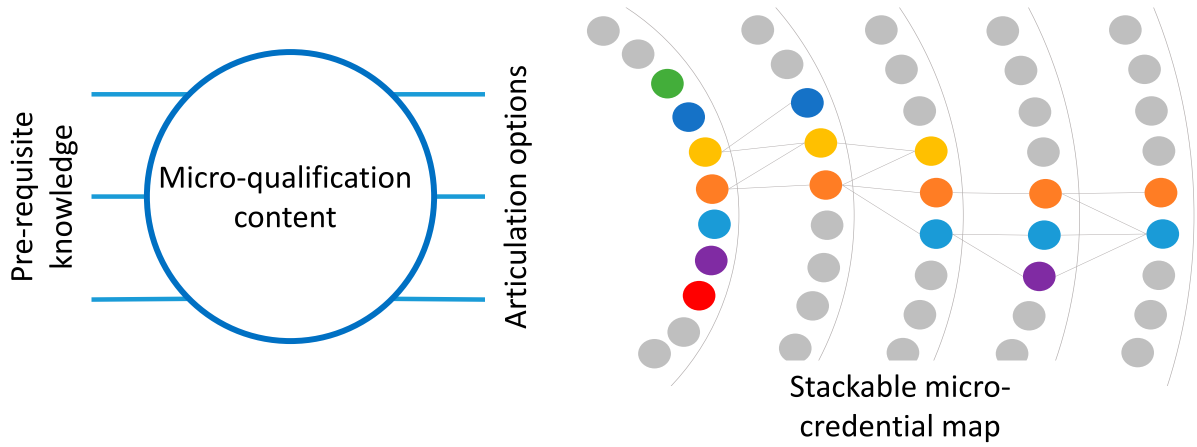

Figure 2. Author's depiction of unique individual exposure and accreditation structure.

Micro-credentials are uniquely positioned to enable presentation through online learner interfaces. The shortened development and learning time allow learners and content developers more freedom in the mode of interaction, making use of various online and interactive interfaces. Resultantly, many online-content host platforms and intermediaries have been developed to interface learners with content developers to increase and enable better coverage [63].

McGreal and Olcott [61] highlighted the great importance and interest in an academic shift to micro-credentials but also that academic institutions are hesitant to adopt these forms of learning, due to quality and implementation concerns. The authors proceeded to map a guideline for the shift. Key features of this guideline are not yet in place [64]. Tan [65] supported these requirements in an online publication. Additional supporting findings and literature reviews are listed in Table 2.

Table 2. Micro-credentials: published reviews.

Author	Date	Description	Findings	Ref.
Hidayah, Nur	2021	Review of micro-credentials in higher education.	Challenges, opportunities and recommendations for future work are reported.	[64]
Tamoliune, Giedre	2023	Systemic literature review of micro-credential potential.	Improved security and motivation for life-long learning.	[66]
Selvaratnam, Ratna Malar	2020	Integrative literature review of micro-credentials in higher education.	Recommendation for widespread recognition of credentials and implementation.	[54]
McGreal, Rory	2022	Report on emerging micro-credential research and trends.	Recommendation on how higher education can implement micro-credentials.	[61]

Table 2. *Cont.*

Author	Date	Description	Findings	Ref.
Wheelahan, Leesa	2021	Bernsteinian analysis of micro-credentials in higher education.	Reframing and acceptance of higher education making use of micro-credentials are reported.	[62]
Pirkkalainen, Henri	2023	Study of micro-credentials for learners and higher-education institutions.	The success of micro-credentials lies in higher-education institutions' implementation.	[67]
Varadarajan, Soovendran	2023	A systemic review of the implementation of micro-credentials for stakeholders.	Research questions are highlighted and recommendations for implementation are outlined.	[68]
Gish-lieberman, Jaclyn J	2021	A longitudinal literature study of micro-credentials in education.	Micro-credentials assist greatly with formative development, but more research is required for implementation.	[69]
Hunt, Tiffany	2020	The use of micro-credentials in personal professional development.	Outlines the potential and progressive implementation.	[70]
Sankey, Michael	2021	State of the art of micro-credentials in Australasia.	Implementation is growing rapidly, but more work is required on a global level	[71]
Thi, Nguyen	2023	Systemic literature review of micro-credentials.	The early stage of development, and more research is still required.	[72]
Olcott, Don Jr	2022	Potential impact of micro-credentials in the USA.	Transitioning to a different approach may be possible with micro-credentials for improved affordability and reception.	[73]
Mcgreal, Rory	2024	Present state of implementation of micro-credentials.	Micro-credentials should be further implemented for improved education structure.	[74]

2.4. Personality and User Profiling

Personality profiling is a technique that uses specific metrics to quantify an individual's personality traits and preferences. These traits are most often measured using extensive testing and assessment to develop a position on a spectrum for various traits and personality characteristics [75]. Personality profiling is not only used in organisational behaviour management, but has become a useful tool in education as well.

Personality profiles are used to align learner preferences to educational techniques and practices, and, in so doing, creating a more personalised learning experience. Furthermore, these personality profiles can assist teachers and lecturers to customise prescribed content to the learner for maximum retention and engagement [76,77]. A personality profile also assists the student in identifying their strengths and weaknesses and increasing self-awareness, which has also been shown to increase learner engagement with poor-performing content [78].

With the introduction of AI, monitoring and content matching can be automated and improved. This field requires more development [79–81]. When using these measures, it has been increasingly important to manage educational practices ethically and responsibly. As with any form of assessment, it is important to ensure that personality profiling is used in a fair, transparent, and responsible manner, with appropriate safeguards in place to protect student privacy and confidentiality [82,83].

2.5. Blockchain for Academic Integrity and Accreditation

Blockchain technology is used as a means to secure and verify qualifications and credentials. With the emergence of more sophisticated credentials for fraud and forgery, the blockchain provides an improved way to secure, verify and manage qualifications and credentials for education institutions, employers and individuals [14].

Blockchain methodologies are used to create decentralized identity (DID) systems. DID systems enable individuals to own and control their own digital identity, which assists in securing and managing their online professional profile [84]. This also makes blockchain ideal for accrediting and verifying micro-credentials or a stacked combination of micro-credentials. Blockchain can be used to validate digital badges more securely, providing learners with a way to showcase a convincing and secure portfolio of skills and knowledge to employers and educational institutions [85,86].

Chukowry, Nanuck and Roopesh [87] displayed a detailed design for the verification of digital badges making use of blockchain technologies. This study showed the link between micro-credentials and securing digital badges using blockchain. Though these credentials can be securely authenticated using blockchain, the accreditation and quality control of the content of such micro-credentials is still lacking. The use of blockchain is a continuously evolving field, with continuing research being conducted and new applications being rolled out [88]. Supporting reviews and findings are listed in Table 3.

Table 3. Blockchain in education applications and published reviews.

Author	Date	Description	Findings	Ref.
Guustaaf, Edward	2021	Review of blockchain projects in education.	Outlines different strategies and configurations.	[89]
Aini, Qurotul	2021	Evaluation of the implementation of blockchain at universities.	Still difficult for education institutions to implement block chain, but can show great advantages for security.	[90]
Delgado-von-eitzen, Christian	2021	Systemic literature review of blockchain in education.	Shows great potential for security and accessibility, but must still be researched and the implementation must still be developed.	[91]
Raimundo, Ricardo	2021	Review of blockchain systems in higher education.	Shows great potential for security improvement, but requires further development.	[92]
Lutfiani, Ninda	2020	Review of the use of blockchain in education.	Review of possible implementation and advantages of blockchain.	[93]
Fang, Yiming	2020	Review of blockchain in education.	Still a lot of development required to alleviate skills, and there are security issues to be alleviated.	[94]
Castro, Renato Q	2021	Review of blockchain in higher-education qualifications.	Some institutions have implemented solutions, but a unified response is required.	[95]
Park, Jae	2021	Review of blockchain in education.	Shows development, but requires maintenance motivation (such as mining) and widespread adoption.	[96]
Ocheja, Patrick	2022	A systemic review and practical case studies of blockchain in education.	Most effort focussed on verification and not, which is of greater potential, on in-depth academic records.	[97]
Loukil, Faiza	2021	A systemic review of blockchain in education.	Enhances security, accountability and transparency, but requires legal support and widespread scalability.	[98]
Fedorova, Elena P	2020	Review of application of blockchain in higher education in Russia.	No widespread knowledge of blockchain, legislative support required, and connectivity shortcomings.	[99]

3. Technology-Enhanced Education: Presentation of the Theory

3.1. Key Qualitative Factors (Theory Variables)

The literature analysis explored an in-depth review of present trends for online education to develop a cohesive model that will incorporate different emerging technologies and techniques to present a future map for an effective learning model. The use of online resources, third-party social networks and micro-credentials has the potential to greatly improve the reach and impact of open education.

Therefore, the development of an online application that can be presented on various mobile devices, including smartphones, tablets, desktop and laptop computers and smart televisions is proposed. This application will propose utilising the identified technologies and resources to open education to all walks of life, improving the success rate and impact. The functions and technologies combined in the proposed application are further expanded on in Table 4.

Table 4. Literature-guided grounded theory summary.

Shortcoming	Improvements	Technology
Teacher–pupil structure	Peer learning and social learning	Online learning
	Interactive and vocational training	Gamification
Excessively long study period	Focussed and tailored content	Micro-credentials
	Customised learning pace	
Inefficiency in conveying information	Teaching-approach matching	Personality profiling with machine learning and AI
	Focussed and tailored content	Micro-credentials, personality profiling
	Intrinsic motivation	Gamification
"Drilling" instead of creation and innovation	Tailored-content matching	Personality profiling with machine learning and AI
	Teaching-approach matching	
	Interactive and vocational training	Gamification
Assessment is examination-centred	Continuous assessment	Online learning
	Gamified assessment	Gamification
	Verified micro-qualifications and quantifiable experiential/vocational training	Blockchain

3.2. Technology-Infused Improvement and Opportunities

The literature engagement summarized points of improvement and the associated technologies. Cross referencing these findings with the outlined shortcomings in the paradigms will allow the study to identify technologies and approaches that should be incorporated into the proposed model. The proposed model for the futurescape of technology-supported education is outlined by comparing the improvements in the educational paradigms as well as the accompanying technologies in Table 4. These findings outline the features required from an educational system. A possible technical design for the implementation of this model is described in Section 4, below.

4. Model Design

4.1. Conceptual Model of Online Education Framework

The gathered literature has highlighted great advances and the advancements that have been made in education using different digital and online technologies. How these technologies can be connected to gain benefit from recent developments and eliminate shortcomings through combinations of different technologies is poorly studied. A new model of how these technologies and advancements can be connected is proposed. The new model is shown as a functional diagram in Figure 3. The different components, marked A to G, are further discussed in the following sections.

4.2. Content Recommendation and Profile-Matching Algorithm

The model presents an online student learning content-hosting platform (Learner Management System) in part A of the diagram in Figure 3. The platform filters all hosted content through a recommendation and content-matching algorithm. The algorithm extracts inputs from a Learner Profile Database and a Content Profile Database to match both content that is in the learner's interest and of their learning level and also content that is best suited to their learning style, as outlined by personality profile records.

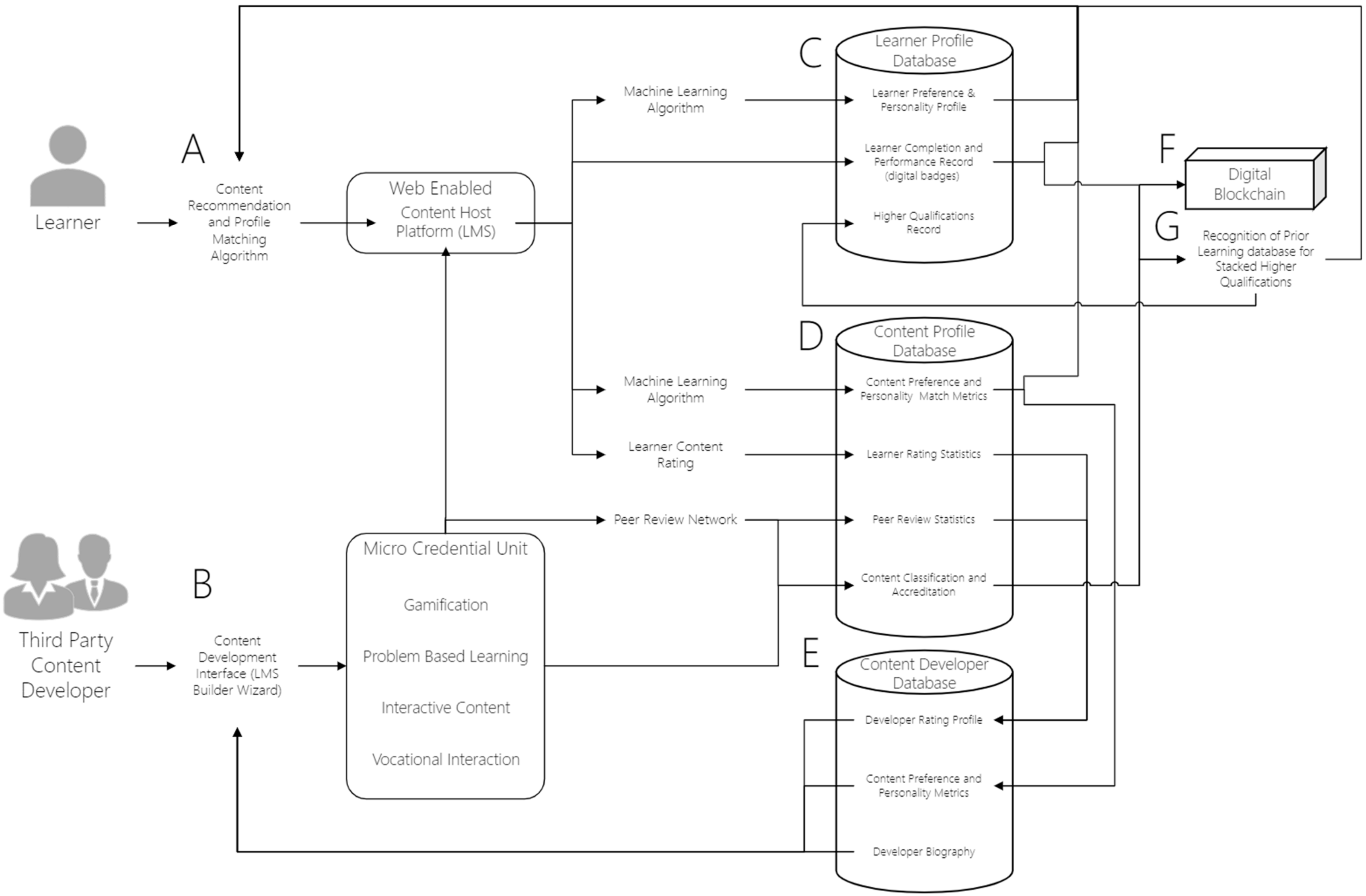

Figure 3. Functional diagram of proposed cohesive online-education model.

The algorithm for the recommendation of content in combination with a performance- and personality-match evaluation machine-learning algorithm iteratively measures and maps the students' performance, learning level progression and learning style preferences to continuously update and improve the accuracy of future recommendations. Using machine learning or AI allows the algorithm to account for the progression and maturation of a learner's learning style, content preference and continuously developing expertise. AI makes it possible to adapt to both the difficulty and the learning approach of the recommended content, as outlined by Ortigosa [100] and Bergaoui [101].

The AI algorithms should be limited only to recommendations to avoid the development of a so-called "search bubble", to allow the student ethical access to all prospective content. This ensures that the learner maintains autonomy on the learning journey, but can benefit from expert recommendations, as are usually provided by career counselling, and, in this case, are provided by the AI recommendation algorithm.

This content platform should also provide a seamless continuous assessment model in order to validate retention of the content by the learner, and issue validated online badges of completion. These assessments can be integrated into the content in gamified form, limiting progress to a next level until the learning milestone is reached. An alternative approach could be interactive video or video content, through which progression and varying content can be prescribed by a sub-level of the AI algorithm.

4.3. Content Development Interface (LMS Population Wizard)

The model also recommends the decentralization of content to independent teachers/lecturers and content developers. This allows for the expansion of content formats and learning levels, in turn presenting the student with a variety of high-quality, international and relevant content.

Component B presents an online content-development wizard to allow for standardization across the platform. This wizard should provide a user-friendly interface to assist the content developers, who will most often not be content or graphic-design specialists, to easily generate quality learning components. The wizard should be updated with a variety of existing and emerging online learning and gamification modules to allow for not only didactic or video content, but other more expansive and engaging interactive and problem-based content. This should also account for vocational training and real-world engagements by companies and possible employers (in turn, allowing employers to benefit from the problem-solving actions of the learners).

Following the completion of the content micro-credential, the platform should run the learning programme through a relevant peer-review and rating process to obtain learning outcomes and level data, after which it will be uploaded to the content database (section D) and presented through the learner management system (LMS) portal (section A). The content development interface should enable the developer to create appropriate assessment strategies customized to the content. These assessments should be based on a continuous assessment strategy that is automated to allow for completion by either short-response evaluation or AI word processing.

4.4. Learner Profile Database

It is proposed that a learning profile database is created, as shown in section C of Figure 3. This database should record learner activity, performance, and engagement level with content through the two AI algorithms (recommendation and monitoring). These parameters identify the learner's personality and learning profile in order to recommend content and learning style.

The learner database will also record the digital badges that the learner has obtained using the platform. It will also record the higher accredited qualifications that the learner has already achieved. This database can easily be exported to future AI job platforms, which can identify and align specialised candidates with employers, either on a full-time or contractual basis, in turn ensuring a better match of work culture, area of expertise and performance-cost level (further described in the section Conclusions and Future Work).

4.5. Content Profile Database

Similar to the learner database, section D of Figure 3 shows the content database. This database stores all short learning programmes and records the programme parameters. These parameters include education level, content personality-profile learning style classification and quality ratings. The content personality profile will be generated from the AI algorithm that measures learning performance and engagement statistics with the individual learner's personality profiles. This algorithm will create a personality preference rating that can, in turn, be matched through the LMS to ideal learners.

The content will also be classified according to quality parameters. Quality parameters and ratings will be generated through a peer review process, either from other independent content developers or existing educational institutions. An additional quality rating will be generated from learners that engage with the content. The quality parameters associated with the content should be used to rank and sort best-suited high-quality content with the limitations of either student numbers or cost-related implications. The database should also record the digital badge metadata that are used to validate student qualifications through a blockchain ledger.

4.6. Content Developer Database

Similar to the learner profile database, a database is proposed in section E of Figure 3 that captures information about registered content developers. The developer's biography should be captured, which will inform the content classification for developer qualification and instruction certification (area of expertise and level of presentation).

The database should also capture historic quality ratings of the content that has already been developed dynamically to account for improvement, engagement qualification, and experience improvement. Along with this, a detailed record of learning style preference associated with the developer should be captured to add a content-developer dimension to the content preference recommendation in section A of Figure 3.

4.7. Block Chain Verification and Digital Badges

Security and validation of the generated qualifications and digital badges will be achieved using a blockchain ledger, as shown in section F of Figure 3. This will assign metadata to the individual digital badges that a student accumulates. This blockchain will be informed by the content profile database that recognizes and classifies the content to identify the quality, expertise description, and education level.

4.8. Recognition of Prior Learning

A critical part that allows the implementation of the proposed model through a smooth and effective transition and changes over the period is the recognition of this micro-credential learning knowledge gained. This can be achieved through various methods, of which the most practical solution appears to be that individual institutions of learning will accredit the captured digital badges of the different learners to accumulate credits for an already existing higher and accredited qualification, as shown in section G of Figure 3.

Receiving feedback from a variety of different institutions should also be incorporated into the recommendation algorithm, informing the learner of requirements for higher qualifications (i.e., advising the student on progress towards a higher qualification from a certain institution and recommending a micro-qualification to complete these identified qualifications, as shown in Figure 4). There are developments still required in this field, from both institutional and legislative perspectives.

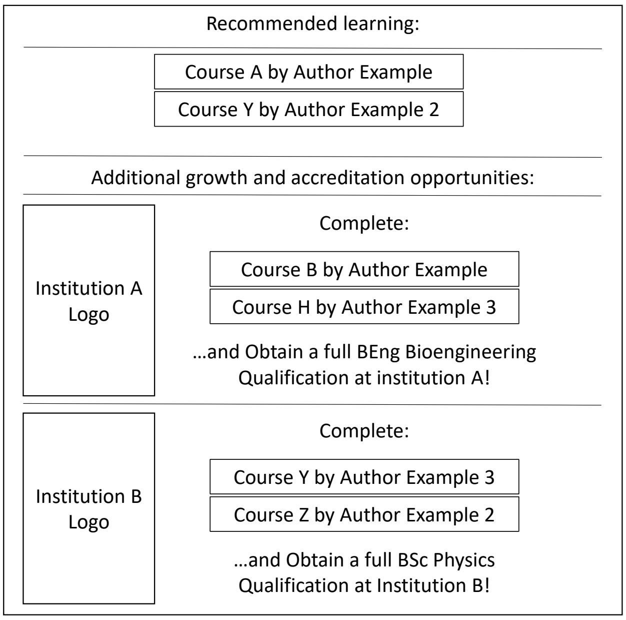

Figure 4. Example of front-end functionality of LMS recommendation algorithm.

5. Conclusions and Future Work

This paper presented the literature that summarized emergent technologies in education and online-education methodologies. These techniques and technologies have made major strides to improve the shortcomings of historic practices in education, with great success. It was shown that more benefit can be gained by combining various of these techniques and technologies, but little literature could be found to outline such a model.

The grounded theory approach made it possible to develop a theory that is based on proven technologies, even though very little quantitative data or analysis is available in the literature. The extensive qualitative studies in the published literature outlined key features and successes that were achieved. An iterative analysis allowed the study to identify and investigate appropriate technologies in detail.

A new model that cohesively integrates these techniques and technologies was presented. This model incorporated online learning, gamification, big data and cloud storage, and machine learning and artificial intelligence, as well as blockchain, to create a proposition in which these emergent technologies can be combined to generate even more benefit than when these technologies are used independently.

This study focused on systems-level design, and only presented a high-level proposal. The grounded theory approach was ideal for creating an exhaustive starting point for future studies and quantitative studies. A more detailed design of the presented model should still be created. Though this model does consider a gradual transition from traditional practices to technological advances, some legislative and accreditation adjustments are also still needed to make this model possible. Further ethical considerations of such a model should also still be investigated.

Specifically, research following this study should include the following:

- The design of a content development platform that demystifies gamification for the average user and makes the creation of smart content easy and accessible with minimum training required.
- The design of various machine-learning and artificial-intelligence algorithms for the tracking and proposing of online content for learners.
- Digital blockchain design that is capable of tracking micro-credentials and higher combined qualifications.
- The design, structuring and validation procedures of digital badges and recognition for vocational training and experience.

- The integration of institutional RPL procedures to enable the link between institutions and open education using digital recognition technologies.
- International legislative frameworks to allow for global standardisation or global recognition of regional training.
- Testing, and empirical and quantitative studies of the various components of the integrated system including software, the sociological impact, and learner and educator response.

The integration of existing platforms and the merger of these platforms should be considered during the detailed design. These platforms include open-learning platforms such as Udemy, EdX, LinkedIn and various others. Possible future study should explore liquid models for staffing and employment and online personal-skills hosting platforms that make effective use of vocational training and the associated digital badges as well.

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