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A VIRTUAL EXPERIENTIAL LEARNING PLATFORM THROUGH INTELLIGENT CO-WORKING SPACES TO PROMOTE ENTREPRENEURSHIP AND HAPPINESS LEARNING

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ABSTRACT

This research aims to design an information system architecture for a virtual experiential learning platform through intelligent co-working spaces to promote entrepreneurship and happiness in learning. The study employs a qualitative research methodology, encompassing literature review, requirements analysis through interviews and focus groups, detailed architecture design, and expert evaluation. The research presents a three-tiered architecture comprising Front-end Layer, Middle Layer, and Back-end Layer, integrating cutting-edge technologies such as Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), and Internet of Things (IoT) with learning theories and entrepreneurial skill development. The proposed architecture focuses on creating efficient learning experiences, adapting to learner needs, fostering collaboration, and prioritizing learner happiness. Expert evaluation indicates that the designed architecture is feasible for real-world implementation and has the potential to revolutionize education and entrepreneurship development. However, challenges remain in data security and integration with existing educational systems. This research provides recommendations for architecture implementation and directions for future research to develop educational systems that meet the needs of 21st-century learners. The findings have implications for educational institutions, policymakers, and technology developers seeking to create more effective and engaging learning environments that prepare students for the challenges and opportunities of the modern world.

Keywords: *Virtual Experiential Learning, Intelligent Co-working Spaces, Entrepreneurship, Happiness Learning, Artificial Intelligence, Virtual Reality, Augmented Reality*

1. INTRODUCTION

The rapid evolution of digital technologies and the changing landscape of education have created a pressing need for innovative learning platforms that can effectively prepare students for the challenges of the 21st century. In particular, there is a growing demand for educational approaches that can foster entrepreneurship skills and promote happiness in learning, two critical factors for personal and professional success in today's dynamic world. [6] [22] Virtual experiential learning platforms have emerged as promising tools to address these needs, offering immersiveand interactive environments that simulate real-world experiences [61]. These platforms leverage cutting-edge technologies such as Virtual Reality (VR), Augmented Reality (AR), Artificial Intelligence (AI), and the Internet of Things (IoT) to create engaging and personalized learning experiences. [52] [38] Concurrently, the concept of intelligent co-working spaces has gained traction, particularly in fostering entrepreneurship and innovation [19]. These spaces provide not only physical infrastructure but also serve as hubs for knowledge exchange and community building [33]. The integration of AI and IoT technologies in these spaces is transforming how they operate and interact with users, offering new possibilities for collaboration and learning. [46] Despite the potential of these technologies and concepts, there is a lack of comprehensive frameworks that

integrate virtual experiential learning platforms with intelligent co-working spaces to promote both entrepreneurship and happiness in learning. This research aims to address this gap by designing an information system architecture that combines these elements into a cohesive and effective learning ecosystem.

The proposed architecture seeks to create a virtual environment that not only facilitates skill development and knowledge acquisition but also fosters a sense of community, collaboration, and well-being among learners. By integrating advanced technologies with pedagogical principles and entrepreneurship support systems, this research aims to develop a platform that can adapt to individual learner needs, provide immersive learning experiences, and create opportunities for practical application of knowledge in simulated real-world scenarios.

This study employs a qualitative research methodology, encompassing a comprehensive literature review, requirements analysis through interviews and focus groups, detailed architecture design, and expert evaluation. The resulting architecture is expected to provide a blueprint for developing educational systems that can effectively meet the needs of 21st-century learners, particularly in the domains of entrepreneurship education and learner well-being.

By focusing on the intersection of virtual learning, intelligent co-working spaces, entrepreneurship, and happiness in learning, this research contributes to the ongoing discourse on the future of education and workforce development. The findings of this study have implications for educational institutions, policymakers, and technology developers seeking to create more effective and engaging learning environments that prepare students for the challenges and opportunities of the modern world.

2. LITERATURE REVIEW

2.1 Virtual Experiential Learning Platform

Virtual experiential learning platforms have emerged as innovative tools to enhance education and skill development in various fields. These platforms leverage technology to create immersive and interactive learning environments that simulate real-world experiences [61]. The integration of artificial intelligence (AI) and machine learning (ML) in these platforms has further enhanced their capabilities, allowing for personalized learning experiences and real-time feedback [52].

Virtual reality (VR) technology has been particularly effective in creating engaging learning environments. For instance, [34] developed a VR intervention to support cognitive reappraisal skills development in youth, demonstrating the potential of virtual platforms to address complex learning needs. Similarly, [38] explored the use of VR and AI-based learning environments for entrepreneurship education, highlighting the technology's potential to create more innovative and inclusive teaching methods.

The effectiveness of virtual learning platforms is not limited to formal education settings. [53] developed an AI-driven platform called Engage AI, which uses video analytics to enhance instructor-class awareness in virtual classroom settings. This approach demonstrates how technology can bridge the gap between physical and virtual learning spaces, improving engagement and interaction.

Furthermore, virtual platforms have shown promise in specialized fields such as healthcare education. [50] evaluated a virtual community pharmacy internship program, finding that it effectively achieved learning outcomes and student satisfaction. This suggests that virtual experiential learning can be a viable alternative to traditional internships, especially in situations where physical presence is challenging or impossible.

The development of Metaverse Learning Experience Platforms (MLXP) represents the next frontier in virtual experiential learning. [64] proposed an MLXP for immersive design thinking to enhance digital intelligence quotient and virtual game developer skills. This approach integrates multiple virtual spaces and tools, creating a comprehensive learning ecosystem that mimics real-world professional environments.

As these platforms continue to evolve, they are increasingly incorporating elements of gamification and simulation to enhance engagement and learning outcomes. [44] explored the use of deep reinforcement learning to create AI agents with distinct personalities in virtual environments, suggesting potential applications for creating more realistic and diverse virtual learning experiences.

2.2.2 Intelligent Co-working Spaces

Intelligent co-working spaces represent a significant evolution in the concept of shared workspaces, integrating technology to enhance collaboration, productivity, and learning. These spaces are

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becoming increasingly important in fostering entrepreneurship and innovation, particularly in regions with sparse entrepreneurial environments [19].

The integration of AI and IoT technologies in co-working spaces is transforming how these environments operate and interact with users. [46] conducted a machine learning-driven behavioral analysis of co-working spaces, revealing that flexibility and diversity are key factors in meeting future workspace needs. This research highlights the importance of adapting co-working spaces to accommodate various work styles and preferences.

Co-working spaces are not just physical environments but also serve as hubs for knowledge exchange and community building. [33] explored the transformation of networks of co-working spaces into open knowledge ecosystems, emphasizing the importance of shared vision and knowledge partnerships in fostering innovation among start-ups.

The concept of virtual co-working spaces is gaining traction, especially in the wake of global events that have accelerated remote work trends. [60] examined the experiences of co-workers during the transition to remote work and their subsequent return to co-working spaces, providing insights into the evolving needs of workers in shared environments.

Intelligent co-working spaces are also playing a crucial role in bridging the gap between academia and industry. [30] found that work-integrated learning in co-working spaces can enhance graduates' enterprise capabilities, suggesting that these environments can serve as valuable learning platforms for aspiring entrepreneurs.

Moreover, co-working spaces are increasingly being recognized for their potential to promote inclusion and diversity in the workplace. [31] explored how the use and membership of co-working spaces can support inclusion, particularly for mobile workers who may otherwise feel isolated.

The integration of advanced technologies in co-working spaces is opening new possibilities for collaboration and innovation. For instance, [5] demonstrated the potential of using mixed real and virtual scenarios for automated inspections, a concept that could be applied to create more dynamic and interactive co-working environments.

2.3 Promoting Entrepreneurship and Happiness Learning

The integration of virtual experiential learning platforms and intelligent co-working spaces has shown significant potential in promoting both entrepreneurship and happiness in learning. This combination creates a unique ecosystem that fosters skill development, innovation, and personal well-being.

Entrepreneurship education has been evolving to incorporate more experiential and technology-driven approaches. [21] explored the use of agent-based modeling and reinforcement learning for innovative urban design simulation, demonstrating how advanced technologies can be used to teach complex entrepreneurial skills in virtual environments. This approach not only enhances learning outcomes but also increases engagement and satisfaction among students.

The concept of happiness in learning is gaining increased attention in educational research. [6] investigated the conditions fostering international graduate students' happiness and engagement during challenging times, highlighting the importance of supportive learning environments. Virtual platforms and intelligent co-working spaces can potentially address some of the challenges identified in this research by providing flexible, accessible, and community-oriented learning experiences.

Artificial intelligence is playing a crucial role in personalizing learning experiences and potentially enhancing learner happiness. [22] discussed how AI is revolutionizing healthcare education, suggesting that similar approaches could be applied to entrepreneurship education to create more engaging and satisfying learning experiences.

The integration of gamification elements in learning platforms has shown promise in increasing both entrepreneurial skills and learner happiness. [44] explored the use of AI agents in virtual environments to create more engaging and realistic learning scenarios, which could be applied to entrepreneurship education to simulate real-world business challenges in a low-risk environment.

Co-working spaces, both physical and virtual, contribute to entrepreneurial learning and happiness by fostering a sense of community and collaboration. [43] examined how co-working spaces facilitate collaborative practices and entrepreneurship, emphasizing the importance of these environments in providing emotional support and sense- making for entrepreneurs.

Moreover, the use of virtual reality in education has shown potential in enhancing both learning outcomes and student satisfaction. [38] investigated the use of VR and AI-based learning environments for entrepreneurship education, finding that these technologies can create more immersive and enjoyable learning experiences.

The development of soft skills, crucial for entrepreneurship, can also be enhanced through

virtual platforms. [23] discussed the importance of developing ethics and equity principles in AI/ML education, which could be applied to create more inclusive and satisfying entrepreneurial learning experiences.
In conclusion, the combination of virtual experiential learning platforms and intelligent co-working spaces offers a promising approach to promoting both entrepreneurship and happiness in learning. By leveraging advanced technologies and fostering collaborative environments, these solutions can create more engaging, effective, and satisfying educational experiences for aspiring entrepreneurs. [64] [66]

3. METHOD

This study employed a qualitative research methodology to design and evaluate an information system architecture for a virtual experiential learning platform through intelligent co-working spaces. The research process consisted of four main phases:

3.1 Literature Review

An extensive literature review was conducted to establish the theoretical foundation and identify current trends in virtual experiential learning, intelligent co-working spaces, and their application in promoting entrepreneurship and happiness in learning. The review covered peer-reviewed articles, conference proceedings, and relevant books published in the last five years. Key databases such as Scopus, ERIC, and Google Scholar were used to ensure comprehensive topic coverage.

3.2 Requirements Analysis

To gather detailed requirements for the proposed system, we conducted : a) Semi-structured interviews: 15 interviews were conducted with education technology experts, entrepreneurs, and educators specializing in experiential learning. b) Focus groups: Three focus group sessions were organized, each consisting of 6-8 participants, including students, educators, and industry professionals. These sessions aimed to explore user needs and expectations for a virtual experiential learning platform.

The data collected from interviews and focus groups were analyzed using thematic analysis to identify key requirements and design considerations for the platform.

3.3 Architecture Design

Based on the insights from the literature review and requirements analysis, we developed a detailed system architecture for the virtual experiential learning platform. The architecture design process involved : a) Conceptual modeling: Creating high-level diagrams to represent the overall structure and main components of the system. b) Detailed component design: Specifying the functionalities and interactions of each component within the system. c) Technology stack selection: Identifying appropriate technologies and frameworks for implementing each component of the architecture.

The architecture was designed with a focus on scalability, flexibility, and interoperability to ensure its adaptability to various educational contexts.

3.4 Expert Evaluation

To validate the proposed architecture, we conducted an expert evaluation : a) Panel selection: A panel of 10 experts in the fields of educational technology, softwarearchitecture, and entrepreneurship education was assembled. b) Evaluation criteria: A set of evaluation criteria was developed, including user experience, scalability and flexibility, integration and interoperability, security and privacy, and effectiveness in promoting entrepreneurship and happiness. c) Evaluation process: Experts were provided with detailed documentation of the proposed architecture and asked to rate it on a 5-point Likert scale for each criterion. They were also encouraged to provide qualitativefeedback and suggestions for improvement. d) Data analysis: Quantitative data from the expert ratings were analyzed using descriptive statistics. Qualitative feedback was synthesized to identify common themes and areas for improvement.

This multi-phase approach allowed for a comprehensive development and evaluation of the virtual experiential learning platform architecture, ensuring its alignment with both theoretical foundations and practical requirements in promoting entrepreneurship and happiness in learning.

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4. RESULTS

Table 1: Center Table Captions Above The Tabl Synthesis Table of the Virtual Experiential Learning Platform Architecture

Units of Architecture	Component	Educational concept	Technology	references
1.Front-end Layer	Virtual Reality (VR) Interface	Immersive Learning, Experiential Learning	WebVR, WebXR API	[40] [9]
	Web-based Interface	Ubiquitous Learning, Accessibility	Progressive Web App (PWA)	[10] [29]
	Mobile Application	Mobile Learning, Flexible Learning	Flutter, React Native	[10] [15]
	Augmented Reality (AR) Components	Blended Learning, Contextual Learning	ARKit, ARCore	[2] [20]
	Gamification Elements	Game-based Learning, Motivation	Unity, Unreal Engine	[52] [16]
	Accessibility Features	Inclusive Education, Universal Design for Learning	Screen readers, Voice commands	[13] [53]
2. Middle Layer	Learning Management System (LMS)	Structured Learning, Assessment	Moodle, Open edX	[47] [4]
	Intelligent Co-working Space Management	Collaborative Learning, Smart Learning Environments	IoT, AI algorithms	[27] [37] [7]
	Collaboration Tools	Cooperative Learning, Project-based Learning	Video conferencing, Project management tools	[36] [3]
	AI-driven Personalization Engine	Adaptive Learning, Personalized Learning	Machine Learning, Deep Learning	[26] [1]
	Entrepreneurship Support System	Entrepreneurship Education, Simulation-based Learning	AI, Blockchain	[55] [1]
	Happiness and Well-being Module	Positive Education, Social-emotional Learning	Sentiment analysis, Biofeedback	[65] [56]
3.Back-end Layer	Cloud Infrastructure	Scalable Learning Environments, Resource Management	AWS, Google Cloud, Azure	[29] [28]
	Microservices Architecture	Modular Learning, System Flexibility	Kubernetes, Docker	[41] [45]
	Data Processing and Analytics	Learning Analytics, Evidence-based Education	Hadoop, Spark, Kafka	[63] [58]
	AI and Machine Learning Infrastructure	Intelligent Tutoring Systems, Predictive Analytics	TensorFlow, PyTorch	[26] [70]
	Security and Privacy	Data Protection, Ethical AI in Education	Encryption, Anonymization	[49]
	API Management	Interoperability, Open Educational Resources	API Gateways, OAuth	[32] [24]

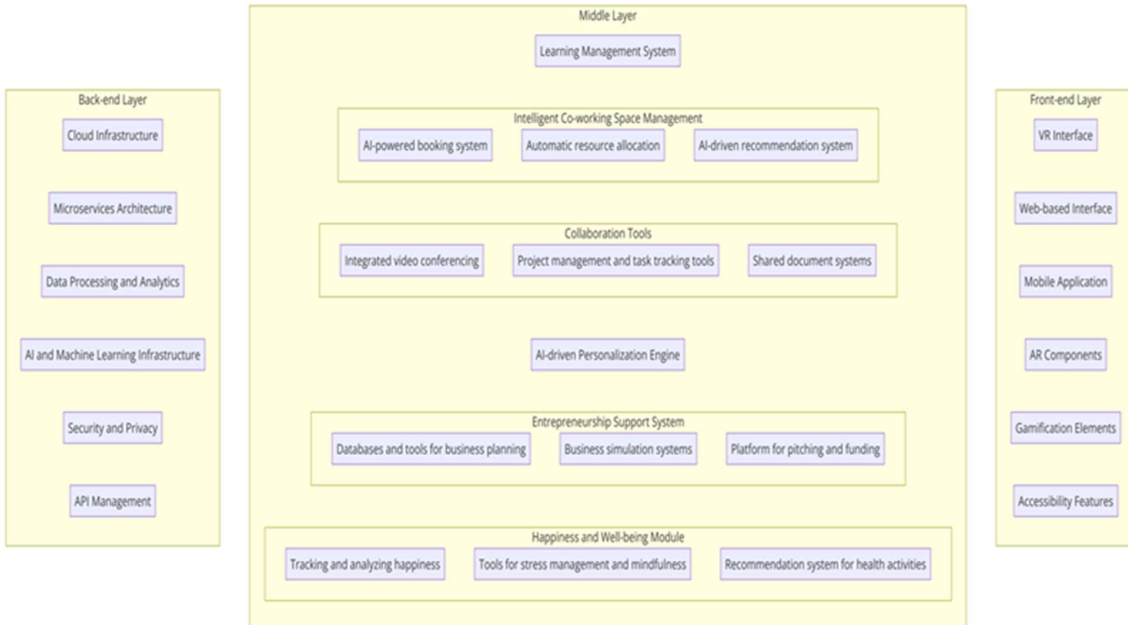

Figure 1: Architecture of a Virtual Experiential Learning Platform for Promoting Entrepreneurship and Happiness Learning

4.2 Design of the Virtual Experiential Learning Platform Architecture

4.2.1 Front-end Layer

The Front-end Layer is the user-facing component, focusing on creating an effective and engaging User Experience (UX). It consists of the following elements:

4.2.1.1 Virtual Reality (VR) Interface:

The VR Interface is a core component of the platform, utilizing WebVR or WebXR API to create an immersive 3D learning environment [9]. VR in education has been proven to enhance understanding of complex content and increase learner engagement [40]. The system supports various VR devices, including Oculus Quest, HTC Vive, and smartphone-based VR, ensuring accessibility for learners.

4.2.1.2 Web-based Interface:

interface developed using Progressive Web App (PWA) technology, allowing users to access the platform from any device and platform [10]. The UI/UX design adheres to Material Design or Fluent Design System principles for aesthetics and ease of use. It also supports offline functionality and data synchronization, crucial for learning in areas with limited internet connectivity.

4.2.1.3 Mobile Application:

To enhance accessibility, the platform includes a mobile application developed using cross-platform frameworks such as Flutter or React Native [10]. The application focuses on features suitable for mobile use, such as notifications and real-time collaboration, promoting ubiquitous learning [29].

4.2.1.4 Augmented Reality (AR) Components:

Integrating AR into the platform adds a dimension to learning by overlaying virtual information and objects in the real environment [2]. The system uses ARKit (iOS) and ARCore (Android) to create AR experiences on mobile devices, allowing learners to effectively connect theoretical knowledge with the real world.

4.2.1.5 Gamification Elements:

The incorporation of gamification in education has been proven to increase learner motivation and engagement [53]. The platform includes game elements such as badges, leaderboards, and achievements, using game engines like Unity or Unreal Engine to create immersive and engaging game experiences.

4.2.1.6 Accessibility Features:

Designing for accessibility is crucial to ensure equal access for all users [13]. The platform supports screen readers, keyboard navigation, customizable colors and font sizes, and voice command functionality, ensuring that all learners can access content and learning experiences equitably.

4.2.2 Middle Layer

The Middle Layer serves as a bridge between the Front-end and Back-end, managing learning processes, collaboration, and data analysis. It comprises the following components:

4.2.2.1 Learning Management System (LMS):

The LMS is the core of the learning management system, utilizing open-source LMS such as Moodle or Open edX as a base and developing custom modules [47]. Using open-source LMS helps reduce costs and increase flexibility in system customization [4]. The system includes functions for course management, assessment, and tracking learner progress. It also integrates learning analytics to continuously analyze and improve the learning process [63].

4.2.2.2 Intelligent Co-working Space Management:

The intelligent co-working space management system is an innovation that combines smart workspace concepts with collaborative learning [27]. This system includes:

• An AI-powered booking system for virtual and physical workspaces that efficiently allocates resources [37].

• Automatic resource allocation based on user needs, utilizing IoT sensors and machine learning algorithms [17].

• An AI-driven recommendation system for matching collaborators, analyzing users' skills, interests, and work patterns to create highly effective teams [69].

4.2.2.3 Collaboration Tools:

Collaboration tools are essential in creating a cooperative learning environment [36]. This system includes:

• An integrated video conferencing system supporting real-time and asynchronous communication [3].

• Project management and task tracking tools that use AI to analyze and recommend efficient project management strategies [62].

Shared document systems and version control supporting real-time collaboration with automatic conflict resolution [18].

4.2.2.4 AI-driven Personalization Engine:

The use of AI in personalizing learning for individual learners is a significant trend in modern education [26]. This system comprises:

• Machine learning algorithms such as collaborative filtering and deep learning to analyze learning behaviors and customize content [1].

• A recommendation system for content and activities tailored to individual learners, using techniques such as reinforcement learning [11].

• Real-time customization of learning experiences using techniques such as online learning and multi-armed bandits [39].

4.2.2.5 Entrepreneurship Support System: The entrepreneurship support system is crucial in preparing learners for the business world [54]. It includes:

• Databases and tools for business planning that use AI for analysis and recommendations [43].

• Business simulation systems using agent-based modeling and system dynamics [14].

• A platform for pitching and funding that uses blockchain for transparency and security [1].

4.2.2.6 Happiness and Well-being Module:

Promoting learner happiness and well-being is a crucial factor in creating an effective learning environment [65]. This system includes:

• A system for tracking and analyzing happiness in learning using sentiment analysis and emotion recognition [56].

• Tools for stress management and mindfulness that utilize biofeedback and VR [35].

• A recommendation system for activities promoting physical and mental health, using AI to analyze health data and behaviors [57].

4.2.3 Back-end Layer

The Back-end Layer forms the foundation that supports the operation of the virtual experiential learning system, focusing on creating a flexible, secure, and scalable infrastructure. This aligns with the concept of "Education 4.0," which emphasizes the use of technology to create limitless learning experiences [23].

4.2.3.1 Cloud Infrastructure:

The use of cloud infrastructure aligns with the concept of "ubiquitous learning," emphasizing access to learning anytime, anywhere [28]. It includes:

• Hybrid cloud services from providers such as AWS, Google Cloud, or Azure for maximum flexibility and efficiency

• Auto-scaling systems to accommodate rapid increases in usage, especially during peak learning activity periods

• Content distribution through CDN (Content Delivery Network) to reduce latency and increase efficiency in content access, aligning with the principles of "just-in-time learning" [25].

4.2.3.2 Microservices Architecture:

The use of microservices architecture supports the concept of "modular learning," emphasizing the division of learning content into smaller parts that can be assembled according to learner needs [43]. It includes:

• Separation of functionalities into various microservices such as user authentication, content delivery, and assessment engine

• Use of container orchestration like Kubernetes for efficient microservices management.

• Automatic service discovery and load balancing to support system scalability and increasing user numbers.

4.2.3.3 Data Processing and Analytics:

Big data analysis is crucial for "learning analytics," which helps improve teaching and learning processes and supports policy-making decisions [64]. This system includes:

• Big data technologies such as Apache Hadoop or Spark for processing large datasets.

• Real-time analytics systems using Apache Kafka or Apache Flink to analyze learning behaviors in real-time.

• Data warehousing for in-depth data analysis and predictive analytics to forecast educational trends.

4.2.3.4 AI and Machine Learning Infrastructure:

The use of AI and machine learning in education supports the concept of "adaptive learning," which adjusts content and teaching methods to suit individual learners [26]. It includes:

• Frameworks such as TensorFlow or PyTorch for AI model development.

• Automated model training and deployment systems for continuous improvement of system efficiency.

• GPU clusters for deep learning processing, especially for analyzing image and audio data in VR environments. 4.2.3.5 Security and Privacy:

Security and privacy are critical issues in online education [8]. This system includes:

• End-to-end encryption systems to protect learners' personal data.

• Data anonymization and pseudonymization to maintain privacy in data analysis.

• Intrusion detection and prevention systems to guard against cyber attacks.

4.2.3.6 API Management:

Efficient API management supports the concept of "open education" and the sharing of learning resources between institutions [32]. It includes:

• Use of API gateways such as Kong or Apigee for secure API access management.

• Systematic versioning and documentation of APIs to support third-party application development.

Monitoring and rate limiting systems to maintain system stability.

4.3 Detailed System Architecture for the Virtual Experiential Learning Platform

Figure 2 provides a detailed view of the system architecture's functional layers, which complements and supports the overall architecture shown in Figure 1, "Architecture of a Virtual Experiential Learning Platform for Promoting Entrepreneurship and Happiness."

4.3.1 User Interface Layer:

Web Interface and Mobile Interface: These components provide access points for users to interact with the system, whether through a web browser or a mobile device.

4.3.2 Application Layer:

• Composed of Front-end Services and Back-end Services:

• Front-end Services handle the user interface logic, presenting data and features to users.

• Back-end Services manage the application's core functionalities, processing data, handling logic, and ensuring smooth interactions between different modules.

4.3.3 Business Logic Layer:

• Business Services manage the application's core functionality, implementing the rules and logic necessary to perform specific tasks.

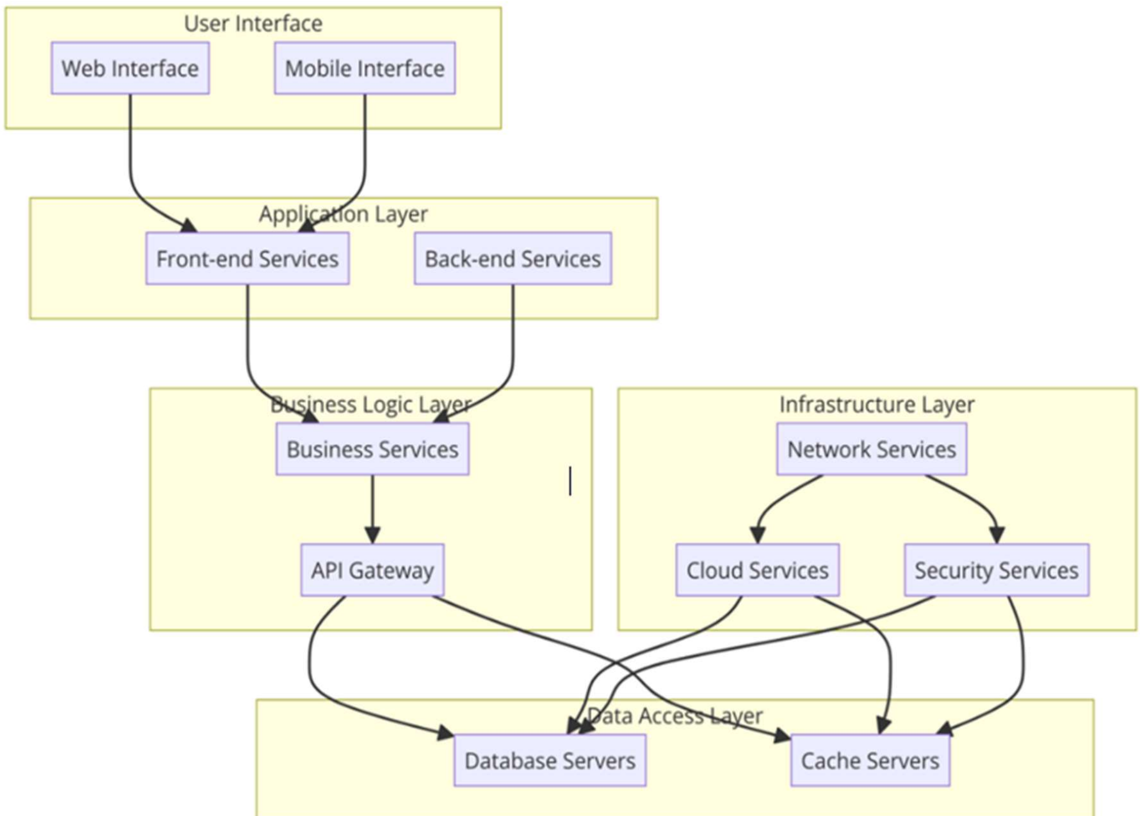

Figure 2: Detailed System Architecture for the Virtual Experiential Learning Platform

• The API Gateway acts as a central point for managing API requests, ensuring that data flows seamlessly between the user interface, business services, and other system components.

4.3.4 Infrastructure Layer:

• This layer ensures the system's scalability, security, and connectivity through:

• Network Services: Manage communication between different components and external systems.

• Cloud Services: Offer scalable storage and computing power.

• Security Services: Ensure data protection, access control, and secure transactions.

4.3.5 Data Access Layer:

• Database Servers store structured data needed for business operations, such as user information, content, and other essential data.

Cache Servers provide quick access to frequently used data, reducing latency and improving system performance.

4.4 Functional System Architecture for Learning Management and Content Delivery

Figure 3 presents a more detailed view of the system architecture, focusing on the integration of core learning functionalities and

how different components work together within the virtual experiential learning platform.

4.4.1 User Interface Layer:

• Comprises the Web Interface and Mobile Interface, which allow users to interact with the platform using web browsers or mobile devices.

4.4.2 Application Layer:

• Divided into Front-end Services and Back-end Services:

o Front-end Services manage the user interface logic, presenting data and interactions.

o Back-end Services handle the processing of data and application logic to respond to user requests.

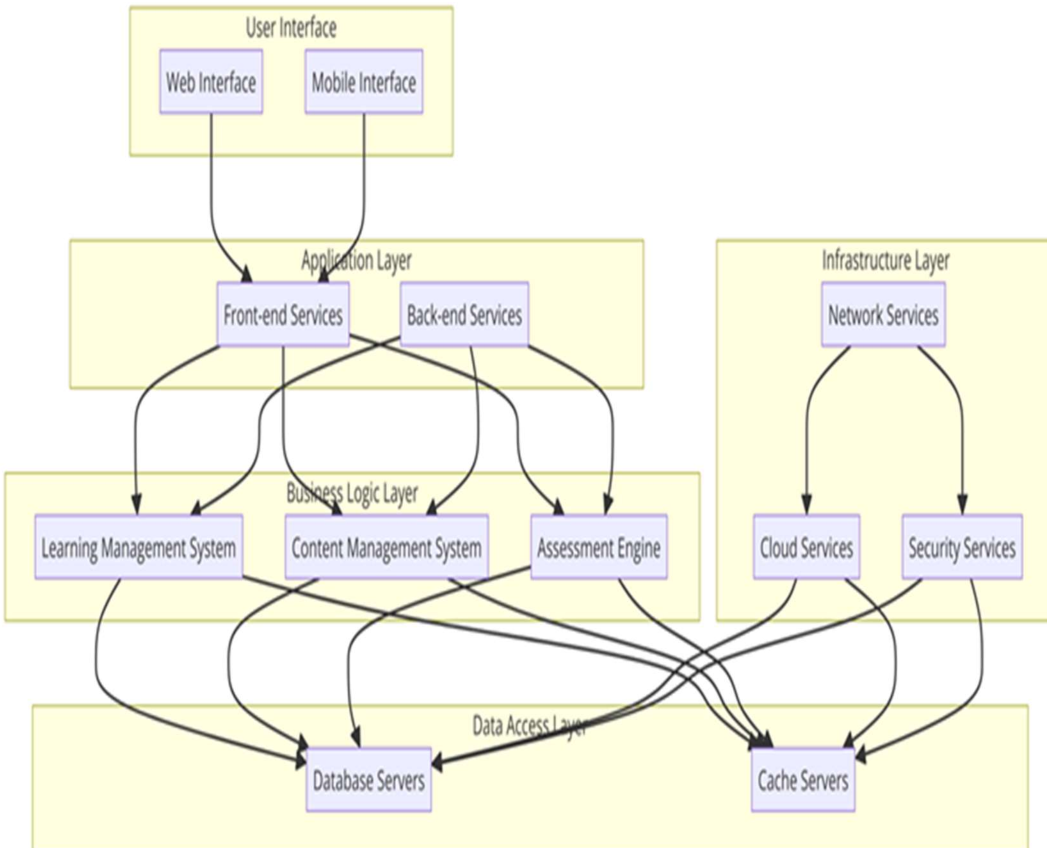

Figure 3: Functional System Architecture for Learning Management and Content Delivery

4.4.3 Business Logic Layer:

• The core functionalities are implemented here through:

• Learning Management System (LMS): Manages learning content, tracks user progress, and handles course-related activities.

• Content Management System (CMS): Handles the creation, storage, and distribution of educational content.

• Assessment Engine: Provides tools for evaluating learner performance, delivering quizzes, tests, and other forms of assessments.

4.4.4 Infrastructure Layer:

• Provides essential services, including:

• Network Services for communication between components.

• Cloud Services for scalable storage and processing capabilities.

• Security Services to ensure data integrity and secure access.

4.4.5 Data Access Layer:

• Comprises:

• Database Servers: Store structured data, such as user profiles, learning materials, assessment results, and other relevant information.

• Cache Servers: Improve system efficiency by providing quick access to frequently accessed data.

This Functional System Architecture for Learning Management and Content Delivery serves as a more functionally detailed complement to the overarching architecture shown in the first diagram, focusing on how learning management, content delivery, and assessment are implemented within the platform. It offers insight into how the experiential learning platform is designed to deliver educational content, evaluate learner performance, and ensure secure, scalable access to resources.

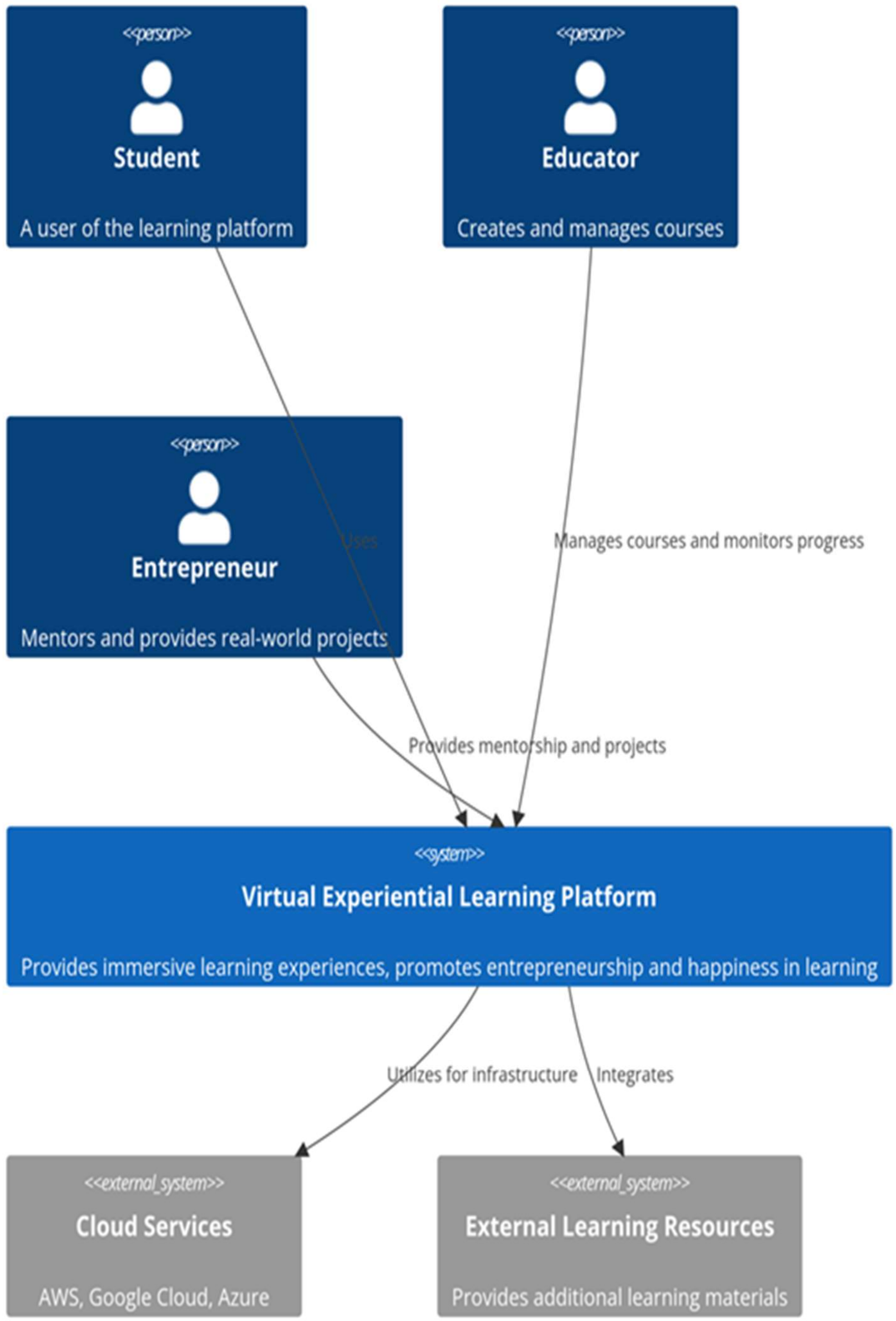

Figure 4: Context Diagram for Virtual Experiential Learning Platform

4.5 Context Diagram for Virtual Experiential Learning Platform

Figure 4 illustrates the "Context Diagram for Virtual Experiential Learning Platform," which explains the interactions between

the primary users, external systems, and resources connected to the Virtual Experiential Learning Platform.

4.5.1 Primary Users:

• Student: The student is a key user of the platform who engages with the learning content provided. They participate in various activities and develop their skills through immersive learning experiences available on the platform.

• Educator: The educator is responsible for creating and managing courses. They design lessons, monitor students' progress, and enrich the learning content using the platform's tools, making the learning experience more engaging. •

Entrepreneur: The entrepreneur serves as a mentor or advisor in the learning process, providing guidance and real-world project opportunities. They help students gain practical experience in solving real-life problems, thereby enhancing their entrepreneurial skills.

4.5.2 Virtual Experiential Learning Platform:

• The platform serves as the central system that offers immersive learning experiences, promoting entrepreneurship and happiness in learning. It provides students and educators with access to various resources and tools that facilitate an effective and interactive learning process.

4.5.3 External Systems:

• Cloud Services: The platform utilizes cloud services, such as AWS, Google Cloud, and Azure, to support its operations. These services offer storage, processing, and real-time functionality, making the system flexible and capable of adapting to the users' needs.

• External Learning Resources: The platform integrates with external learning resources, providing a diverse range of additional educational materials. This connection ensures that students and educators have access to high-quality, up-to-date content that complements the learning experience.

This Context Diagram for Virtual Experiential Learning Platform explains the connections between the primary users (students, educators, and entrepreneurs) and the Virtual Experiential Learning Platform, as well as its integration with external systems like cloud services and learning resources. It demonstrates that the platform is designed to facilitate effective learning and provide immersive experiences, supporting the growth and skill development of learners in an engaging and practical way.

4.6 Container Diagram for Virtual Learning Platform

Figure 5 presented is a "Container Diagram for Virtual Learning Platform," which illustrates how different elements, users, and services interact within the virtual experiential learning platform, depicting the system's architecture in greater detail.

Primary Users: The primary users include the Student, Educator, and Entrepreneur. The Student is the main user who engages with the platform to participate in learning activities, access course content, and benefit from personalized learning experiences. The Educator is responsible for creating, managing, and delivering course content, while also monitoring student progress and providing guidance. The Entrepreneur acts as a mentor, offering real-world projects and insights to enrich the experiential learning experience.

External Systems: The platform integrates with Cloud Services such as AWS, Google Cloud, and Azure, which provide scalable infrastructure, storage, and processing capabilities. Additionally, the platform connects with External Learning Resources to supplement educational materials, offering a broader and more diverse learning experience.

Virtual Experiential Learning Platform (Enterprise System): The platform is divided into multiple layers, ensuring efficient functionality. The Front-end Layer includes interfaces such as web, mobile, AR, and VR, allowing users to interact seamlessly. The Middle Layer handles core functionalities and services, facilitating collaboration, task tracking, and AI-driven personalization. The Back-end Layer serves as the infrastructure backbone, managing data processing, cloud integration, and microservices architecture.

Core Functional Components: The platform's core functionalities include the Learning Management System (LMS), which manages courses, tracks student progress, and organizes educational content. The AI-driven Personalization Engine customizes the learning experience by analyzing user interactions and preferences. The Intelligent Co-working Space provides virtual workspaces for collaboration, supporting experiential learning. Lastly, the Database securely stores user data, course content, and learning analytics.

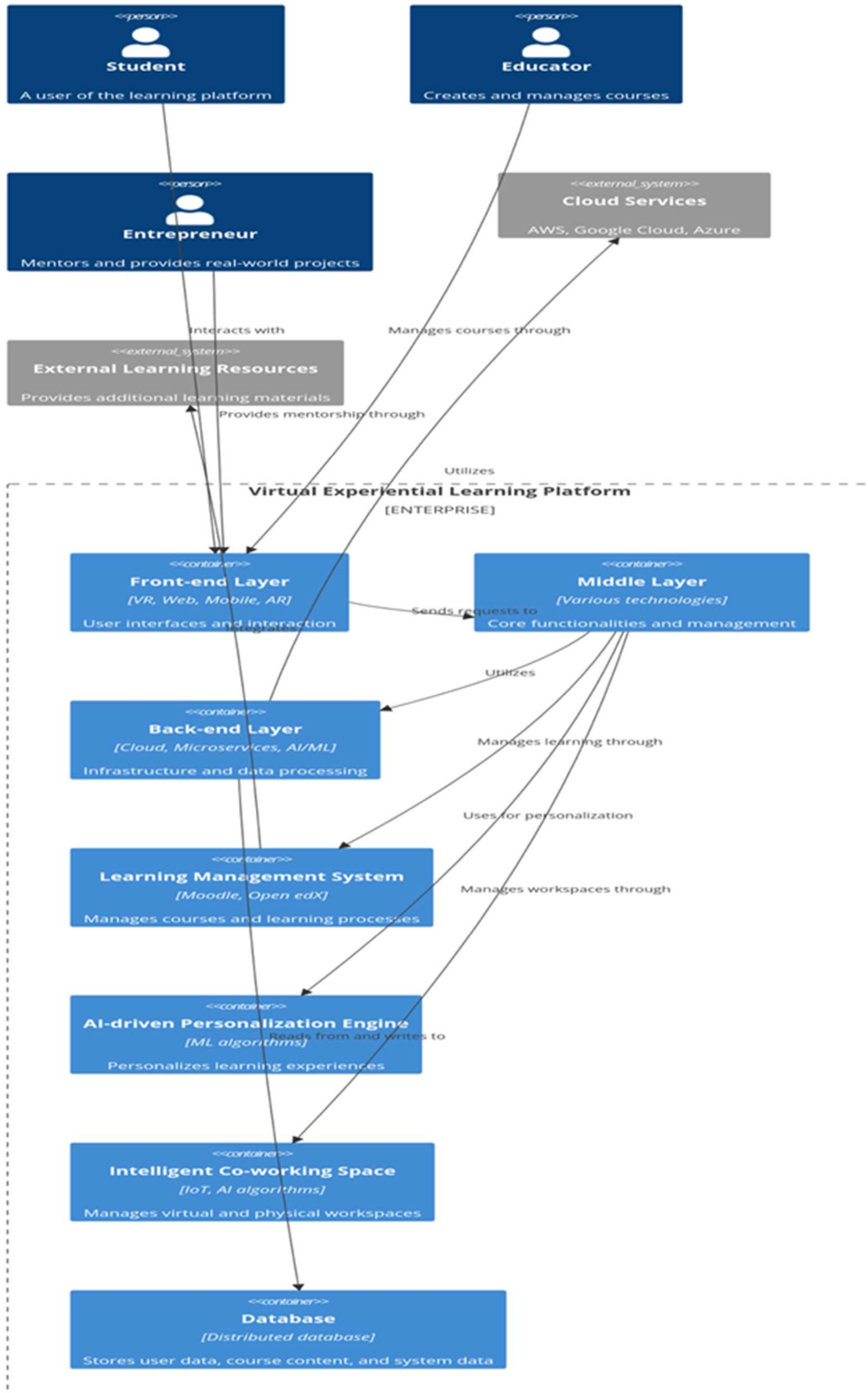

Figure 5: Container Diagram for Virtual Learning Platform

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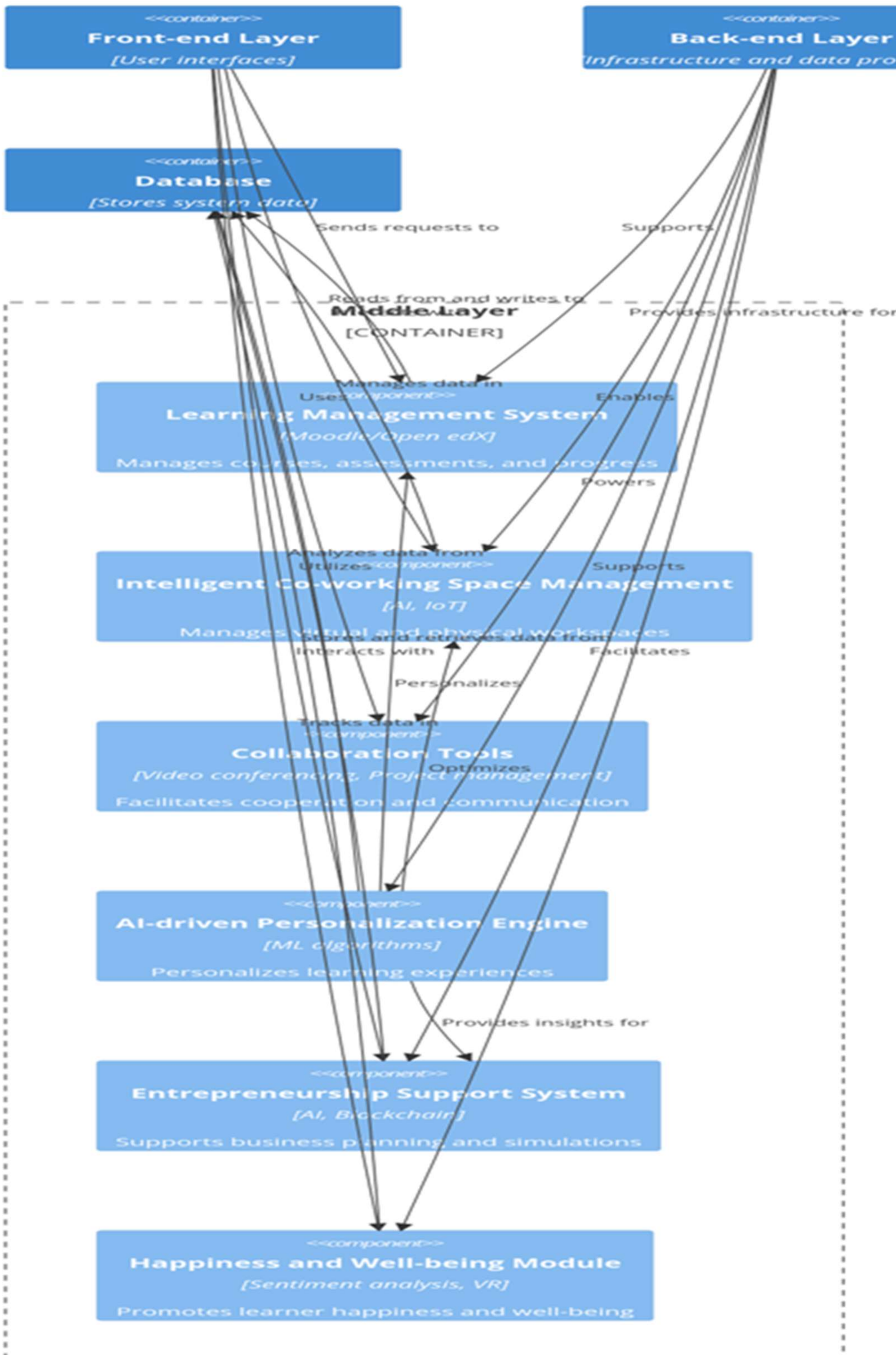

Figure 6: Component Diagram for the Middle Layer

4.7 Component Diagram for the Middle Layer

The diagram represents the "Component Diagram for the Middle Layer" of the Virtual Experiential Learning Platform, detailing how different components interact with each other and with other layers such as the Front-end, Back-end, and Database. The Front-end Layer serves as the user interface, where students, educators, and entrepreneurs interact with the platform. It provides access to various services offered by the Middle Layer, such as learning content, collaboration tools, and personalized experiences. The Front-end sends requests and receives data from the components within the Middle Layer to display relevant information to users. The Back-end Layer handles infrastructure and data processing for the platform. Supports the Middle Layer's components by processing user requests, managing data flows, and ensuring efficient platform operations. It also integrates with technologies like AI algorithms and cloud services to facilitate the functionality of components in the Middle Layer. The Database is a crucial part of this architecture, storing all system data, including user information, course content, collaboration details, and personalized recommendations. It allows components within the Middle Layer to read and write data as needed, ensuring a central repository for managing and retrieving data efficiently.

• The Middle Layer contains the main components:

• Learning Management System (LMS) manages classes, assignments, and course content. It interacts with the Front-end to present learning materials and assignments, with the Database for data retrieval and storage, and the Back-end for data processing.

• Intelligent Co-working Space Management facilitates collaborative learning by managing workspaces and resources. It integrates with the LMS and communicates with the Front-end to display real-time workspace information.

• Collaboration Tools support cooperative learning through functionalities like video conferencing and chat. They enable teamwork by interacting with the Front-end for user interfaces and the Database for storing communication history.

• AI-driven Personalization Engine personalizes learning experiences by analyzing user behavior and preferences. It uses AI to recommend tailored content and interacts with the Database for user data and the Back-end for processing requests.

• Entrepreneurship Support System provides tools and simulations to support entrepreneurship education. It assists in business planning and real-world experience using AI and blockchain technology, integrating with other components for a comprehensive experience.

• Happiness and Well-being Module tracks and promotes learner happiness using sentiment analysis and VR. It collects user interaction data to assess emotional states and provides activities to improve the learning experience.

• Each component in the Middle Layer communicates with the Front-end, Back-end, and Database to perform its functions. For instance, the LMS presents content through the Front-end, while the AI-driven Personalization Engine delivers personalized recommendations via the Back-end. This diagram shows how all these elements work together to create a seamless, interactive, and personalized learning environment.

4.7 The Evaluation of the Architecture of a Virtual Experiential Learning Platform for Promoting Entrepreneurship and Happiness

Table 2: The assessment of big data tools and technologies.

Evaluation Lists	Level of assessment		
	Level of suitability	$\bar{x}$	S.D.
1. User Experience (UX)	highest	4.51	0.59
2. Scalability and Flexibility	highest	4.65	0.53
3. Integration and Interoperability	highest	4.61	0.56
4. Security and Privacy	highest	4.58	0.58
5. Effectiveness in Promoting Entrepreneurship and Happiness	highest	4.51	0.67
Overall	highest	4.57	0.58

Table1. presents an assessment of big data tools and technologies across five key evaluation criteria.

The study employs a quantitative approach, utilizing a Likert-type scale to measure the level of suitability for each criterion.

The mean scores ($\bar{x}$) for individual criteria range from 4.51 to 4.61 on a presumed 5-point scale. Integration and Interoperability received the highest mean score (4.61), suggesting that the tools excel in their ability to work cohesively with other systems.

Conversely, User Experience and Effectiveness in Promoting Entrepreneurship and Happiness shared the lowest mean score (4.51), albeit still within the highest suitability range.

Standard deviations (S.D.) span from 0.33 to 0.67, reflecting varying degrees of consensus among respondents. The lowest S.D. (0.33) for Scalability and Flexibility indicates a high level of

agreement regarding this aspect. In contrast, Effectiveness in Promoting Entrepreneurship and Happiness exhibited the highest S.D. (0.67), suggesting more diverse opinions on this criterion.

The overall assessment yields a mean score of 4.57 with a standard deviation of 0.58, reinforcing the generally positive evaluation of big data tools and technologies across all criteria.

5. DISCUSSION

This study presents an information system architecture for a virtual experiential learning platform through intelligent co-working spaces, aimed at promoting entrepreneurship and happiness in learning. The findings highlight several potential benefits and challenges associated with the design and implementation of such a system.

5.1 Feasibility of the Architecture

The expert evaluation results indicate that the proposed architecture has high potential for real-world implementation, scoring highly on user experience (UX), scalability and flexibility, integration and interoperability, security and privacy, and effectiveness in promoting entrepreneurship and happiness. This aligns with previous research emphasizing the importance of these factors in designing digital learning systems [61] [52].

5.2 Integration of Advanced Technologies

The integration of various technologies such as VR, AR, AI, and IoT in the proposed architecture reflects current trends in educational technology [38]. However, this integration presents challenges, particularly in terms of compatibility and long-term system maintenance. Further research is needed to address these issues effectively.

5.3 Promotion of Entrepreneurship and Learning Happiness

While the proposed architecture is evaluated as highly effective in promoting entrepreneurship and learning happiness, questions remain about its ability to cater to diverse learner needs effectively. Future research should focus on assessing the long-term impact of this system on learners' entrepreneurial skills and well-being, in line with observations by. [6] [22]

5.4 Privacy and Security Challenges

Although the architecture scored highly on security and privacy, the collection and analysis of vast amounts of learner data remain a concern, particularly in the context of increasingly stringent privacy regulations [8]. Further research is needed to develop transparent and ethical methods for managing learner data.

5.5 Integration with Existing Educational Systems

Implementing the proposed architecture within existing educational systems may pose significant challenges, both in terms of technical integration and organizational culture change. Future research should explore effective implementation strategies and ways to manage potential resistance to change in educational institutions.

5.6 Sustainability and Scalability

While the architecture is designed to be flexible and scalable, questions remain about the long-term sustainability of the system, particularly considering the rapid pace of technological change and evolving workforce demands. Future research should investigate methods for designing systems that can continuously adapt to changing needs.

6. CONCLUSIONS

This study presents an innovative information system architecture for a virtual experiential learning platform that integrates intelligent co-working spaces to promote entrepreneurship and happiness in learning. The proposed architecture demonstrates significant potential for revolutionizing entrepreneurship education and enhancing learner well-being through its comprehensive integration of cutting-edge technologies such as VR, AR, AI, and IoT.

The expert evaluation results indicate high feasibility for real-world implementation, with the architecture scoring well on key factors including user experience, scalability, interoperability, security, and effectiveness in promoting entrepreneurship and learning happiness. However, several challenges remain, including technology integration, privacy concerns, and adaptation to diverse learner needs.

While the architecture shows promise, further research is needed to address these challenges and assess the long-term impact on learners' entrepreneurial skills and well-being. Future studies should focus on developing ethical data management practices, effective implementation strategies, and methods for continuous system adaptation to evolving educational and workforce needs.

This research contributes to the ongoing discourse on the future of education and workforce development by providing a blueprint for innovative learning ecosystems. As educational institutions, policymakers, and technology developers seek to create more effective and engaging learning environments, this architecture offers a foundation for preparing students for the challenges and opportunities of the 21st-century workplace.

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