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Original research

Cloud based adaptive learning system: virtual reality and augmented reality assisted educational pedagogy development on clinical simulation

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Abstract: An adaptive learning system provides support for student's academic progress by varying learning routes and pedagogical contents to satisfy various students' unique academic needs. The primary goal of this research work is to enhance and expand occupational efficiency through the use of technological pedagogical content knowledge (TPCK) frameworks in nursing education. The authors developed an adaptive federated cloud computing learning system in order to better prepare students for the demands of real-world professional practice. The article examined the use of virtual reality(VR) and augmented (AR) technologies in nursing education and developed an instrument that skillfully combines knowledge from the reputable literature on clinical competencies with the peculiarities and ingenuousness particular to virtual simulations. Designated for the remote sharing and utilization of combined educational resources, cloud computing is a distributed information communication technology (ICT) infrastructure built on the Internet of Things (IoT) framework. To increase the occupational efficiency among the nurses and midwives, an educational simulation applied in a way that gamifies the curriculum component for interactive educational pedagogy will be necessary. As a completely integrated part of the curriculum, simulation has proven to be beneficial for nursing students at all levels of instruction. Nursing educators have a plethora of options at their disposal to introduce simulation-based learning approaches into their curricula in the modern era. A three-dimensional (3D) interactive environment that provides users with a sense of spatial presence is created through computer technology, which is an immersive digital ecosystem of VR and AR utilized to improve teaching and learning in nursing education. In this study, the authors offered a cost- effective clinical simulation laboratory for clinical students, nurses, midwives, and practicing healthcare professionals in a manner that ensures constant learning and occupational efficiency by adopting the TPCK model in its central discussion and implementation. The TPCK model has demonstrated how to recognize the boundaries between technological components and pedagogical structures as well as how they are connected when creating facts in nursing education.

Keywords: Clinical simulation, Clinical 3D gamification, Cloud computing, Virtual reality (VR), Augmented reality (AR), Adaptive learning system

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1. Introduction

Electronic learning (E-Learning) and online learning environments have grown in tandem with the rapid development of information communication technologies (ICTs) [1]. E-learning systems are becoming increasingly valuable as a result of the growth and expansion of the Internet, which has led to a rise in popularity of computer networks that enable the resource sharing via a distributed cloud infrastructure [2]. Education is an essential human entitlement, a driving force behind personal development and one of the best ways to end poverty and promote equality in global health, peace and stability in modern society [3]. It is the most important factor in ensuring equity and inclusion that consistently yield substantial returns on human capital investment. When human intellectual development is placed at the center of the education system, people benefit from it in terms of employment, income, health and poverty reduction [4]. This is achieved by helping students to find roles and talents that best fit their individual needs. The educational learning theories in 21st century have undergone changes, progressing from instructivism, constructivism to social constructivism [5]. Theories of learning are conceptual frameworks that explain how individuals absorb, process and remember knowledge. Education systems integrate socio-constructivist theory to facilitate constructive processes of knowledge acquisition, as idea maps are utilized to help organize and synthesize newly learnt curriculum content. In general, socio-constructivism gains popularity as a result of the ways in which education is evolving and how technologies such as virtual reality (VR) and augmented reality (AR) are being used in the classroom [6]. As a result of technological advancements, new paradigms in education and learning were produced, which offered innovative pedagogical approaches that enabled students to achieve learning goals through the adoption of synthetic settings and adaptive learning systems. This virtual environment improved students' comprehension by offering a level of realism that was not possible with a conventional two-dimensional interface, resulting in an interactive learning environment that was rich in senses and pedagogical experiences [7]. In nursing education, simulation-based learning is frequently employed, including VR techniques, which have seen significant expansion in recent years [8].

Nursing education has integrated theoretical and practical components to provide the information, skills, attributes and values that nursing students need to learn, with a particular emphasis on clinical practice, which is a crucial component of healthcare disciplines [9,10]. Psychomotor, cognitive, and affective domains of learning are some of these components. Clinical psychomotor skills are acquired in nursing school and are essential to becoming a nurse and practicing safe nursing care [11]. Finding pertinent clinical learning opportunities and procedural nursing skills for undergraduate nursing students may be a challenge for nurse educators. There is a scarcity of nursing instructors, more students being admitted, competition from other medical specialties, disagreements over lab and clinical placement locations, and concerns about patient safety among faculty and students are some issues of concerns. Thus, calls for educational reform in nursing schools are made in an effort to guarantee the occupational proficiency and standard of nursing education [12]. In order to effectively apply their knowledge in the practice of clinical medicine, students should have access to well-equipped laboratory sites where they can engage in patient care before working with real patients. These sites should also include game-based virtual reality and innovative, interactive learning strategies that help students strengthen their digital communication skills. A safe and active digital learning environment, appropriate feedback and the opportunity for students to experience real-life scenarios without taking any risks are all provided by simulation, one of the interactive learning methodologies used in nursing education [13]. A growing number of countries, including Australia, are depending more and more on educational institutions to provide realistic, simulated learning experiences that adequately prepare nursing students for professional practice due to the fluctuating work schedules and high competition for obtaining quality industry work placements [14]. Ironically, in the healthcare sector, more and more pressure is put on newly graduated nurses to require them to be work ready. It means that they must be able to independently apply the skills acquired in their degree programs in challenging and ever-evolving healthcare settings for service delivery.

The skills required of nursing students to think about their future careers and to manage the challenges brought on by their work commitments should be instilled in them from their undergraduate courses [15]. The Healthcare Simulation Dictionary defines VR as an immersive, three-dimensional, computer-generated environment [16] that enables global medical laboratories to develop pedagogical and didactic models for educational and clinical training [17]. In order to provide an affordable, portable and realistic simulation that meets a variety of user and technology preferences, maxSIMhealth leverages disruptive technologies (such as three-dimensional printing (3D), gaming and new technologies such as extended reality) as well as creative solutions [16, 18]. With the goal of educating future generations of academics with strong multidisciplinary competences to work together in unfamiliar settings and communicate professionally to successfully solve medical-tech problem, maxSIMhealth's efforts will revolutionize the existing state of health professional education. In order to increase proficiency and lower complications, healthcare trainees practice real-world skills on simulators before trying them on actual patients. As it is extremely expensive and often impractical to equip large cohorts of learners with simulators, COVID-19 forced in-person learning to be done online [19, 20]. VR simulation and 3D printing made it possible to produce precise, reasonably priced simulators that are easily tailored to meet the requirements of students in education [21].

Virtual reality simulation (VRS) provides an opportunity for students to engage in critical thinking, decision-making, performance, efficient psychomotor control, and communication while performing a vital role [22]. In addition to the unique retention of information and skill acquisition that this analysis highlighted, a systematic study investigated the effectiveness of VRS as a learning strategy in the development of clinical nursing skills in nursing education [23]. At present, desktop virtual simulation and immersive virtual reality simulation are the two primary types of virtual worlds utilized in nursing education. The results of using these two categories of virtual worlds as instructional aids for registered nurses and nursing students are assessed in this evaluation. VR provides a risk-free, non-contact education engagement. The purpose of this study is to examine the literature on instructional VR nursing simulations and to analyze the methods from both a didactic and technical perspective. Immersive technology has brought about a paradigm shift in the educational professions, which gives a rise to new approaches to both teaching and learning [1]. Through intelligence, technology has brought about innovative learning methods for students as well as the chances to direct classroom education to meet the individual needs of all learners. The rest of this paper is structured as follows: The background of VR simulation is explained in section 2. The theoretical framework is presented in section 3. The research design and methodology are explained in section 4. The technological pedagogical content knowledge (TPCK) model of the system implementation is explained in section 5. The design implementation is provided in section 6, while the conclusions are presented in section 7.

2. Research background

Using a variety of approaches, the literature review of the present study revealed that VRS promotes knowledge acquisition and enhances skill performance in most studies [24]. A variety of cognitive contexts are evaluated in order to study knowledge, and VRS makes it possible for knowledge to be acquired through learning experiences, which is an important way for nursing students to acquire information while receiving feedback on their activities [25]. Furthermore, VRS has been shown to improve knowledge retention by integrating virtual patients into a case-based learning method and replicating real-world settings in realistic scenarios at any time. On the other hand, VRS helps transfer information by putting theoretical knowledge into practice by employing a variety of educational programs and is applied in game-based virtual reality phone applications [26]. The results of this study demonstrated that the application of VRS in a variety of learning strategies, including case studies, specific scenarios in safety education, pediatric courses, disaster training, and psychomotor skills showed improvements in the performance of a variety of skills. Better decision making and the transmission of safer practices that facilitate experiential learning were thus demonstrated by VRS.

Within the realm of computer-based environments, virtual reality encompasses a variety of settings that allow users to explore microworlds created by software and hardware technologies that are close to the subject matter [27]. On the other hand , VR is a class of computer-controlled multimodal communication technologies that allows for more natural interactions with data and makes innovative, educationally engaging use of the senses [28]. In essence, VR is a way to recreate or simulate an environment and makes the user the feel like they are physically there, in control and actively interacting with it on a personal level [25]. Through the use of 3D display with near-eye visualization and location tracking, VR is a simulated technology experience utilized in business, education and entertainment to give viewers an immersive impression of a virtual environment. The experience of being fully immersed in a digital environment, conveyed to the senses through perceptual and psychological means, is evoked by virtual reality [29]. By using a virtual reality system, a user can escape the real world and enter a virtual environment where artificial intelligence is used to produce the sights, sounds, smells and other senses instead of natural objects. Using VR approaches to create educational applications opens up new ways for teaching and makes understanding the technology and processes much more important. VR is categorized into three main forms that facilitate interactive pedagogical learning: (a) Immersive (Fully Immersive) VR systems; (b) Semi-Immersive VR systems; and (c) Non-Immersive VR systems. The least advanced implementation of VR technology is found in non-immersive VR systems, where the VR software is installed on a desktop personal computer [30].

By using a conventional high-resolution monitor and an interactive repository of clinical content, users of the desktop system can access the virtual world. Conventional interfaces such as keyboard, mouse and joystick can be used to interact with the virtual world. The graphics processing system with a relatively high performance can be connected to a large screen monitor, a large screen projection system, or several television projection systems to make up semi-immersive virtual reality systems. These systems provide an enhanced sense of presence or immersion through a broad field of view, and stereographic imaging can be accomplished with the use of shutter glasses. The most direct way to explore the virtual surroundings is via an immersive (fully immersive) VR system [31]. An interface for two-handed haptic interaction was presented in this study. We chose an application scenario that requires simultaneous hand and needle manipulation on a mannequin patient. Utilizing bimanual haptic interaction, the technology combines a physics-based soft tissue simulation visualization for engagement [32]. To the best of our knowledge, modeling deformable objects using haptic rendering in conjunction with finite element methods is not commonly done, especially when working with two haptic devices in a complex scenario. The problems include synchronizing the data among system components in the adaptive learning environment and striking a compromise between the real-time restrictions and the high computing demands for fidelity in simulation. According to [33], the semi-immersive virtual reality system has been effectively deployed and evaluated on two distinct computer platforms: an adaptive system that leverages an Internet of Things cloud computing infrastructure and a mobile laptop-based system. These two platforms were selected because of their cost scalability and authenticity. We measured the event-based timings and evaluated the update loop timings of several software components to estimate latency and compare performance.

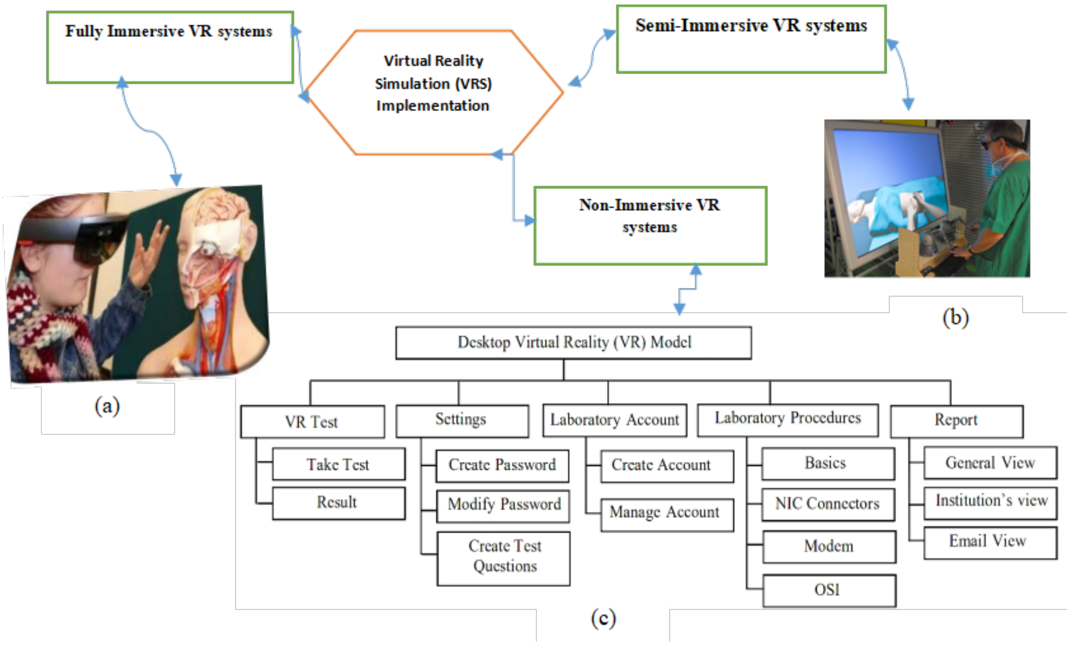

Figure 1. Combined VR simulation implementation
(a). Fully Immersive VR System; (b). Semi- Immersive VR System [34]; (c). Desktop VR Model [30]

3. Research objective

The aim of this research is to develop an adaptive learning system based on cloud computing information federated loop-based. Cloud computing technology was employed in order to create a customized online learning environment that meets the specific learning demands of clinical nursing students who require additional learning sites. Our main goal was to identify each student's individual preferences and organize the course's learning activities accordingly. The adaptive system was designed to address the issue of individualized instruction and broad student access, which led us to use cloud computing technology. With a dynamic system approach and game-like designs, digital efforts in the curriculum can take into account the interactions between heterogeneous entities and create interfaces for many application. Simulators provide students with real-world experience without putting them in danger, making them an interactive learning technique in education. In addition to a stimulating and safe learning environment, proper feedback and enjoyment, students' sense of self-worth is also strengthened. Bachelor's degree candidates should possess the skills required to think about their future careers and overcome challenges related to their jobs. The goals listed above were achieved in this paper.

4. Theoretical framework

The potential of students to improve their academic performance through individualized synchronous and asynchronous self-study is taken into consideration by the adaptive learning system (ALS) [35]. Adaptive learning is the process of dynamically modifying the curriculum to meet the needs of each individual student while providing a variety of learning opportunities and integrating multimedia content [36]. To provide varying study groups with heterogeneous learning habits and content amalgamation, an adaptive learning approach is usually employed. These systems facilitate adaptive learning, which is the process of customizing a learning program for each student in order to enable the system to accommodate individual aptitude variations [37]. An intelligent tutoring system can use technology-based personalization to cater to students' interests and tailor training to their background, experiences, and prior knowledge [38]. This is known as adaptive learning technologies, which are becoming more and more common in educational settings at all levels of digital interaction. An Internet of Things (IoT)-based distributed infrastructure for the distant sharing and use of different resources and services is provided by cloud computing systems for sharing multimedia digital contents for educational engagement [2, 39]. A big federated information system management is made possible by cloud computing services in education, which provide a way for the general public to participate in an Internet-based computing model [40]. These services offer a huge and dynamic resource pool with lots of virtual resources available to them. To increase the effectiveness of resource use, these virtual resources are distributed dynamically based on the load.

The application system can then calculate the necessary storage capacity, processing power and other services to be allocated in line with the job needs when a resource pool of computing tasks has been assigned. Cloud computing is a technological solution that streamlines the operation of information technology (IT) services to deliver fast, secure and on-demand services by integrating IT resources with a range of centralized products and devices [41]. The cloud based adaptive learning system was developed using cloud computing technology to address a number of issues related to ALS [42], such as the existence of a single point of information access, load imbalance, the need for centralized access to resources, the waste represented by idle equipment resources and others. The system is designed to be delivered synchronously and asynchronously through an on-premise server.Virtual integration server software is used to create a virtual resource pool consisting of several virtual machines that act as virtual server solutions [43]. By sharing resources, these virtual machines maximize their efficiency and allocate resources using a policy-driven methodology. In order to ensure security, the system uses embedded software to provide resource control functionality. This software automatically applies a pre-allocation strategy to control networking, storage, and computing resources in addition to other customized client data and resources and enables dynamic resource allocation from the aggregated target resource pool [44]. The software determines application priority as the application load grows. The reallocation of resources to the virtual machines is determined by this priority evaluation based on established resource allocation criteria and is subject to confirmation. The two methods that are normally available are moving programs to a cloud server with higher resources and moving virtual machines to other applications on a cloud server that is inactive, which frees up additional resources on the local system.

The cloud IoT architecture for sustainable e-learning in higher education in healthcare requires an adoption of immersive AR, extended reality (XR) and VR simulation environment [45]. It will establish connections with interactive and collaborative resources that can achieve the targeted immersive learning environment, featuring professors and students in the virtual meeting rooms for educational planning. An integrated VR-based cyber-physical approach has the advantage of making collaborative knowledge frameworks more adaptable to the changing academic needs of students. To achieve the targeted learning objectives, a number of partners may collaborate with virtual enterprise platforms and bring together their physical and digital resources. With the emphasis on interactive and collaborative methods of remote education, XR technology minimizes the need for travel by bringing educational services closer to students and learners in distant locations [46]. According to [47], an immersive learning environment with virtual meeting rooms, digital avatars of teachers and students, and interactive VR services aims to illustrate the effectiveness of learning in the solar system. By engaging teachers in their work in a more authentic and immersive way and providing students with training and opportunities for skill development, the practices aid in the development of teachers' teaching abilities. In addition, the virtual mainstreaming of the audio metaverse makes it possible to generate spatial sound in conjunction with XR-enabled video streaming services, hence facilitating the production of interactive experiences [48]. Through more authentic and immersive integration into their field of work, as well as providing students with skill-building training and activities, the practices assist instructors in becoming more successful educators. The metaverse has been used as a teaching tool in digital education to create collaborative learning environments with a variety of ICT tools and technologies for digital collaboration and interactive engagement in the digital classroom.

Remote collaboration through the metaverse promotes cultural competence and teamwork while increasing student engagement through immersive learning [49]. Students' critical thinking and creativity are stimulated when they interact with and modify 3D items on the platform, which enhances their ability to acquire skills through problem-solving simulations and ultimately improves their technological literacy. In the metaverse, AI-powered avatars provide individualized learning opportunities and role-playing exercises that improve emotional intelligence. As [50], has demonstrated, it also makes extensive examination of historical and architectural places possible by offering interactive 3D models that combine academic and practical learning. The introduction of XR and internet of everything

(IoE) modules for integrated learning, supported by metaverse technology, opens the door for the integration of instructional materials into narratives and practical gamifications. Although, immersive educational services can be improved by the metaverse, XR and IoT architecture, consumers still have difficulties in appropriately handling this technology. IoT devices and VR/AR gadgets are frequently abused, disregarding their intrinsic value, even with secure connection support [51]. Every metaverse-enabling technology has its own distinct features. In addition to providing realistic models to students for gaining real-world experience, simulations are important for education because they also create safe environments in which students can repeat procedures without risk in order to understand concepts and theories more easily. VR is widely acknowledged as a noteworthy technological advancement that can aid in the learning process by creating incredibly lifelike 3D simulations that offer immersive and interactive elements.

On the other hand , [52] provided a model of how virtual reality technology can be applied for the development of instructional materials in the field of construction processes that stimulate educational importance. The authors created models of buildings in two common scenarios so that students could engage with the virtual representations in a way that would allow them to initiate the construction sequence required by real construction work. The methodology examined how various construction elements fit together and are integrated into the model. In order to simulate volumetric analysis studies, [53] established a brand-new web-based virtual learning environment. Using real-time interactive simulations of volumetric analysis experiments, their work enhanced learning by simulating real-world settings in a chemical laboratory using advancements in Web and VR technology [54]. In addition to being a useful tool for distance learning and lifelong learning in chemistry, the virtual laboratory they described in their study was also an affordable option for colleges and universities lacking the necessary infrastructure [55]. A web-based 3D multi-user virtual world called Second Life, developed by San Francisco-based corporation Linden Lab, is the foundation for the simulated scenario [56]. Many instructors from around the world use Second Life, one of the most well-liked virtual reality platforms. It provides infinite possibilities for engagement, a sense of belonging and the chance for individuals to develop their own skills. According to statistics, more than 100 educational institutions have set up shop in Second Life and are operating in the virtual environment. As humans retain up to 90% of what they learn through active multimedia participation, [57] proposed a model needed to incorporate VR into engineering curricula.

Nursing curricula that incorporate simulated learning typically include learning experiences that help students acquire and practice skills in safe physical settings that mimic a hospital or other healthcare settings [58]. Often referred to as "simulated learning environments (SLE)," these tools, which include mannequins and low-to-high-fidelity task trainers, are usually used in conjunction with roleplay and simulated patient scenarios to enable incremental learning from novice to expert without endangering real patients [58]. Beyond the training and practice of psychomotor skills, current nursing programs aim to develop contextualized asynchronous and synchronous learning experiences that support the development of affective (beliefs, emotional intelligence, empathy) and cognitive (facts, critical thinking, clinical reasoning) skills while maintaining the theoretical foundations of nursing education. Simulation education in nursing is most frequently based on Kolb's experiential learning theory (ELT), which supports the notion that knowledge is acquired through concrete or abstract experiences of learner and that reflection is necessary to make new understandings and generalizations [59]. A potential solution to provide nursing students with more realistic simulated learning experiences than those obtained with traditional simulation media is to employ technology-enabled approaches, such as the use of extended XR media, which includes immersive virtual reality (IVR), AR and MR. The diversity of XR technology embedded media offers tremendous promise for creating simulated learning environments that require active student participation and engagement, which is thought to be essential for enhancing learning outcomes [60]. A significant benefit of XR technologies such as IVR is the ability to place students in virtual environments utilizing head-mounted displays and simulate the contextual (physical and mental) feelings of being present and immersed in the virtual world around them. A technique known as MR combines aspects of IVR and AR to establish a continuous interaction between virtual and physical items. By using MR, users may seamlessly engage with both digital and real-world things, such as lifelike mannequins [61].

5. System model

Nursing educators can benefit from the additional use of two popular frameworks that can help with the design process: the Substitution, Augmentation, Modification, Redefinition (SAMR) model and the Technological Pedagogical Content Knowledge (TPCK) framework. The term technical pedagogical knowledge, technological knowledge and content knowledge describes the interaction between these three forms of knowledge and states that in order to integrate technology effectively, all three must be present, which requires expert collaboration. The SAMR model classifies the numerous ways in which technology can be incorporated into teaching and learning activities. These ways range from simple substitution to the application of diverse XR technology media to create new and distinctive learning experiences. A guiding principle for creating successful XR educational experiences is the incorporation of learning theories into the design process, as emphasized by frameworks such as TPCK and SAMR. A key component to employ these technologies in successful teaching and adaptive pedagogy is incorporating learning theory into the design process [62]. Understanding how students can pick up new behaviors, skills and information is based on learning theories. Integrating these theories into the design process therefore guarantees that teachers are actively involved in creating XR experiences that effectively promote students' learning.

Furthermore, in order to support the learning objectives, educators must also recognize and choose the appropriate technological equipment [63]. Even with the well-established benefits of IVR systems, not all students or teaching concepts benefit equally from simulated learning through head-mounted displays. In order to ensure optimal results, learning designers, educators and subject matter experts should adhere to scientific techniques and/or frameworks while designing lessons. Producers and educators of XR educational content can benefit from a practical strategy that utilizes design-based research approaches such as the scrum framework or design phases [58]. The design of an XR learning environment can be conceived and organized using the helpful roadmap shown in Figure 2. More specifically, this roadmap might be a useful tool to guarantee that learning theories and educational objectives are successfully incorporated into the design process.

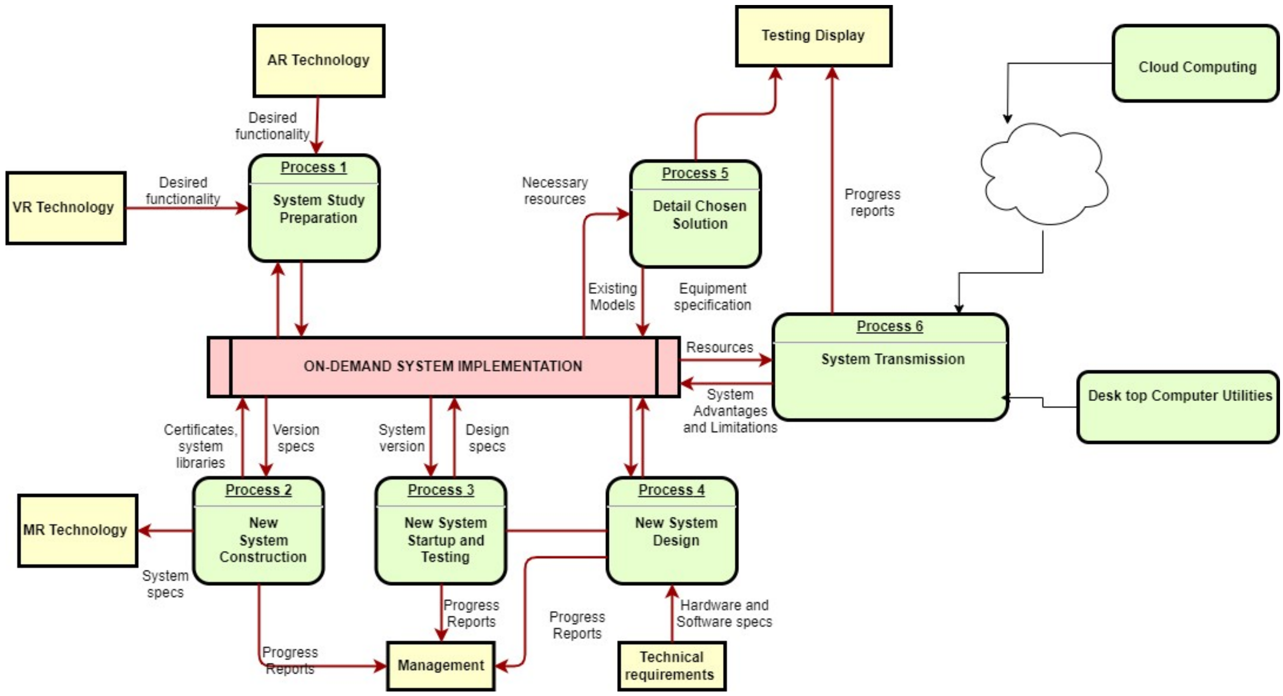

Figure 2. Technological pedagogical content knowledge (TPCK) model: Author illustration

Figure 2 compares the incremental process methodologies with the TPCK development pipelines. **Process 1:** System Study Preparation— selecting and loading VR or AR technology according to parameters that can be applied to the technology or educational goals. **Process 2:** New System — estimating the pedagogical project's effects or outcomes in a realistic manner, taking into account how likely or practical each outcome is, for example, do we have the necessary technical staff on hand? **Process 3:** Commissioning and testing of the new system —this entails comparing the results to the chosen criteria for the new system. **Process 4:** New System Design — the optimal method for addressing the pedagogy component transmission is ultimately decided upon the preceding processes. **Process 5:** Selected Solution in Detail- Communicating the process's outcomes in the last phase, where the carefully thought-out project process is presented to explain the reasoning behind the selected challenge, design, technology, results and assessment techniques. **Process 6:** System Transmission - The transmission protocol determines whether the desktop protocol, cloud computing delivery, or both have basic delivery capabilities. In addition to utilizing theoretical frameworks and principles, educators and developers of XR materials can take into account these examples to make sure that their designs produce memorable and easily accessible learning experiences. Recognizing that learning is a socially complex process is essential in forging a novel approach in pedagogical synthesis [64]. Knowing the unique qualities of each student and the ambient elements that could affect learning outcomes is essential for the successful integration of technology-enabled teaching methods [65]. The primary drawback of every case study provided was that it was not designed or supported for a wide curriculum or long-term integration into the university system.

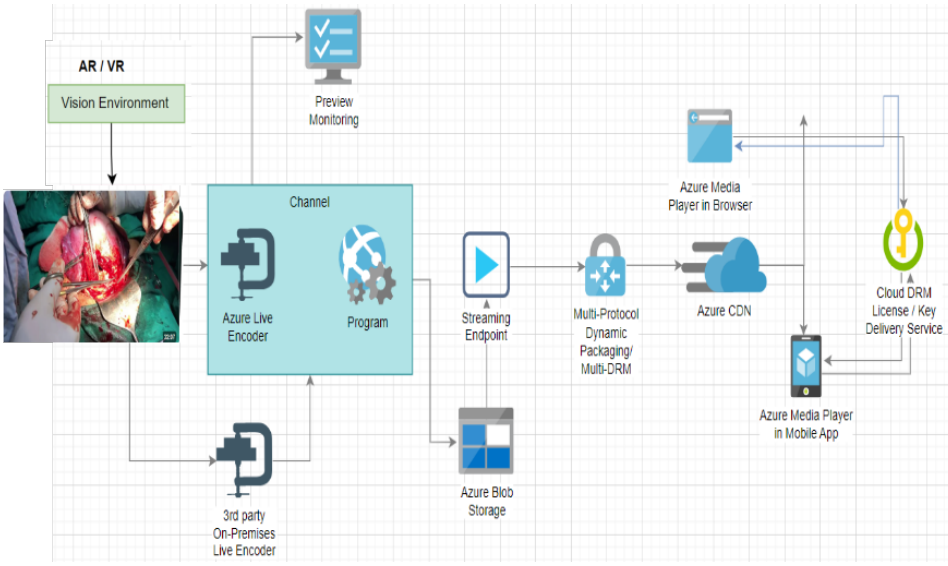

Figure 3. Cloud-adaptive VR and AR learning environments: Author illustration

6. Design implementation

Refer to Figure 3 and Figure 4, the modernization of XR technology in nursing simulation education has been primarily spearheaded by a small group of nursing and technology specialists who are passionate about using XR to maximize student learning, with a focus on the background of Australian higher education [66]. In order to facilitate the co-creation of synchronous and asynchronous learning experiences between nursing educators and XR technology, this project designed a cloud-based adaptive learning system. IoT resource federation is made possible by the digital infrastructure, which consists of dispersed networks, database software, cloud servers, mobile apps, and enterprise tools [67]. Using computer dispersed networks, usually public or private networks consisting of wireless area networks, local area networks, or virtual private networks, cloud computing technology allows institution or individuals to share a variety of services seamlessly and affordably. In order to better prepare students for the demands of real-world professional practice, this article examined the use of VR and AR technologies in nursing education. Specifically, it focused on the issues faced by post-secondary educational institutions that offer nursing programs. In order to overcome these obstacles, XR technology, which encompasses AR, MR, and VR, offers a variety of media platforms for the development of immersive, practical learning experiences gained in virtual settings that can mimic some of the dynamic elements of actual healthcare settings. Through an examination and explanation of three actual situations, this document analysis explored the application of XR technology in nursing education as shown in Figure 1. XR technology specialists work with nursing educators to offer synchronous and asynchronous learning experiences that go beyond traditional nursing simulation resources to better prepare clinical students for the rigors of real-world professional interactions.

Since VR projects are highly engaging for learners, researchers in the fields of learning theory and virtual reality largely agree that VR technology is exciting and offers a distinctive and effective learning approach for students when it is appropriately developed and utilized. Since it has been demonstrated that certain students can master content and project their understanding of what they have learned, VR is also beneficial when the experience of an actual simulated environment is applied to learning. One of the most beneficial applications of VR is in the visualization, manipulation, and engagement with information, which is essential for learning it. Another benefit is that it enables learners to show and engage with the environment and information, which some have deemed to be its greatest benefit. When teaching practice in the physical world poses a risk to students, teachers, equipment or the environment, adaptive technology can be a very effective substitute [68]. The advantages of this technology have been emphasized by researchers and developers in a wide range of industries, including aviation inspection and maintenance, anti-terrorism training, automotive spray painting, nuclear decommissioning, firefighting, crane driving and safety, and pedestrian safety for young people. Technology has initiated a paradigm shift in education. Technology has enabled the development of new instructional techniques. Virtual reality may adapt classroom instruction to meet each student's needs by utilizing a state-of-the-art technology. The development of educational applications using virtual reality techniques opens up new avenues for the teaching of health-related subjects. Virtual reality is promising as a tool for hands-on learning. Virtual reality has created new opportunities for study, practice and teaching in physical sciences, engineering, and medicine, among other fields. Students can accomplish learning objectives with the help of virtual reality learning environments or VLEs. VLE-based programs have become a popular alternative to traditional teaching methods (the instructivism approach) in mainstream education in colleges and schools.

As VR learning environments combine constructivism, instructivism and socioconstructivism, they have been found to have a higher pedagogical effectiveness on learners [69].

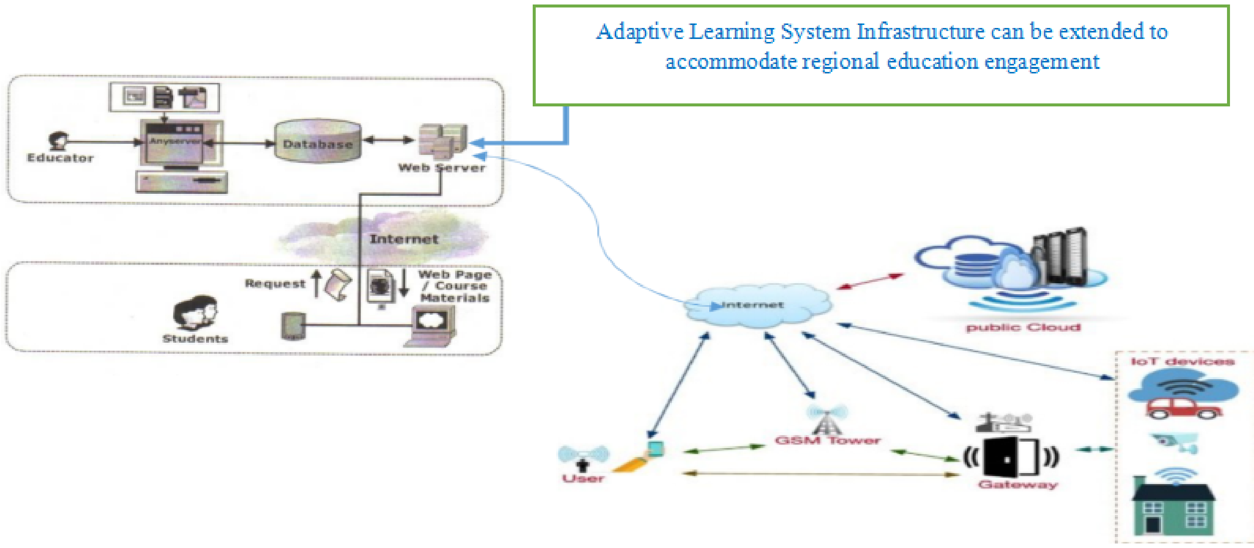

Figure 4. Adaptive Learning Infrastructure Cloud Model [2]

Table 1. Identifying particular interest in AR and VR simulation for nursing education

Simulation Component	Fact-Based	Performance Indication
Authentic Learning Experiences:	Create realistic scenarios that mirror actual clinical situations.	Authenticity fosters clinical decision-making and critical thinking in students by assisting them in applying theoretical information to real-world situations [70].
Standardization:	Ensure consistency across simulations.	Standardized situations facilitate consistent skill practice for learners, leading to improved learning results [71].
Interactivity and Engagement:	Foster active participation	VR and AR simulations engage students through interactive experiences, enhancing their understanding and retention of complex concepts [52].
Safety and Risk-Free Learning:	Provide a safe environment for skill development	Simulations allow students to make mistakes without real-world consequences, promoting confidence and competence [72].
Collaboration and Communication:	Encourage teamwork and effective communication.	Simulations involving multiple learners promote collaboration, vital for healthcare professionals [9].
Critical Thinking and Problem-Solving:	Develop analytical skills.	Complex scenarios challenge students to think critically, analyze information, and make informed decisions [73].
Cost-Effectiveness:	Optimize resources	VR and AR simulations can be more cost-effective than traditional methods, especially when scaling up to accommodate larger student cohorts [74].

7. Design specification & result

The research design specification and result is shown in Table 1.

8. Discussion of research findings

As the adaptability of the IoT cloud increasingly impacts the environment, the release of our conceptualization and system definition tool for general nursing and midwifery education represents a significant turning point for both research and practical applications. The primary goal of our work is to enhance and expand occupational efficiency through the use of technological pedagogical content knowledge (TPCK) frameworks. We have redesigned cloud adaptive systems instead of just copying existing models. We have developed an instrument that skillfully combines knowledge from reputable clinical competency literature with the peculiarities and ingenuousness particular to virtual simulations. It is not merely theoretical, but has been tested and empirically validated to ensure that we accurately capture the breadth and depth of digital health literacy. Our methodology also offers the opportunity to investigate novel relational dynamics in nursing and midwifery education.

One can not help but wonder how knowledge of an adaptive learning platform could influence a person's decision to trust it, give it assignments or even follow its instructions. Our tool attempts to shed light on these nuanced relationships, the underlying beliefs and behaviors related to clinical simulation.

Furthermore, our goal is to not only comprehend clinical simulation in a vacuum, but to place it in the larger context of technology acceptance. There is no single technical tool that has the same adoption curve due to a variety of circumstances. With cloud adaptive systems, adoption will offer more pedagogical utilization in training and human capital development. Fundamentally, our work is only the beginning of the automation of digital health and technology-enhanced nursing education, not its conclusion. It is an appeal to practitioners and academics to explore the field of artificial intelligence (AI) more thoroughly, with a more critical eye and a keen awareness of how nursing and midwifery practice intersects with the adoption of AI and platform applications.

Conclusion

In the future, nursing and midwifery training might take place in semi-centralized labs outfitted with VR/AR technologies, as suggested by this reality. Teachers may interact and impart knowledge remotely, and students could have physical access to the required tools in these places. For medical education, this method may be a more practical and economical way to use immersive technologies, particularly in situations where it is not feasible for each student to be confined in a specific location, this paper provides a great leverage. XR technology could help prepare graduates who are ready for the workforce by providing educational advantages that go beyond those of traditional simulated learning media.

The integration of XR technology into nursing education provides a novel and creative solution by giving students the chance to experience events that might be unavailable due to financial, time, safety, or availability constraints, express their understanding of phenomena, see the dynamic relationships between variables in a system, and visualize abstract concepts in a 3D format. The significant case have highlighted the potential of XR to improve students' simulated learning experiences based on the cooperation between XR technology professionals and nursing educators. Our methodology also creates opportunities to investigate novel relational dynamics in nursing and midwifery education and provides enhanced and expanded occupational and training efficiency through the use of technological pedagogical content knowledge (TPCK) frameworks.

Authors' contribution

The conceptualization of the project was conceived by David Oyekunle, Ugochukwu Okwudili Matthew supervised the research work, Bah Esseme Alain Claude Bah Esseme was responsible for validation, Ajibola Olaosebikan Waliu handled the methodology, Temitope Samson Adekunle supervised the review and editing of the manuscript. All authors have read and approved to the published version of the manuscript.

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Conflict of interest

There is no conflict of interest regarding this publication.

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