THE IMPACT OF VIRTUAL REALITY IN HIGHER EDUCATION

by

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Abstract

The use of virtual reality in higher education plays a major role in addressing key areas of teaching, research, and learning. The applicable use of virtual reality sets the stage for ways to integrate an immersive environment, customizable based on higher education constituents preferences. The purpose of this research was to determine emerged functions on how virtual reality influences education in higher education utilizing thematic analysis and narrative review. The themes that were identified showed the impacts, uses and challenges faced by virtual reality. It also extended beyond normal use of virtual reality due to how virtual reality can be integrated and used effectively for teaching, learning and research. Limitation and future research were identified to help lay the foundation for future research work on those limitation with a major focus building on where this research stopped. The finding of this research will help educators develop content geared towards alternative mode of instruction with virtual reality among other instructional methods.

Keywords: virtual reality, higher education, impact, inclusive

Introduction

The advancement in teaching and learning incorporates innovative technology strategies in higher education to boost collaborative efforts across all career disciplines. The use of virtual reality presents a platform for an immersive experience, among other implementations, to bridge the gap in teaching, learning, and practice of different subject areas without the need for physical access to specific teaching environments referenced in teaching materials. The exploration of virtualized environment integration has set the stage for inclusivity in content access for many beyond the initially planned use of virtual reality to level the field in digital accessibility (González-Zamar & Abad-Segura, 2020). The potential exhibited in the virtual reality space has gradually added to scientific breakthrough trends in higher education research through the creative applications of innovative immersive strategies in human-computer interaction. Several key attributes are tied to virtual reality that amplifies the impact it has on higher education settings. The creation of virtualized environments geared from devices in the digital sense makes up a full scope of perceptions created by students in a generated simulated environment where a link is created between students, instructors, and researchers in a digital computerized system environment (González-Zamar & Abad-Segura, 2020).

Incorporating tools in innovative strategies for knowledge creation in a way when presented to higher education audiences, introduces a balance in information sharing. An extraordinary achievement using virtual reality in course topics provides a collaborative way to go through step-by-step course topics to bring students, instructors, and researchers in the same room contributes to the body of knowledge. The thoughts shared by students on virtual reality goes to show how the complexity of educational systems has been unified through key considerations of virtual reality in the conceptualization of best approaches to program curriculum integration (Cicek et al., 2021).

Problem Statement

Inclusive learning has become a topic of focus for many higher education institutions (Ortiz Colón et al., 2018) which includes digital accessibility of learning materials throughout the course of a student's academic studies. Individuals wanting to be in an academic setting but are not able to do so due to reasons beyond their control demonstrates the need to create an alternative approach to presenting brick and

mortar educational experiences to a section of demographics (Jdaitawi & Kan'an, 2021). There is a need to create a sense of belonging and inclusion in classroom interactions simulated in a virtualized environment. The opportunity to implement virtual reality will bridge the gap by serving a wider audience that ordinarily would not have been considered or included in instructional planning to address student needs.

Purpose of the Study

The purpose of this study is to examine the functions of virtual reality in higher education as it relates to the enhancement of innovative teaching and learning and the impact it creates. The aim is to lay out various applicable uses of virtual reality in areas involving human-computer interactions to build and create an inclusive digital immersive experience in higher education environment settings to meet the students' needs. Consistent with the purpose of the study, the following research question is asked.

Research Question

RQ1: What are the key findings that emerged from the literature on how the functions of virtual reality influences education in higher education?

Research Objective

The findings of this research will bring to light key functions of virtual reality in higher education as it relates to virtual reality application domains, inclusive learning, impacts, and use cases that influences teaching and learning in higher education. The goal of this research will take into consideration some of the elements that contribute to the effective implementation of virtual reality in a manner that ties in with the research's key findings for continuous improvements in how virtual reality can broaden instructional outreach in higher education.

Review of the Literature

Application Domains of Virtual Reality

The rise of technological advancements in this modern world has sparked many virtual reality use cases in the higher education space to boast teaching and learning experiences for the higher education population. Scholars' gravitation towards virtual reality is propelled by the immersive and visualization experience despite virtual reality not being new (Radianti et al., 2020). The disconnect of reality into total immersion in a virtualized environment brings into perspective a series of actions that can be conducted in the virtualized environment depending on the associated accessories making interactions possible (Radianti et al., 2020). According to stated facts about virtual reality, adopting virtual reality can be hindered by certain barriers (Radianti et al., 2020). The barriers can be associated with the cost, prolonged use's side effects, and isolation (Renner et al., 2020, as cited in McCarthy & Richter, 2019). The demographics on virtual reality usage collected by Statista gave an insight of two major age groups that owned virtual reality with an outstanding percentage ratio among those virtual reality owners' presents a broader understanding of the likelihood of virtual reality usage and its application in higher education (Renner et al., 2020, as cited in Clement, 2021).

The central focus of attention on the capabilities of virtual reality has yielded a comprehensive virtual reality mapping of educational applications (Radianti et al., 2020, as cited in Jensen & Konradsen, 2018; Merchant et al., 2014). The outcome of experiences in learning is analyzed to see any element of patterns in the virtual reality domain application sorted to reveal specific teaching approaches (Radianti et al., 2020). The benefit of virtual reality in the educational atmosphere has presented an opportunity to provide immersive and interactive modes of instructional approaches to traditional ways of teaching. Despite

these benefits, cost still makes it difficult for higher education institutions to purchase due to budget constraints (Santos & Peslak, 2022). Research conducted with a focus on education has shown how skills development has risen to the top because of immersive and interactive learning through virtual reality (Santos & Peslak, 2022). Despite the many obstacles shown in related work on virtual reality's impact on education, its projected growth, adoption, and applications continue to be an area where a clear distinction will need to be observed to weigh its advantages and disadvantages.

Use Cases of Virtual Reality

The initial release of virtual reality was marketed for the gaming industry which slowly gained traction in different areas and sectors of varying fields. Among these included training, teaching, learning and simulations in the education sector (Hamad & Jia, 2022). Daily use cases vary greatly and with the expansion on virtual reality technology, more of its strengths will continue to focus on developing a deep understanding. The definition of virtual reality as indicated by Hamad and Jia (2020), points to a generated environment in a three-dimensional look where users can conduct interactions. Projections of these environments allows for simulations in flight schools which mimic real live events when flying an aircraft. Aircraft can be in many shapes and sizes and the use of virtual reality opens the door to use a single interface through different simulation scenarios for those who wish to learn how to fly or to those who want to have an experience built on real-life activity without the associated cost of using an actual airplane (Hamad & Jia, 2022).

The research analysis results based on the mode of learning by Hamad & Jia (2022) are challenged by the idea that, variables surrounding media effect are directed towards virtual reality on a motivational basis but not for knowledge gained in a declarative basis (Meyer et al., 2019). This assertion from this research focused on different interaction methods as it is related to media. Drawing parallels on this evidence investigated the redundancy of effect on media interaction in an immersive virtual reality when those principles were compared (Meyer et al., 2019). Meyer et al. (2019) further suggest the hindrance to learning because of the rich virtual reality environment sensors leading to cognitive load (Makransky et al., 2019b; Richards & Taylor, 2015).

Addressing the challenges of student attention in classrooms and raising the level of engagement for topics that students deem irrelevant, employing technology such as virtual reality in some teaching modes piques the interest of students (Hamad & Jia, 2022, as cited by Christopoulos et al., 2018; Radianti et al., 2020). In addition to this, distractions are minimized when in a virtual reality environment and creates a great opportunity for students to focus on study materials and to allow teachers to create a platform for one-on-one interactions with students to help build student-teacher relationship (Hamad & Jia, 2022 as cited by Gadelha, 2018). Virtual reality extension is based on mixed reality where laboratory experiment instructions are made available for students to interact and then recreate those experiments in virtual reality (Hamad & Jia, 2022).

The study and exploration of complex subjects in a non-traditional way to build on characteristics of virtual reality and its applicable use function to aid in learning outcomes far supersedes the regular mode of instructional technology (Hamilton et al., 2020). This provides an opportunity to build on experiential cognitive skills in learning with simulated environments that would be very hard to have present in the real world. As an extension of this, collaboration becomes a big area of interest where people from around the world can meet without having to be in the same location but in a virtual reality world (Hamilton et al., 2020). This is an area that is beginning to pick up and will slowly grow as technology changes and demand for those types of technology increases.

Impact of Virtual Reality

Research has constantly shown the impact that virtual reality exhibits in varying aspects

of its usability. Flavián et al. (2019) introduce the notion of how people have changed the way they experience virtual and reality. This forms the core experience for the basis of building mediated technology platforms that combines the mentioned experience. Collaboration among higher education professors dispersed in different locations has fostered the use of cost-effective virtual workspaces to create impactful research findings in higher education (Godin & Pridmore, 2019). Despite the positive impact of these virtual reality experiences, Godin & Pridmore (2019) further point out how many use cases have failed right from the onset of the virtual reality usage. The perceptions created on virtual reality identify the major influences on the use of virtual reality in collaborative situations to try to justify how that would enhance the global workplace team experience (Godin & Pridmore, 2019). One area of impact posed by virtual reality is the side effect of simulation sickness after prolonged stay in a virtual reality environment that could interfere with the learning experience (Meyer et al., 2019). It is no secret how outcomes of learning are higher in virtual reality produced games but the increase in attaining educational goals is also achieved through virtual reality simulations due to the high participation of higher education in research-related activities involving some form of human-computer interactions for virtual reality (Hamilton et al., 2020).

Inclusive Learning

Inclusive learning incorporates areas of alternative approaches to traditional ways of learning where individuals with learning disabilities which are because of developmental and intellectual issues without any control of the situation. These can typically extend to social skills as well (Almuaqel, 2023). The limitations resulted plays a significant role in regular progress that can be made in an educational environment. Learning disabilities is not a new topic in society today. Considering the concerns from the population affected by it, providing avenues for such demographics is a great way of achieving inclusive learning. Higher education administrators dedicate resources to help focus on enabling learning for the student population with developmental and intellectual disabilities (Almuaqel, 2023). The dedication of research towards inclusive learning has suggested and enables many inclusive ways of approaching and addressing these functional issues and concerns for the identified groups of people that fall into those respective categories. Digital space like the metaverse shows a promising future in aiding in building social interactions in aspects of student inclusive learning (Dhillon, P.K.S., & Tinmaz, H., 2024). The advancement in digital transformation with technology comes virtual reality. This has been a resource heavily utilized to help address some of the developmental and intellectual disabilities issues that have being raised for including those students to better create and provide an experience comparable to the regular education experience that they would ordinarily not have exposure to. There is no doubt how technologies in the digital space have improved and benefited the sharing of information, teaching, and learning for such individuals (Almuaqel, 2023). The contribution of research in suggesting inclusive learning strategies to help bridge the gap for students with disabilities who have difficulties in attending class sessions due to certain limitations, virtual reality has offered a way to take teaching lessons far and wide.

In the research conducted by Almuaqel (2023), it points out how virtual reality can help people with attention-deficit/hyperactivity disorder process things based on findings conducted by other researchers in inclusive learning spaces. In the same journal written by Almuaqel (2023), the need to raise awareness of inclusive learning for individuals with cognitive issues and the use of virtual reality tools to accomplish such awareness will be an effective approach to create a basic understanding of such needs for those who will benefit from it (Almuaqel, 2023). The effectiveness of virtual reality in inclusive learning opportunities has a lasting impact on education. The gaps in previous findings in relation to strengthening the use of virtual reality indicates inclusive learning is a pivotal point for researchers in consolidating what is already known about inclusive learning with virtual reality (Almuaqel, 2023). The number of studies focused on young adults and adolescents with disabilities was fourteen which is 25%. Based on that percentage, nine of the studies representing 64% examined aspects of virtual reality and how it can

help with learning for young adults and adolescents with disabilities (Almuaqel, 2023). Individual preferences on how virtual environments are setup plays a vital role in making users comfortable in those environments. In addition to the resources made available to ease with virtual reality transitions to minimize significant side effects of prolonged use, compelling evidence has been provided through studies on ways to train personnel in school to better provide the necessary support to students who need accommodations (Almuaqel, 2023). This has been an integral part of many academic institutions where students can seek assistance when accommodations are needed.

Thoughts on inclusive learning viewed from different perspectives when presented, has demonstrated the benefits it can add to the success of research in human-computer interaction. To better understand the needs of users who need assistance to enable them to excel with their peers in the classroom and join in on conversations pertinent to assigned project tasks, so they feel included and not neglected. This in essence help form a community of support. Virtual reality on the other hand introduces different approaches to social skills which have been tested through research on how social interventions can be initiated where the need arises (Almuaqel, 2023).

Methodology

Approach

This research utilized 25 selected reviews of literature from peer-reviewed journal articles on the topic of virtual reality in different application scenarios and use cases along with the security implications and considerations on its impacts in higher education using thematic analysis. Thematic analysis approach to this research identifies patterns in the data collected from peer-reviewed selected articles to set a clear insight and understanding of patterns based on a six-stage theme analysis technique (Naeem et al., 2023 as cited by Boyatzis, 1998; Elliott, 2018; Thomas, 2006). Key search terms such as " virtual reality", "virtual reality challenges", "virtual reality inclusiveness" and "virtual reality impact" were used. The selected articles also incorporated the influence of virtual reality in higher education. The articles identified and selected were reviewed and analyzed by employing narrative review. The strategy for using narrative review was to help gain in depth knowledge and understanding on the key roles virtual reality has and the different shift in perspectives from past, present, and future research through thematic analysis. Achieving this research goal entailed using a tool called Delve to perform thematic analysis by organizing the identified selected journal articles once it has been imported considering only relevant excerpts from the articles. The list of articles was obtained using Google Scholar and GALILEO with the predefined search terms to generate a theme. Validity of the research was accomplished through the credibility of the peer reviewed journal platform and careful review of each journal for relevance and the scope of details presented in the research. The significance of this research extended beyond normal virtual reality usage and shared a deep dive into some neglected areas of student development in higher education (Almuaqel, 2023).

Analysis

Thematic analysis complemented with narrative review served as the key focus of analysis based on the methodical approach identified utilizing the key search terms with an emphasis on relevance to the core purpose of study and research question. The narrative review aspect of the analysis encompassing 25 identified peer-reviewed journals was based on relevant excerpts from the journal articles to develop a conceptual model in describing the key themes (Macapagal & Tablarin, 2021). The relationship between each journal article's contributed voice on the topic of virtual reality and its impacts in higher education were isolated and grouped based on the significance of enhancing education to help correlate common themes. Table 1 shows correlated themes from the literature reviews analyzed for this research that references the contributions made by the author(s) that relates to the purpose of study for this research. The themes that emerged depicted the quality of education through adaptation of virtual reality and its implications to develop a conceptual pathway in the theme groupings.

Table 1: Theme, Author(s) and Key Articles Main Contributions

Theme	Year	Authors	Main Contribution
1	2019	Matias N. Selzer, Nicolas F. Gazcon, Martin L. Larrea	Effects of virtual presence and learning outcome using low-end virtual reality systems
1	2020	Julian Hirt, Thomas Beer	Use and impact of virtual reality simulation in dementia care education: A scoping review
1	2020	Jaziar Radianti, Tim A. Majchrzak, Jennifer Fromm, Isabell Wohlgenannt	A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda
1	2017	Matt C. Howard	A meta-analysis and systematic literature review of virtual reality rehabilitation programs
1	2020	Nouf Matar Alzahrani	Augmented Reality: A Systematic Review of Its Benefits and Challenges in E-learning Contexts
1	2020	Mariana-Daniela González-Zamar, Emilio Abad-Segura	Implications of Virtual Reality in Arts Education: Research Analysis in the Context of Higher Education
1	2020	Euan Bonner, Ryan Lege	Virtual reality in education: The promise, progress, and challenge
1	2021	Igor Cicek, Andrija Bernik, Igor Tomicic	Student Thoughts on Virtual Reality in Higher Education-A Survey Questionnaire
1	2021	Shaista Rashid, Amira Khattak, Murtaza Ashiq, Shafiq Ur Rehman, Muhammad Rashid Rasool	Educational Landscape of Virtual Reality in Higher Education: Bibliometric Evidences of Publishing Patterns and Emerging Trends
1	2018	Ronak Dipakkumar Gandhi, Dipam S. Patel	Virtual Reality – Opportunities and Challenges
2	2019	Marie-Stéphanie Bracq, Estelle Michinov, Bruno Arnaldi, Benoît Caillaud, Bernard Gibaud, Valérie Gouranton, Pierre Jannin	Learning procedural skills with a virtual reality simulator: An acceptability study
2	2019	Guido Makransky, Thomas S. Terkildsen, Richard E. Mayer	Adding immersive virtual reality to a science lab simulation causes more presence but less learning
2	2020	Gareth W. Young, Sam Stehle, Burcin Yazgi Walsh, Egess Tiri	Exploring Virtual Reality in the Higher Education Classroom: Using VR to Build Knowledge and Understanding
2	2019	Christian P Fabrisa, Joseph A. Rathnera, Angelina Y. Fonga, and Charles P. Sevigny	Virtual Reality in Higher Education
2	2020	Nikolaos Pellas , Andreas Dengel, and Athanasios Christopoulos	A Scoping Review of Immersive Virtual Reality in STEM Education

2	2021	Stylianos Mystakidis, Eleni Berki, Juri-Petri Valtanen	Deep and Meaningful E-Learning with Social Virtual Reality Environments in Higher Education: A Systematic Literature Review
2	2020	Krisjanis Nesenbergs, Valters Abolins , Juris Ormanis, Artis Mednis	Use of Augmented and Virtual Reality in Remote Higher Education: A Systematic Umbrella Review
2	2021	Benjy Marks, Jacqueline Thomas	Adoption of virtual reality technology in higher education: An evaluation of five teaching semesters in a purpose-designed laboratory
2	2019	David Checa, Andres Bustillo	A review of immersive virtual reality serious games to enhance learning and training
3	2020	Androniki Ioannou, Evridiki Papastavrou, Marios N. Avraamides, Andreas Charalambous	Virtual Reality and Symptoms Management of Anxiety, Depression, Fatigue, and Pain: A Systematic Review
3	2013	Maryam Vafadar	Virtual Reality: Opportunities and Challenges
3		Alexandra D. Kaplan, Jessica Cruit, Mica Endsley, Suzanne M. Beers, Ben D. Sawyer, P. A. Hancock	The Effects of Virtual Reality, Augmented Reality, and Mixed Reality as Training Enhancement Methods: A Meta-Analysis
3	2022	Nannan Xi1, Juan Chen, Filipe Gama1, Marc Riar, Juho Hamari	The challenges of entering the metaverse: An experiment on the effect of extended reality on workload
3	2020	Paul M. G. Emmelkamp, Katharina Meyerbröker, Nexhmedin Morina	Virtual Reality Therapy in Social Anxiety Disorder
3	2020	Eunhee Chang, Hyun Taek Kim, Byounghyun Yoo	Virtual Reality Sickness: A Review of Causes and Measurements

Results

Throughout the review of the selected articles, it became very evident the significance of virtual reality as a whole and the impacts associated with the adoption of virtual reality in higher education. Three key themes were identified based on the analysis conducted which placed a central focus on insights and a better understanding for the impacts of virtual reality in higher education. The three themes that emerged were: (1) Quality experiential learning, (2) virtual reality adaption and (3) virtual reality implications. Student experience in higher education is one of the key areas of maintaining and increasing student retention. The integration of virtual reality adds an alternate mode of instruction through a transformative approach to acceptability and usage of immersive technology. The exposure of incorporating innovative ways of skills building and training, distinguishes one higher education from the other through outcomes strategically integrated to improve on student learning experience. In essence, providing multiple avenues to reach the same goal without the need to change current instructional methods.

The adaptation of virtual reality in higher education creates opportunities for interactive learning environments through real world danger simulations to boost student engagement while also contributing to cost savings for physical structures that supports traditional mode of in-person teaching and learning. The flexibility of virtual reality adds to resource allocation which bridges the gap in how students access and interact through experiential environments and spaces uniquely identified and setup to meet specific student needs. Throughout the analysis for existing research on virtual reality, the level of student engagement peaked in higher education environment with virtual reality compared to environments with no virtual reality. A big piece of the engagement was attributed to curiosity of the capabilities of virtual reality in ways that can easily integrate with existing technology infrastructure. The use of digital accessibility platform to create an immersive experience to boost inclusive learning to help build on student confidence level through skills building and training without the need to physically be present to accomplish those goals become very clear/

Considering all the benefits of virtual reality, a big piece of virtual reality are the challenges associated with the adaption, training and what can be done to address key challenges with virtual reality cost and health concerns. These concerns were considered to make it clear areas of virtual reality that needs to improve to reduce the risk of cognitive issues due to prolonged use.

Discussion and Conclusion

The goal of this study was to determine the key findings on the functions and influence of virtual reality in higher education. The research indicated the various aspects of virtual reality on its impacts as an alternative mode of instruction to help reach a wider higher education demographics through immersive experiences. The findings do suggest that adopting and integrating virtual reality impacts student experience in a way that brings computing resources closer and available to students regardless of location. This trajectory also increases student engagement in a positive way. Even though the challenges faced by higher education because of adopting virtual reality, those challenges do not deter institutions from adopting virtual reality technology. Based on the findings for this research, virtual reality has a lot of potential in many use-cases but will not replace existing strategies for teaching and learning (Bracq et al., 2019) but rather an extension of what already exists.

Depending on the established educational outcomes, strategizing on effective ways to offer trainings relevant and applicable to higher education constituents builds a level of trust and accountability despite budgetary constraints, can significantly have a long-lasting effect on immersive experience. Adaption of any new technology can face resistance but realizing the value virtual reality adds to higher education experience as seen in this research findings makes a solid case why creating avenues for customized learning experiences transforms e-learning opportunities but will rely on effective training and use of virtual reality in a well-integrated immersive environment (Alzahrani, 2020).

In future research, analyzing how virtual reality is used by different higher education institutions will allow for different use-case contexts in the areas where virtual reality is underutilized. The limitation of this study was determining how virtual reality can scale across multiple higher education departments at the same time. Overcoming this type of limitation can help zoom in on issues relating to virtual reality integrations and how smooth integration and successful training on effective use can be achieved.

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