THE IMPACT OF VIRTUAL LEARNING ENVIRONMENTS ON THE DIGITALIZATION OF HIGHER EDUCATION IN THE KURDISTAN REGION-IRAQ

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ABSTRACT:

Virtual Learning Environments (VLEs) are open space that allows teachers and students to share resources and interact among learners. Implementing VLE such as Virtual/Augmented Reality and Online Laboratories in higher education systems are become positively valued in educational environments by providing huge applications and experimentations to science and engineering students for increasing their skills by conducting authentic investigations of the physical world through overlaying visual components over physical things and conducting real experiments via the Internet 24/7. Those innovations have enhanced students' enthusiasm and assisted them in developing more vita investigative abilities. Therefore, VLEs applications are becoming necessary to include in the higher education system in Kurdistan Region-Iraq now to allow educators and students and know more about the potential benefits of VLEs in higher education.

For that, this paper shows the status of the Higher Education System and universities in Kurdistan Region-Iraq and how the widely modern technologies (e.g. Online Laboratories and VR/AR Technology) can impact educational approaches to enhance and modernize the quality of Higher Education in the Kurdistan Region-Iraq, digitalization Education system, and elements that can be impacted.

KEYWORDS: Higher Education System, Digital Transformation, VLEs, Online Laboratories, VR/AR Technology.

1. INTRODUCTION

Education and knowledge transfer are the basis for a thriving society and civilization. Researchers are constantly looking for new methods and technologies to transfer knowledge easily, quickly, and effectively to students and change the education from traditional to the era of digitalization to have better learning opportunities. Needless to say, it has become the core focus for them. Virtual Learning Environments (VLEs) can be a natural coming step for the evolution of current education.

Nowadays, VLEs are become widely used to enhance student learning and engagement (Boulton et al., 2018). They have transformed the way of educational content by creating a virtual world (imaging or simulating), and remote access to equipment and interaction with materials for providing students with the ability to access high-quality education and training (Ossiannilsson et al., 2016). These environments can help students explore their topic and subject by living with them, putting things together, and feeling engaged in a way that is remarkable in this environment. Meanwhile, many studies proved the benefits of VLEs in secondary education curriculum design by providing a foundation and skills to students for future engagement in knowledge-based design industries (Noel & Liub, 2017).

More specially, Online Laboratories and VR/AR educational applications support various subjects of university curricula, such as History, geography, Natural Sciences, Medical, engineering, architecture, etc (Niu et al., 2021; Prezhdarova & Pastarmadzhieva, 2020). Hence, using these applications in education can enhance the quality of the Higher Education System and cultivate students' creativity and critical thinking, especially in Kurdistan Region-Iraq.

Thus, this paper is initiated with the following questions:

- *Q1*: Why Higher Education System in Kurdistan Region-Iraq is still not well-improved the quality of education regarding the global stander?

- *Q2*: How to improve the learning process and digitalization education quality based on Online Laboratories and VR/AR.
- *Q3*: What are the benefits of engaging Virtual Learning Environments (VLEs) and digitalization in Education?

Based on these questions, the paper aims to study the situation of Higher Education in the Kurdistan Region, and provide several details of Online Laboratories and VR/AR Technology in terms of including applications used in STEM education. Then, show the benefits of adapting these two technologies in the higher education system.

The rest of this paper is organized as follows. Section 2 shows the methodology of work. Section 3 concentrates on the higher education system of the Kurdistan Region-Iraq and environmental education. Section 4 introduces Virtual Learning Environments and benefits and focuses on particular Online Laboratories and VR/AR technologies impacting STEM education. Section 5 summarizes the findings and provides a brief discussion concerning the using Online Laboratories and VR/AR technologies in higher education in Kurdistan Region-Iraq. Finally, the conclusion and recommendation are show in Section 6.

2. METHODOLOGY

As shown in Figure 1, the methodology of this work is based on the Descriptive Research Method to identify the status of Higher Education universities in Kurdistan Region-Iraq. Analytical, research attempts to establish why it is that way or how it came to be, and how to support the Higher education system to enhance education.

In this study, using descriptive research design is aimed at casting light on current issues or problems of Higher Education Universities in this region through and identifying the current state of universities' performance-based Quacquarelli Symonds

(QS)[1], Times Higher Education (THE)[2], and some reports that enable to a description of the situation thoroughly.

In its essence, descriptive research has mentioned one variable required to higher education, which digitalization Higher Education system, to explain the research findings. The main advantage of this method is that it effectively analyse non-quantified topics and issues and provides an answer to the research topic (Dudovskiy, 2021).
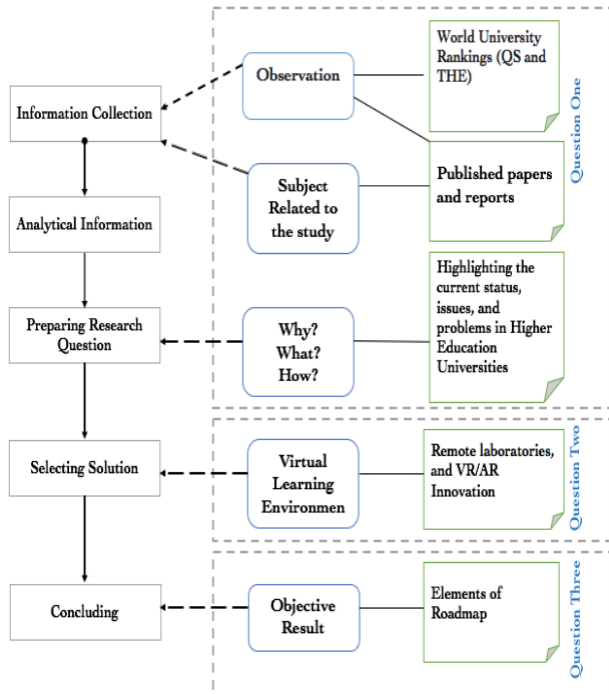

Figure 1. Methodology Research based on Descriptive Research Method

The collecting information phase for observing the state of higher education in the Kurdistan region has been checked by two main annual publications of World University Rankings, which are Quacquarelli Symonds (QS) and Times Higher Education (THE). These two impact rankings can provide trusted performance data on universities around the world. More information has been collected through some published papers as well. later on, it is highlighted some points regarding the current education system. This step has aided to confirm the first research question of this paper. The second phase can provide the impact of VLEs in education, and highlight how Online labs and VR/AR technology can help digitalization education. It is can provide the answer of second research question. The third phase is to provide the enhanced roadmap and adoption VLEs with the most important effects on the education system in Kurdistan Region-Iraq, which is provide the answer of third question.

3. HIGHER EDUCATION LANDSCAPE IN KURDISTAN REGION-IRAQ

Currently, more than100,000 students are enrolled at universities and Institutes in Kurdistan Region-Iraq in 16 Public Universities, 19 Private Universities, and 14 Private Institutes[3]. The vast majority of students attend public universities that are not charged tuition. Most of the universities and institutes in this region are new and nearly less than two decades old. Overall, significant studies include STEM fields such as Chemistry, Biochemistry, Biology, Microbiology, Petroleum and Gas Engineering, Electrical engineering, Computer Science,

Medicine, etc., next to humanity and arts fields. Due to the Region's stability, the universities are always drawing higher-level professors from other historically prestigious universities inside Iraq and abroad. In accordance with this strategy, the universities are provided with a boost in competitiveness and further stress on the capacity of the Region's higher education system (REGION, 2013).

The key point is that Kurdistan's universities still have the main challenge in order to enhance the education system and develop the curriculum. Another challenge is the enrollment numbers of students compared with capacity of each university, especially in STEM fields. The last challenge is that the education system is operated within a centralized system. Nevertheless, it should be concluded say that the Ministry of Higher education in the Kurdistan Region has always continued to reform and reshape the higher education system, especially the decentralization of universities is considered the most important one (REGION, 2013).

In sum, it seems that the Kurdistan Region of Iraq always focuses on the higher education sector by advancing from a traditional model of teaching methods to a Western-style that emphasizes critical thinking, focuses on curriculum reform, increases autonomy for universities and technical institutions, extends professional development programs, and the promotion of research (KRI, 2020). These points are considered critical positives regarding improving higher education in the region. On the other hand, more continuations are still needed by integrating technologies into the higher education system to achieve these goals.

Besides, though the higher education system in the Kurdistan region case has expanded rapidly in the last two decades it has been seen and explored that the quality of the education system in universities is still limited and out of range (Atrushi & Woodfield, 2018). This is especially true when looking at the annual publications for World University Rankings globally such as Quacquarelli Symonds (QS) and Times Higher Education (THE). Simply, it is important to understand why it is required to improve the quality of education in the Kurdistan Region-Iraq. Hence, the initiated point is that Higher Education System in Kurdistan Region-Iraq must improve the quality of education well regarding the global standard.

4. VIRTUAL LEARNING ENVIRONMENTS IN HIGHER EDUCATION

Several researchers have introduced Virtual Learning Environments (VLEs) idea as a new teaching method in learning (Wartenberg et al., 1998) and experimental methods (Slatora et al., 1999).

A few years ago, the main challenge in VLEs was developing educational tools and methods in education, and delivering the principles and teaching the material to students in a meaningful way (Slatora et al., 1999). Today, VLEs online learning and teaching systems (e.g. LMS and MOOC, Online laboratories and VR/AR) have been increasingly used in many universities around the world. The objective of using such technologies is to offer significant benefits to education in STEM fields. This has been highly increased during the covid-19 pandemic.

In 2011, a critical review paper pointed out the impact of VLEs (Mikropoulos & Natsis, 2011). The paper showed the positive value of VR integrated into VLEs on users' attitudes and learning outcomes.

Therefore, in a nutshell, it can say that VLEs are online learning and teaching environments that allow educators to replace the educational processes from traditional to the Internet, or support the current educational processes. The core functionality of VLEs

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[1] https://www.topuniversities.com/university-rankings
[2] https://www.timeshighereducation.com/content/world-university-rankings

[3] https://gov.krd/mohe-en/publications/universities/

is (Puzhevich, 2020) planning and management of lessons and activities, accessing digital learning materials, group discussions with a teacher, submitting homework, tracking students' performance and sending grading, etc. Furthermore, several benefits of VLEs implementation in higher education are flexibility, accessibility, affordability, management, and engagement.

Therefore, it can be mentioned that VLEs can be a friendly environment for students. Thereby, mixing different technologies into the higher education system in Kurdistan Region-Iraq can help the current educational roadmap enhance education.

4.1 Online Laboratories Impact on Education

Online Laboratories bringing interactive practical to engineering and science students from separate geographical locations via the internet, including real data in remote labs.

Nowadays, with the increasing number of students in engineering and science, laboratory experiences have to be available for them (Frerich et al., 2014). Online Laboratories are innovative and support tools used for improving students' practical skills, not a substitute for hands-on laboratories (Heradioa et al., 2016; Tawfik et al., 2011), and proper support for practical aspects of the teaching and learning process in education (Heradioa et al., 2016; Wuttke et al., 2005).

Online Laboratories can be categorized as Remote and Virtual Laboratories (Brinson, 2015). A Remote Laboratory is an experiment that is set up in another laboratory (Real components) for students to access physical equipment through the Internet at any time and any place (Salah et al., 2014; Jong et al., 2014). A Virtual Laboratory is a simulated lab environment typically implemented as a software program that allows the students to perform their experiments. Both of them can be available 24/7 from anywhere. The architecture of Online Laboratories is shown in Figure 2.
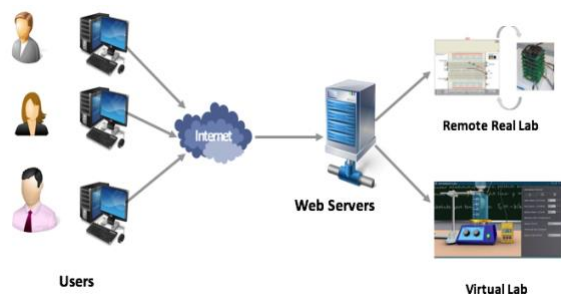

Figure 2. The Architecture of Online (Remote and Virtual) Laboratories

4.1.1 Using Online Laboratories Platforms for STEM Education

The material of the available experiments are free as in VISIR System. Currently, many high-quality Online Laboratories and interactive learning courses have been integrated with LMS platforms. Open educational resources and learning environments have been changed rapidly during the last two decades in Engineering, Medicine and Health Sciences, Physical Sciences and Mathematics, Life Sciences, etc. They have become widely available for universities and institutes worldwide (Jong et al., 2014).

In some cases, the required equipment, space, and maintenance staff for implementing new hands-on labs can be high-costed. Therefore, Virtual and Remote Laboratories can reduce the costs of hands-on required and provide many other benefits such as Availability, Accessibility, and Safety to students. Some

challenges of using Online Laboratories are usefulness, immersion, and usability (Heradioa et al., 2016).

During the last decade, many online access laboratories have been developed by higher education institutions on different topics (Orduña et al., 2012; Monzo et al., 2021). For example:

– iLab[4]: These remote laboratories aim to share real expensive equipment and educational materials among university students and broadly in science and engineering education.

– Labshare[5]: It is a cloud-based Laboratory for lab resource management and utilization that the Australian government has funded to create a national network of remote laboratories.

– Lila[6]: It aims to exchange and access to set of Online (Virtual and Real) laboratories between institutions. Supporting this, it provides resources for integrating remote and virtual experiments into sciences and engineering curricula.

– OpenLabs[7]: It is open-source software for distributed Online Laboratories, known as Virtual Instrument Systems in Reality (VISIR). Currently, more than 15 nodes have been initiated around the world (García-Loro, et al., 2021). In 2015, it was selected among the best remote labs and successful cases of a remote Electronics Laboratory around the world (Salah et al., 2015a; Salah, 2015b).

– WebLab-Deusto[8]: It includes several remote laboratories to aim the increase experiential learning. There is currently a LabsLand[9], a spin-off of the WebLab-Deusto project, and it provides a repository of connected remote laboratories from different institutions.

– Go-Lab[10]: It aims to facilitate innovative learning technologies in STEM education, with a particular focus on various Online Laboratories and inquiry learning applications (Apps). It is a free platform that any teachers from anywhere can used. It is designed to meet the needs of educators in higher education, institutes, and schools.

– RExLab[11]: It aims to meet the practical need in science and technology and pursue initiatives that integrate science education into the educational process by promoting the improvement of education in all interdisciplinary areas.

– Vlabs [12](Virtual Labs): It aims to provide remote access to simulation-based Labs in various disciplines of Science and Engineering and enthuse students to conduct experiments by arousing their curiosity.

4.2 VR/AR Impact on Education

VR/AR is a rapidly growing innovation that can add higher quality to the educational system, a strong influence on education and training in higher education. The Virtuality continuum was presented by Milgram & Kishino (1994), as shown in Figure 3. It can create new learning opportunities, strategies, and methods (Niu et al., 2021) in education. According to Dabbagh (2003) the learning effect relies on modes, learning methods, and teaching tools in education. Thus, VR/AR can be regarded as a good teaching tool for delivering education, as well as interactive learning features provided by VR/AR can enhance a learner's creativity (Fowler, 2015; Cai et al., 2019) and engagement in VLEs (Barari et al., 2020).

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[4] http://icampus.mit.edu/projects/ilabs/
[5] www.labshare.edu.au/project
[6] https://www.lila-project.org
[7] http://openlabs.bth.se/
[8] https://weblab.deusto.es/website/

[9] https://labsland.com/en
[10] https://www.golabz.eu/
[11] https://rexlab.ufsc.br/
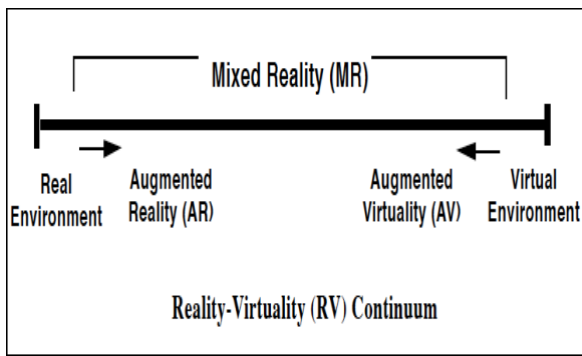[12] https://www.vlab.co.in/

Figure 3. Simplified representation of a "virtuality continuum" (Milgram and Kishino, 1994)

Krokos et al. (2019) mentioned that using VR/AR for practice allows students to apply their knowledge better. While other researchers (Barari et al., 2020) pointed out the possibility of accessing the learning objectives and teaching approaches at levels in Bloom's taxonomy using VR/AR.

Similarly, in 2018 Jensen and Konradsen systematically reviewed several papers to show the advantage of VR technology in STEM education. They concluded that the VR technology could provide an effective way to improve new perception technology to enhance students' learning motivation in STEM fields by enabling students to interact with 3D objects for making, which is also shown by Maheshwari & Maheshwari (2020).

Zhang et al. (2020) said that VR technology could be a teaching tool for promoting students' learning of physics concepts that are difficult to understand (Sulaiman et al., 2020). So that, VR/AR can provide a higher level of knowledge (Sulaiman et al., 2020), and improve the students' enthusiasm for the STEM courses (Bogusevschi et al., 2020).

Thus, Virtual Reality (VR) can provide an indirect experience in a virtual space by interacting with the human sensory systems and overcoming spatial and physical constraints of the real world. It can be categorized into expression technology for stimulating human sensory systems, and interaction technology for interfacing reality with VR (Papanastasiou et al., 2019; Osipova et al., 2019). Augmented Reality (AR), on the other hand, is an interactive experience of a real-world environment that adds objects generated by computers in the real world (Osipova et al., 2019), as shown in Figure 4.

Figure 4. Virtual and Augmented Reality Architecture

Furthermore, Osipova et al., (2019) have shown a learning system model using VR/AR. This model includes forms adapted for distance learning (see Figure 5).
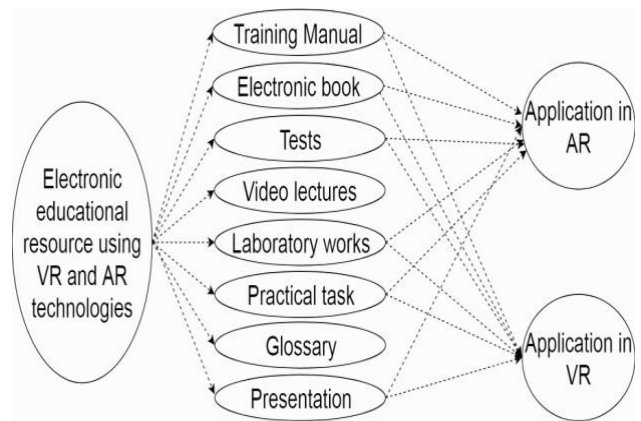

Figure 5. Model of a Learning System Using VR/AR (Osipova et al., 2019)

4.2.1 Using VR/AR Applications for STEM Education

Currently, Virtual and Augmented Reality (VR/AR) are the strongest trends in the education system. Their approach is to display the representation of the virtual 3D-model education laboratory to provide a practical and motivating way of teaching students (Trentsios et al., 2020).

Integrating VR/AR in STEM education can improve teaching methods worldwide. They allow the teacher to explain the material effectively to students, develop creative thinking and increase study motivation (Osipova et al., 2019). Several benefits of using AR/VR applications in STEM studying can be listed such as inspiring students' creativity and sparking their imaginations, helping students to understand better concepts, effective transfer of information, and improving student outcomes (irusu, 2022; Smith, 2021).

There is no doubt, VR/AR applications have been placed in education widely. Their applications have revolutionized by enabling students to learn in an immersive and experiential way by transforming the learning and teaching from traditional to in-depth knowledge for understanding subjects easily (Thompson, 2020). The benefit of using VR/AR in higher education is enhancing learning and soft skills, helping to promote distance learning, improving collaboration between teachers and students, and training students. Furthermore, VR/AR labs are an important step in higher education for encouraging content development (Thompson, 2020), as in VR First global program (VRFirst, 2021).

More examples of VR/AR applications can be listed in different fields: Giza Project[13], SkyView[14], Froggipedia[15], Mondly[16], INSIGHT HEART[17], Franklin's Lab[18]. More examples can be found in (Osadchyi et al., 2021).

5. RESULTS AND DISCUSSION

Adopting Virtual Learning Environments (VLEs) for education can provide a more advanced learning style, unlike in traditional education. They are applicable in all education levels pre-school education, elementary schools, secondary schools, and vocational training, not only higher education.

Online Laboratories and VR/AR have experienced a vast technological revolution now. They have become vastly accessible and powerful using headsets, mobile, and tablets. Additionally, 5G cellphones have helped them to become more accessible to the virtual realm from anywhere. They are also expanding the potential for students in terms of enhanced learning opportunities and laboratory experiences.

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[13] http://giza.fas.harvard.edu/
[14] https://apps.apple.com/us/app/skyview-lite/id413936865
[15] https://apps.apple.com/us/app/froggipedia/id1348306157

[16] https://www.mondly.com/
[17] https://vimeo.com/190273764
[18] https://zspace.com/edu/info/zspace-franklins-lab

Currently, higher education in the Kurdistan Region still needs reforming and advancing its learning style. Hamarash (2013) showed the Roadmap of Reform the education quality in the Kurdistan Region, which included the six aspects of Reforming higher education: Teaching, Research, Investment, Organizational Independence, Administration, Human Rights, as illustrated in Figure 6.
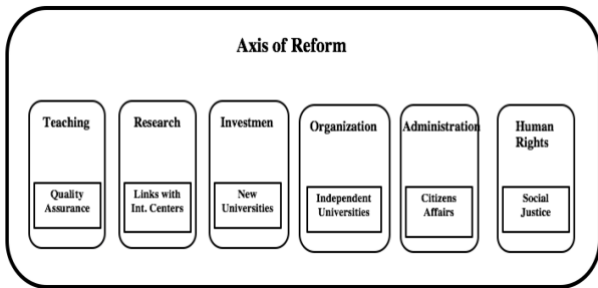

Figure 6. The Reform Roadmap of Higher education in Kurdistan Region Presented by Hamarash (2013).

Missed part in the roadmap includes adaptation of modern technologies in education. So, it is recommended to reshape and rapid reform again by including one more aspect; "Investing in Implementing VLEs, for example Online labs and VR/AR technology, as shown in Figure 7. Hence, adopting technologies in the Higher education system may help reshape and reform Kurdistan Region universities and improve the quality of education regarding the global stander in the coming days. The proposed research questions (Q1) has been answered by achieving steps. Therefore, digital transformation of higher education in the Kurdistan Region can include:

- Transformation in a Campus environment
- Transformation in a Learning Methods
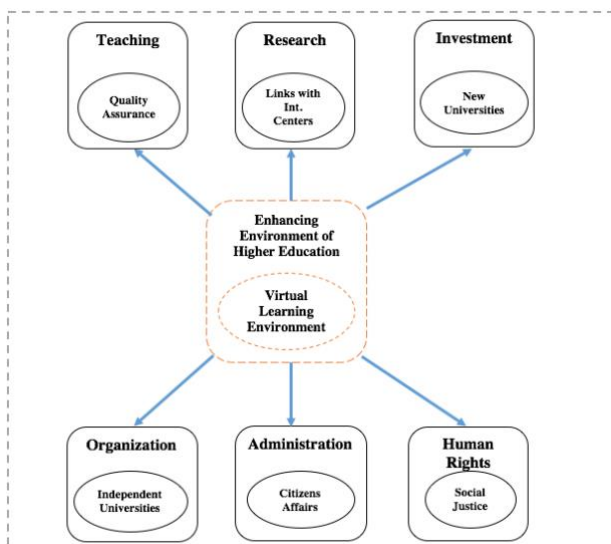- Transformation in a Teaching Methods

Figure 7. Central Elements of Roadmap in Kurdistan Higher Education by Including Digital Transformation Environment that based on Virtual Learning Environments (VLEs)

The impact of implementing VLEs in education system can provide the learning experience, communicate the intended learning experience, facilitate learners' involvement in the experience, and access knowledge anytime and anywhere, so on.
- Teaching Quality: Allows teachers to share educational materials with their students via the Internet.

- International Collaboration: Highly structured collaborative grouping activities and establish communication with other research centers abroad. This can largely support true collaboration through discussions and sharing of new information with international researchers.
- Universities Investment: Support new universities that have been early established and facing some lack of devices for learning.
- Independent: VLEs can highly motivate. It can allow universities to increasing access to technologies, encouraging participation, and the opportunity to learn informally at an anytime anyplace.
- Universities Staff: The VLEs is a successful emerged and viable learning management platform for teaching and learning now. Therefore, VLEs have the ability to deliver quality content and pedagogy for academic staff and administrators in higher education institutions.
- Human Right: Implementing VLEs and digitalization education can towards a better implementation of the right to education for all because it brings a significant added value to all learners and becoming active members of society in the future.

As result, the Higher Education System in Kurdistan Region can currently engage the VLEs aspect presented by online labs and VR/AR. Integrating these two educational technologies will be helped the higher education system modernize curriculum, promote quality teaching and education, and adapt to a new world of high technology and innovation (Alzahrani et al., 2021). Furthermore, these technologies can help increase the qualifications of learners involved in the labour-market, increase the interaction between student-student and student-teacher, and improve the collaborative work. Also, digital technologies-based education helps to upgrade and improve the quality of higher education and can be critical to consider the inputs of using new technology to overcome the overall reluctance of students, teaching staff, and faculty members (Roots, 2021; Hashim et al., 2021).

However, in general terms, digital transformation and the integration of technologies into education can result in fundamental changes in the Higher Education System (Alenezi, 2021). Beyond that, it is a cultural change requiring universities to challenge the status continually. This means walking away from long-standing traditional education processes that Kurdistan Region universities were built upon to favor new practices. Hence, these steps answer the proposed research questions (Q2 and Q3).

All in all, integrating VLEs and Digital Transformation in Higher Education in the Kurdistan Region can achieve several objectives, for example:

- Enhancing the student experience.
- Providing a wide array of online learning options.
- Using technology to track student progress and run intervention protocols.
- Allowing faculties to organize online classes.
- Enhancing campus environment, teaching and learning methods.
- Increasing collaboration among researchers.

6. CONCLUSION

Technological revolution and digital transformation have prompted reforming education higher education institutions in the 21st century, by changing the sufficiency of the traditional curriculum to impart education in the digital age (Santally, 2019; Benavides et.al, 2020). The impacts of emerging Virtual Learning Environments (VLEs) lead to new opportunities for learning and education. Once the focus has defined, digitalization can fundamentally changes the higher education sector's

processes, content, and forms. It can put the higher education sector in a better position to achieve education and research goal such as high quality and relevance, and access to education.

In terms of theoretical and practical concepts, hands-on experience is essential to understand a subject. Many research papers have emphasized laboratory and practice in STEM education.

The Online Laboratories and VR/AR approaches are widely emerged in STEM at the university level to improve and enhance the teaching and learning processes. An extensive literature review on its impact has highlighted that Online Laboratories have been considered as the best option available in various engineering and science fields for students of higher education, especially during odd times like the COVID-19 pandemic.

Consequently, various applications and system platforms of VLEs have been identified. Online Laboratories and VR/AR that can enhance the higher education system and provide education quality in Kurdistan Region-Iraq are needed.

Moreover, this paper has shown that Online Laboratories and VR/AR can be used effectively to teach science-based information and provide students with an exciting new educational reality and assist in enhancing the education system in Kurdistan Region. Also, there are still attempts, but timid, to foster and integrate technology in higher education integration.

Finally, it is recommended that Kurdistan Region Universities should be ready for digital transformations' technological, operational and strategic changes to deliver near-term results and long-term growth.

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