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A Review of Meaningful Learning through Virtual Reality Learning Environment

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Abstract: In the education method, student lead problem to enhance the learning performance due to the speed of technological development and technical boom and to keep up with this technological boom. The recent trends of virtual reality (VR) applications in education have become a means to enable students to acquire information, and through the applications, students can build their knowledge. Nevertheless, more and more this negative impact such as lack of communication, rare of student's motivations in using the technology. This paper provides a comprehensive overview of VR applications. It focuses on why the application of virtual reality is underutilized in the educational field. Many applications within the field of education create new opportunities, increase participation, and enhance student learning, particularly in higher education institutions. VR technology aims to increase student motivation, participation, understanding, and confidence in learning very important issues. The articles in this literature review papers published between 2018 and 2021 were taken from different databases. That paper highlights and discusses the issues and challenges related to implementing VR founded typically surrounds education. It discovers the strategy of usage of VR in the education sector surroundings nearby virtual reality knowledge. The findings reveal the pertain using virtual reality applications in the education domain.

Keywords: learning, virtual reality, technology.

通過虛擬現實學習環境進行有意義學習的回顧

摘要: 在教育方法中，由于技术发展和技术热潮的速度，学生引导问题来提高学习成绩，并跟上这种技术热潮。虚拟现实（虚拟现实）在教育中的应用最近的趋势已经成为让学生获取信息的一种手段，并且通过应用程序，学生可以建立他们的知识。然而，越来越多的负面影响，例如缺乏沟通，学生使用技术的动机很少。本文提供了虚拟现实应用程序的全面概述。它侧重于为什么虚拟现实的应用在教育领域未被充分利用。教育领域的许多应用创造了新的机会，增加了参与度，并加强了学生的学习，尤其是在高等教育机构中。虚拟现实技术旨在提高学生对学习非常重要问题的积极性、参与度、理解力和信心。 2018 年至 2021 年间发表的这篇文献综述论文中的文章来自不同的数据库。该论文强调并讨论了与实施虚拟现实相关的问题和挑战，这些问题和挑战通常围绕教育展开。它发现了虚拟现实知识在教育部门周围使用虚拟现实的策略。调查结果揭示了在教育领域使用虚拟现实应用程序的相关性。

关键词：学习、虚拟现实、技术。

1. Introduction

The world today is in a continuous boom in the field of technology and technological development. Computers, mobiles, and handheld devices have become indispensable for many people, especially learning, health, and engineering. Previous studies have

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shown that university students use this device by 90% in the Gulf countries and unique in the Sultanate of Oman and the United Arab Emirates [1]. This percentage of using the technology devices but still the students suffer from low academic level and an unwillingness to continue studying due to traditional methods and teaching methods in the time of the technology boom and the urgent desire of the student to use modern technologies [2, 3, 4]. Current research indicated that more than 69% of higher education institutions use e-learning schemes. They are the foundation of their ongoing stratagem, with innovative education chances rising through the combination of digital media in the teaching space [43].

One of this technology is the virtual reality application. It is a new technology used in many areas in our world, such as treatment, science, and education. Electronic devices are helping teacher assistants to the student called (CAL). One of the most critical applications that benefit students in virtual reality [2, 5, 7, 39].

Virtual reality applications began to be used in the academic field in 1960 [8, 9]. [10] has written that (CAD) computer-aided design provides and supports participants to interact in a real environment. Besides not complete in any way and not inclusive [11, 44]. Several studies have been conducted on the use of virtual reality in training and education. One of the fundamental reasons that virtual reality applications used for the field of education are that it made a difference in how the student took the science and motivated and push the student to learn in a new and exciting way where the student applied and live the real reality as if in front of him. The student should interact with Virtual reality applications and do the things required in practice before interacting in the work environments [11]. [25, 45] made a structure containing sequential steps explaining the method of virtual reality in terms of when it is used, what uses it, and the importance of using it. Research and studies in these applications are still inadequate and scarce, especially in education and the insinuation and possessions of enhanced reality in the field of education. [12, 14, 40, 46]applied for a virtual program where he experimented with undergraduate students from the Faculty of Health Sciences University Cape town and found that there is a high rate of motivation by 14% Satisfaction, interest, concentration, and confidence also increased, respectively, 13%, 31%, and 11%.

The term virtual reality defines as “computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors.”

2. General Background

2.1. Students Performance in University

Motivation and study habits are the most cause behind student’s failure. Motivation influences study habits, academic readiness, and student attitude.

It is an essential element for encouraging students to study and avoid failure [32]. The assessment is necessary to enhance learning and the students' feedback [47]. Besides that, the interaction between students and educational subjects using the led mode is one of the most important factors that encourage students to raise their academic level and participate in the informative evaluation.

Fast developments in technology have created distance education straightforward. Education is considered a necessity for society, just as COVID-19 has affected the education sector, which completely transformed the educational approach via the Internet [38, 48]. Furthermore, it should be safe for students and individual staff. The research discusses the importance of distance learning and how to address the challenges of e-learning. The paper presents ways to improve learning, and new skills must be developed to lead to lifelong learning [49]. Also, know the pros and cons of innovation and development and its contents [36]. Also, solve technical difficulties: download difficulties and software installation problems Sign-in and audio problems by pre-registering for video lectures and Content must be tested, and there must be a Plan B for teaching.

Furthermore, teaching cannot stop [25]. Training courses should be flexible, interactive, and important. The paper discusses the proposal for a solution. Teachers and students should be guided on how educational resources and curricula are exploited by academic institutions [25, 50].

It is necessary to investigate the e-learning system out of Kazakhstan. The writer pointed to an important point: distance education is divided into two important sections, namely the student and teacher, and stressed in his research the importance of starting the application of e-learning in all regions for its many benefits. One of them leads students to learn and develop themselves independently and encourages them to solve problems themselves and improve their knowledge. In addition, we should investigate and research different teaching methods to improve education and provide better knowledge for students. We should know that E-learning is an ongoing educational project for long-term use. We should expect more benefit from it in the future, and we should keep in mind that students are the future of our countries and society [26, 30, 31].

It is necessary to see the academic pressures and fears experienced by students at the Faculty of Education (King Saud University), whether studying or exams, during the COVID-19 crisis. The questionnaire conducted by university students showed that pressures and fear increase during the final examination period

because the grades are higher since the introduction of distance learning for the Covid-19 crisis and due to the lack of experience in the use of the study site. In addition, the intensive use students will gain knowledge in the performance of the test comfortably, an increase in the work of difficult courses faced by students and the work of training and trial programs for students, and taking into account problems and poor signals faced some students. All that reasons will increase students' performance and adapt to e-learning [27, 34].

Some discoveries examine the factors that allow or obstruct the adoption of e-learning technological expertise in developed countries. The UTAUT2 builds, and it expects average overall performance and effort Expectation, social impact, facilitating conditions, interesting motivation, value, habit, behavioral intent as nicely as merging self-belief as a new variable. The consequences point out that Qatari and American university college students geared up to use E-learning buildings to use their educational experience—confidence as a precedent for behavioral intention. Moreover, therefore, teachers cultivate and establish a top-notch appreciation of benefits.

VR is used to teach impressive skills by interaction with the simulated. The functional capability of VR skills is strongly dependent on the success of a simulation. From previous results, VR can be shown to be sufficient for a variety of educators. Although particular the adoption at first. Overall, VR tends to be better used in combination with existing theories of adoption. They have multiple issues that need to be tackled before implementing VR for education. Digital technology provides unique environments that can benefit student learning but must be specifically crafted for realistic instructional scenarios [35, 36].

In these periods of rapid technical advancement, an educator will be interested in the ability of technology to transform the very essence of learning and may pay attention to future developments with a view to their incorporation into the classroom. Through technological technologies such as the Internet and smartphones, this growth opened the way for a culture that works far differently from the previous ten to twenty years [37]. If the pattern persists, the disparity between the technical expertise of the professor and the students can only expand. In order to keep up with this accelerated speed of progress, it is evident that educational researchers need to continue investigating the effect these developments might have on our classrooms and on learning in general.

E-learning machine available in their college encourages students to use the E-learning. The confinement in this exploration found that they valued esteem not utilized because it influences different applications. Clients feel that Internet administrations are not costly and are not the primary consideration when contrasted with additional individuals besides societal elements in affecting the perception of e-learning facilities' utilization.

[38] used UTAUT2 and Schwartz's theory to influence values on e-learning. The study explores integrating matters that affect individuals with technology adoption models and apply the novel conceptual model to digital education. Their new model (VETA) includes maintaining the status quo and strengthening oneself from Schwartz's theory and having the habit, Expect performance and value price from UTAUT2. Gender and age effects were not included in the small sample.

As mentioned in this paper, the new location where the chance of exploring the environment via the object manipulation scattered within the virtual environments, related with the contents to discover, is frequently seen with student aid. Some mastering things are hard to function in authentic surroundings due to high expenses, lack of infrastructure availability, or hazardous performances. In the virtual world's it is feasible to operate simulations and things to do of any kind. This paper highlights and discusses the challenges and trouble of studying in VR, like Orientation, teaching activity, Accessibility, Active Participation of students, Dynamic Teach and Learn dynamic content perspective, and Virtual simulation.

Reasons to use VR discussed. Furthermore, the advantages and disadvantages of using VR are presented as pointers on when to and not to use VR. A model will use to determine when it uses VR in the education or coaching path presented. The research also discussed that virtual reality encompasses a vicinity in instructions and training and research on instructional purposes of Virtual Reality, further as a lookup on the tutorial use of simulations has proven its values. Also mentioned are many reasons to use virtual reality and the benefits of using virtual reality. The educators or coach has only to see when to use it, and a model's employment can help make that determination. A model can play a component inside the continuing look for methods to use VR in schooling and education courses.

Virtual reality (VR) can be described as pc modeling and simulations that assist anyone in interacting with artificial 3D environments. In addition, the virtual reality (VR) technological expertise is becoming better and immerging with the help of hardware, software program, and the integration of the virtual world technologies, which would possibly exhibit the real world dynamically.

These applied sciences can respond in line with people's form, languages, and then on the right after an actual conversation between human beings and this digital world. Hence, such science has caught up with lots of attention from researchers and companies for the past few years. As more significant research is executed in the coming years, we can see virtual reality (VR) emerge as necessary remain in our properties and

works. Because computers become faster, they shall be ready to create more practical picture photos to simulate facts better. It is going to be interesting to see how it.

VR can be described as immerging technological expertise that might also present the capability to comprehend actual working surroundings. Further, the discussion made on tactics wanted to respect VR [33, 40, 41]. The paper also explores the significance and utilization of VR in Engineer zone like manufacturing, design, meeting, inspection, tooling, prototyping, etc. Moreover, benefits, costs, obstacles, and dangers associated while adopting virtual reality are included and highlighted.

Previous research focused on the leading causes of student weakness at the university academic level, such as motivation, guidance, and teaching aids. Studies lack practical experience, feedback on the real reality for some of the subjects that need an application in this field, significance of the whole experience, and the high costs of this practical application. Need imagination - interaction – immersion and other essential factors to enhance learning with more facilitation. From the previous studies, we came out with three hypotheses. First, determines the methods used in each study. Second, the deference limitations with the technology developments years, Third the proof of the power of this method with the university level undergraduate students level the effect of virtual reality in their learning.

3. Methodology

A systematic review was conducted that gathered previous research from different search engines. That includes the parameters of virtual reality applications and virtual reality applications in learning and academic performance with virtual reality applications using the relevant research papers selected from many different databases. The search was narrowed by introducing exclusion criteria, title, abstract, and keywords of all the research retrieved had to be read to ensure that they were within the scope of our study. The duration of the years that selected this research was from 2018 to 2021. Tables are shown the available matching articles with the result of the total of searching from. The open-access database selected from the different databases is based on virtual reality applications such as science direct, EBSCOHOST, IEEE, and D SCOPUS database. This entire database depending on the mechanizing of the search, is based on the three factors. The first factor is virtual reality applications, the second factor is the virtual reality applications used in education and learning, and the third is on educational performance that uses virtual reality applications.

Table 1 Database open access

Database	Field	Years	Totals
Name		**(2018 – 2021)**	
Science Direct	Virtual reality application	1150	
	Virtual reality application in learning	868	
	Virtual reality applications in academic performance	417	
Scopus	Virtual reality application	1289	
	Virtual reality application in learning	251	
	Virtual reality application in academic performance	293	
EBSCOhost	Virtual reality application	194	
	Virtual reality application in learning	73	
	Virtual reality application in academic performance	28	

Table 2 Database open access

Virtual reality application	2021	2020	2019	2018	Totals
Science direct	410	293	241	206	1152
Scopus	340	384	304	261	1289
IEEE	189.444	279.185	270.647	260.361	
EBESCO	51	55	49	39	194

Table 3 Database open access

Virtual reality application in learning	2021	2020	2019	2018	Totals
Science direct	310	224	183	152	868
Scopus	77	68	67	39	251
EBESCO	17	17	23	16	73
Science direct	310	224	183	152	868

Table 4 Database open access

Virtual reality application in academic performance	2018-2021
Science direct	417
SCOPUS	293
EBSCOHOST	28
Totals	743

4. Research Result and Discussion

The hypothesis determines the methods used in each study. There is a need to explore the experiences and preferences for feedback modes of physiotherapy students and lecturers—the second hypothesis is related to the deference limitations with the technology developments years. Technology is a computer-based interactive tool that contains facts in addition to reasoning. The other hypothesis is the proof of the power of this method with the university level undergraduate level the effect of virtual reality in their learning.

As the authors note earlier, more work is necessary for promoting learning with student feedback assessment. The unexpected findings signal additional studies to understand more about promoting education with student feedback assessment the researcher's

limitation. They used one institution for one health care program (physical therapy). It may reduce the possibility of transmitting the results. Over there it was a limited number of participants who agreed to participate.

Consequently, it was difficult to ascertain whether the data was saturated or not arrived. This paper addresses students' and lecturer's experiences. Understand how this can inform decisions and preferences about choosing the feedback modes that reinforce the student and experience feedback from the lecturer, lacking in the scientific literature. Therefore, a new approach is needed for transferability and consensus on student and lecturer Preferences. Students prefer a media-led lecturer with the highest personal interaction with the lecturers (face-to-face, Screen, video, and digital audio recording. Several questions regarding Preferences and student feedback assessment remain to be addressed, such as consent on lecturer and student preferences [32, 42]. Real and Virtual Engagement in a Realistic Immersive Environment? This question has previously never been discussed because of the lack of research in this area. Increase its educational impact and evaluate the prototype in real-world educational scenarios.

Virtual reality may be used in education and its effect on the educational process where seventy-eight students applied immersive virtual reality. The results showed that this technology is better than traditional teaching and has self-efficacy and immediate attention. With objective learning metrics, Self-reports, and EEG, we report differences via attendance Knowledge of text in an overlay interface, in a virtual book. The results were then aggregated for the design Considerations for educational VR tools. The results are privately related to immersive educational VR design Systems.

5. Conclusion

The conclusion of this review can comprehend in the following phrase: “There is a lack in the student's academic level in the traditional model of education. The use of virtual reality applications influences the engagement and performance of the learners”. Digital technology provides unique environments that can benefit student learning but must be specifically crafted for realistic instructional scenarios.

Virtual reality applications have their place in education, play a vital role, and prove their importance from the results of the selected paper under review in this research work. Previous research focused on the leading causes of student weakness at the university academic level, such as motivation, guidance, and teaching aids. Studies lack practical experience, feedback on the real reality for some of the subjects that need an application in this field, significance of the whole experience, and the high costs of this practical application. Need imagination - interaction – immersion and other essential factors to enhance learning with more facilitation. There is a wide-ranging scope for this topic in research. In the future, it will be interesting to see artificial reality enhanced learning systems. Connect virtual phones as well as will be able to create more realistic images and graphics to simulate reality.

References

[1] HAARALA-MUHONEN, A., RUOHONIEMI, M., PARPALA, A., KOMULAINEN, E., and LINDBLOM-YLÄNNE, S. How do the different study profiles of first-year students predict their study success, study progress, and the completion of degrees? *Higher Education*, 2017, 74(6): 949–962.

[2] TSAYA HUEI, C.H., and ALEXANDER KOFINASB, J. Enhancing student learning experience with technology-mediated gamification: An empirical study. *Computers and Education*, 2018, 121: 1-17.

[3] TULSI, P., and POONIA, M.A. Learning Styles of Engineering Students. *Journal of Engineering Education Transformations*, 2016, 30(2): 2349-2473.

[4] TURBAN. *Decision Support and Expert Systems: Management Support Systems*. Prentice Hall Inc., 1995.

[5] URIEN, B., ERRO-GARCES, A., and OSCA, A. WhatsApp usefulness as a communication tool in an educational context. *Education and Information Technologies*, 2019, 1-18.

[6] WANG, Q., WOO, H., QUEK, C.L., YANG, Y., and LIU, M. Using the Facebook group as a learning management system: An exploratory study. *British Journal of Educational Technology*, 2012, 43: 428-438.

[7] WANI, T., and ALI, S. Innovation diffusion theory. *Journal of public management research*, 2015, 3(2): 101-118.

[8] WANNORAINI B.T., and LATIF, A. *Expert System for selection Academic Program*. Master’s thesis, Universiti Utara Malaysia, 2005.

[9] WANT, R. An introduction to RFID technology. *IEEE Pervasive Computing*, 2006, 5: 25-33.

[10] SHEN, C., HO, J., LY, P.T., and KUO, T. Behavioral intentions of using virtual reality in learning: perspectives of acceptance of information technology and learning style. *Virtual Reality*, 2018, 23: 313-324.

[11] WENTAO SHANG, Y.Y. Challenges in IoT Networking via TCP/IP Architecture. *NDN Technical Report NDN*, 2016.

[12] WINN, W. A conceptual basis for educational applications of virtual reality. *Human Interface Technology Laboratory of the Washington Technology Center*, 1993, 93-99.

[13] WU, B., and CHEN, X. Continuance intention to use MOOCs: Integrating the technology acceptance model (TAM) and task technology fit (TTF) model. *Computers in Human Behavior*, 2017, 67: 221-232.

[14] XIAOZHE, Y., LIN, L., PEI-YU, C., XUE, Y., and REND, Y. Which EEG feedback works better for creativity performance in immersive virtual reality: The reminder or encouraging feedback? *Computers in Human Behavior*, 2019, 99: 345-351.

[15] YANG, X., LIN, L., YU CHENG, P., YANG, X., REN, Y., and MIN HUANG, Y. Examining creativity through a virtual reality support system. *Education Tech Research Dev*, 2018, 1231-1254.

[16] AL-EMRAN, M., ALKHOUDARY, Y.A.,

MEZHUYEV, V., and AL-EMRAN, M. Students and educators' attitudes towards using M-Learning: Gender and smartphone ownership differences. *International Journal of Interactive Mobile Technologies*, 2019, 13(1): 127–135.
[17] HAARALA-MUHONEN, A., RUOHONIEMI, M., PARPALA, A., KOMULAINEN, E., and LINDBLOM-YLÄNNE, S. How do the different study profiles of first-year students predict their study success, study progress, and the completion of degrees? *Higher Education*, 2017, 74: 949-962.
[18] SAMAN, M.Y.M., AZHAN, M. H.B.N., SULAIMAN, S., and ABDULLAH, Z. On Enhancing Active Learning in E-Learning Environments. *International Conference on Quality in Higher Education (ICQH 2013)*, 2013.
[19] PREGOWSKA, A., MASZTALERZ, K., GARLIŃSKA, M., and OSIAL, M. A Worldwide Journey through Distance Education—From the Post Office to Virtual, Augmented and Mixed Realities, and Education during the COVID-19 Pandemic. *Education Sciences*, 2021, 11(3): 118.
[20] EL GOURARI, A., SKOURI, M., RAOUFI, M., and OUATIK, F. The Future of the Transition to E-learning and Distance Learning Using Artificial Intelligence. *2020 Sixth International Conference on e-Learning (econf)*, 2020: 279-284.
[21] MARTÍN-GUTIÉRREZ, J., MORA, C.E., AÑORBE-DÍAZ, B., and GONZÁLEZ-MARRERO, A. Virtual technologies trends in education. Eurasia *Journal of Mathematics, Science and Technology Education*, 2017, 13(2): 469-486.
[22] SOTO, J.B., OCAMPO, D.T., COLON, L. B., and OROPESA, A.V. Perceptions of ImmerseMe Virtual Reality Platform to Improve English Communicative Skills in Higher Education. *International Journal of Interactive Mobile Technologies*, 2020, 14; 4-19.
[23] KHAIRUDIN, M., TRIATMAJA, A.K., ISTANTO, W.J., and AZMAN, M.N.A. Mobile Virtual Reality to Develop a Virtual Laboratorium for the Subject of Digital Engineering. *International Journal of Interactive Mobile Technologies*, 2019, 13: 80-95.
[24] KALOGIANNAKIS, M., NIRGIANAKI, G.M., and PAPADAKIS, S. Teaching magnetism to preschool children: The effectiveness of picture story reading. *Early Childhood Education Journal*, 2018, 46(5): 535-546.
[25] MATHEW, R., MALIK, S.I., and TAWAFAK, R.M. Teaching Problem Solving Skills Using An Educational Game In A Computer Programming Course. *Informatics in Education*, 2019, 18(2): 359 -373.
[26] FERNANDEZ, M. Augmented virtual reality: How to improve education systems. *Higher Learning Research Communications*, 2017, 7(1): 1-15.
[27] VIDAKIS, N., BARIANOS, A., TRAMPAS, A., PAPADAKIS, S., KALOGIANNAKIS, M., and VASSILAKIS, K. Generating Education in-Game Data: The Case of an Ancient Theatre Serious Game. *Proceedings of the 11th International Conference on Computer Supported Education (CSEDU 2019)*, 2019, 1: 36-43.
[28] WANG, P., WU, P., WANG, J., CHI, H.L., and WANG, X. A critical review of the use of virtual reality in construction engineering education and training. *International journal of environmental research and public health*, 2018, 15(6): 1204.
[29] GROVER, S., FRANZ, P., SCHNEIDER, E., and PEA, R. The MOOC as distributed intelligence: Dimensions of a framework and evaluation of MOOCs. *CSCL*, 2013.
[30] TAWAFAK, R.M., ALFARSI, G., and JABBAR, J. Innovative Smart Phone Learning System for Graphical Systems within COVID-19 Pandemic. *Contemporary Educational Technology*, 2021, 13(3): ep306.
[31] SHAKIR, M., ABOOD, R., SHEKER, M., ALNASERI, M., AL-HASHIMI, M., and TAWAFAK, R.M. Users Acceptance of Electronic Personal Synthesis Behavior (EPSB): An Exploratory Study. *Recent Advances in Technology Acceptance Models and Theories*, 2021, 509-520.
[32] TAWAFAK, R.M., MALIK, S.I., and ALFARSI, G. Development of Framework from Adapted TAM with MOOC Platform for Continuity Intention. *Development*, 2020, 29(1): 1681-1691.
[33] ALFARSI, G., YUSOF, A.B.M., TAWAFAK, R.M., MALIK, S.I., MATHEW, R., and ASHFAQUE, M.W. Instructional Use of Virtual Reality in E-Learning Environments. *2020 IEEE International Conference on Advent Trends in Multidisciplinary Research and Innovation (ICATMRI)*, 2020, 1-5.
[34] IQBAL MALIK, S., MATHEW, R., TAWAFAK, R.M., and ALFARSI, G. A web-based model to enhance algorithmic thinking for novice programmers. *E-Learning and Digital Media*, 2021, 20427530211026988.
[35] TAWAFAK, R.M., ROMLI, A.M., and ALSINANI, M.J. Student Assessment Feedback Effectiveness Model for Enhancing Teaching Method and Developing Academic Performance. *International Journal of Information and Communication Technology Education (IJICTE)*, 2019, 15(3): 75-88.
[36] UCAR, E., USTUNEL, H., CIVELEK, T., and UMUT, I. Effects of using a force-feedback haptic augmented simulation on the attitudes of the gifted students towards studying chemical bonds in virtual reality environment. *Behavior and Information Technology*, 2017, 36(5): 540-547.
[37] BABY, B., SINGH, R., SURI, A., DHANAKSHIRUR, R.R., CHAKRABORTY, A., KUMAR, S., and BANERJEE, S. A review of virtual reality simulators for neuroendoscopy. *Neurosurgical Review*, 2021, 43(5): 1255-1272.
[38] MALIK, S., TAWAFAK, R., ALFARSI, G., AL-EMRAN, M., and MATHEW, R. Comparison of E-Learning, M-Learning and Game-based Learning in Programming Education–A Gendered Analysis. *International Journal of Emerging Technologies in Learning (iJET)*, 2020, 15(15): 133-146.
[39] TAWAFAK, R.M., ROMLI, A., MALIK, S.I., SHAKIR, M., ALFARSI, G. A systematic review of personalized learning: Comparison between e-Learning and learning by coursework program in Oman. *International Journal of Emerging Technologies in Learning*, 2019, 14(9).
[40] MALIK, S.I., ALFARSI, G., and TAWAFAK, R.M. A Model for Enhancing Algorithmic Thinking in Programming Education using PAAM. *International Journal of Interactive Mobile Technologies*, 2021, 16: 9.
[41] JABBAR, J., MALIK, S.I., ALFARSI, G., and TAWAFAK, R.M. The Impact of WhatsApp on Employees in Higher Education. *Recent Advances in Intelligent Systems and Smart Applications*, 2020, 639-651.
[42] TAWAFAK, R.M., ALFARSI, G., ROMLI, A., JABBAR, J., MALIK, S.I., and ALSIDEIRI, A. A Review Paper on Student-Graduate Advisory Expert system. *2020 International Conference on Computing and Information*

Technology (ICCIT-1441), 2020, 1-5.
[43] ALFARSI, G., and YUSOF, A.B.M. Virtual Reality Applications in Education Domain. *2020 21st International Arab Conference on Information Technology (ACIT)*, 2020, 1-7.
[44] BURDEA, G.C. Keynote address: Haptic feedback for virtual reality. *Proceedings International Workshop on Virtual prototyping*, 2020, 87-96.
[45] MALIK, S.I., TAWAFAK, R.M., and SHAKIR, M. Aligning and Assessing Teaching Approach with SOLO Taxonomy in a Computer Programming Course. *International Journal of Information and Communication Technology Education (IJICTE)*, 2021, 17(4): 1-15.
[46] TAWAFAK, R.M., ROMLI, A., AL SIDEIRI, A., MALIK, S.I., and JABBAR, J. Concepts of e-learning performance on system use outcomes in Omani Universities. *IOP Conference Series: Materials Science and Engineering*, 2021, 1088(1): 012008.
[47] AL FARSI, G., YUSOF, A.B.M., FAUZI, W.J.B., RUSLI, M.E.B., MALIK, S.I., TAWAFAK, R.M., and JABBAR, J. The Practicality of Virtual Reality Applications in Education: Limitations and Recommendations. *Journal of Hunan University Natural Sciences*, 2021, 48(7).
[48] ALFARSI, G., TAWAFAK, R.M., ELDOW, A., MALIK, S.I., JABBAR, J., and AL SIDEIRI, A. General View about Games based Learning: Literature Review. *Proceedings of the International Conference on Culture Heritage, Education, Sustainable Tourism, and Innovation Technologies - CESIT*, 2020, 139-145.
[49] ALFARSI, G., TAWAFAK, R.M., ELDOW, A., MALIK, S.I., JABBAR, J., and AL SIDEIRI, A. Smart Classroom Technology in Artificial Intelligence: A Review Paper. *Proceedings of the International Conference on Culture Heritage, Education, Sustainable Tourism, and Innovation Technologies - CESIT*, 2020, 229-235
[50] ALFARSI, G., JABBAR, J., TAWAFAK, R.M., ALSIDIRI, A., and ALSINANI, M. Techniques for Face Verification: Literature Review. *2019 International Arab Conference on Information Technology (ACIT)*, 2019, 107-112.

参考文:

[1] HAARLALA-MUHONEN, A.、RUOHONIEMI, M.、PARPALA, A.、KOMULAINEN, E. 和 LINDBLOM-YLÄNNE, S. 一年級學生的不同學習情況如何預測他們的學習成功、學習進度和完成學位？高等教育，2017 年，74(6)：949–962。
[2] TSAYA HUEI, C.H. 和 ALEXANDER KOFINASB, J. 通過技術介導的遊戲化增強學生的學習體驗：一項實證研究。計算機與教育，2018 年，121：1-17。
[3] TULSI, P. 和 POONIA, M.A. 工程專業學生的學習風格。工程教育轉型學報, 2016, 30(2): 2349-2473.
[4] 頭巾。決策支持和專家系統：管理支持系統。普倫蒂斯霍爾公司，1995 年。
[5] URIEN, B.、ERRO-GARCES, A. 和 OSCA, A. 微信 作為教育環境中的通信工具的有用性。教育與信息技術，2019，1-18。
[6] WANG, Q., WOO, H., QUEK, C.L., YANG, Y., 和 LIU, M. 使用 臉書群組作為學習管理系統：一項探索性研究。英國教育技術雜誌，2012，43：428-438。
[7] WANI, T. 和 ALI, S. 創新擴散理論。綜合管理研究雜誌, 2015, 3(2): 101-118.
[8] WANNORAINI B.T. 和 LATIF, A. 學術課程選擇專家系統。碩士論文，馬來西亞北方大學，2005 年。
[9] WANT, R. 射频识别技術簡介。电气与电子工程师协会普適計算，2006 年，5：25-33。
[10] SHEN, C., HO, J., LY, P.T., 和 KUO, T. 在學習中使用虛擬現實的行為意圖：接受信息技術和學習風格的觀點。虛擬現實，2018 年，23：313-324。
[11] WENTAO SHANG, Y.Y. 通過 网络协议架構的物聯網網絡挑戰。技術報告，2016 年。
[12] WINN, W. 虛擬現實教育應用的概念基礎。華盛頓技術中心人機接口技術實驗室，1993，93-99。
[13] WU, B. 和 CHEN, X. 繼續使用 慕課的意圖：整合技術接受模型 和任務技術擬合 模型。人類行為中的計算機，2017，67：221-232。
[14] XIAOZHE, Y., LIN, L., PEI-YU, C., XUE, Y. 和 REND, Y. 哪種反饋對沉浸式虛擬現實中的創造力表現更有效：提醒還是鼓勵反饋？人類行為中的計算機，2019，99：345-351。
[15] YANG, X.、LIN, L.、YU CHENG, P.、YANG, X.、REN, Y. 和 MIN HUANG, Y. 通過虛擬現實支持系統檢查創造力。教育技術研究開發，2018，1231-1254。
[16] AL-EMRAN, M.、ALKHOUDARY, Y.A.、MEZHUYEV, V. 和 AL-EMRAN, M. 學生和教育工作者對移動學習使用的態度：性別和智能手機所有權差異。國際交互式移動技術雜誌，2019 年，13(1)：127–135。
[17] HAARALA-MUHONEN, A.、RUOHONIEMI, M.、PARPALA, A.、KOMULAINEN, E. 和 LINDBLOM-YLÄNNE, S. 一年級學生的不同學習概況如何預測他們的學習成功、學習進度和完成學位？高等教育，2017 年，74：949-962。
[18] SAMAN, M.Y.M., AZHAN, M. H.B.N., SULAIMAN, S. 和 ABDULLAH, Z. 關於在電子學習環境中增強主動學習。高等教育質量國際會議，2013 年。
[19] PREGOWSKA, A.、MASZTALERZ, K.、GARLIŃSKA, M. 和 OSIAL, M. 遠程教育的全球之旅——

從郵局到虛擬、增強和混合現實，以及 新冠肺炎大流行期間的教育.教育科學, 2021, 11(3): 118。

[20] EL GOURARI, A.、SKOURI, M.、RAOUFI, M. 和 OUATIK, F. 使用人工智能向電子學習和遠程學習過渡的未來。 2020 第六屆電子學習國際會議，2020：279-284。

[21] MARTÍN-GUTIÉRREZ, J.、MORA, C.E.、AÑORBE-DÍAZ, B. 和 GONZÁLEZ-MARRERO, A. 教育中的虛擬技術趨勢。歐亞數學雜誌，科技教育，2017，13(2)：469-486。

[22] SOTO, J.B., OCAMPO, D.T., COLON, L. B. 和 OROPESA, A.V.對虛擬現實平台提高高等教育英語交流技能的看法。國際交互式移動技術雜誌，2020，14； 4-19。

[23] KHAIRUDIN, M.、TRIATMAJA, A.K.、ISTANTO, W.J. 和 AZMAN, M.N.A.移動虛擬現實為數字工程學科開發虛擬實驗室。國際交互式移動技術雜誌，2019，13：80-95。

[24] KALOGIANNAKIS, M.、 NIRGIANAKI, G.M. 和 PAPADAKIS, S. 向學齡前兒童教授吸引力：圖畫故事閱讀的有效性。幼兒教育雜誌，2018，46（5）：535-546。

[25] MATHEW, R.、MALIK, S.I. 和 TAWAFAK, R.M.在計算機編程課程中使用教育遊戲教授解決問題的技能。教育信息學, 2019, 18(2): 359 -373。

[26] FERNANDEZ, M. 增強虛擬現實：如何改進教育系統。高等教育研究通訊，2017，7(1)：1-15。

[27] VIDAKIS, N., BARIANOS, A., TRAMPAS, A., PAPADAKIS, S., KALOGIANNAKIS, M. 和 VASSILAKIS, K. 生成教育遊戲數據：古代戲劇嚴肅遊戲的案例。第十一屆計算機支持教育國際會議論文集，2019，1：36-43。

[28] WANG, P., WU, P., WANG, J., CHI, H.L., 和 WANG, X. 虛擬現實在建築工程教育和培訓中的應用的批判性回顧。國際環境研究與公共衛生雜誌, 2018, 15(6): 1204.

[29] GROVER, S.、FRANZ, P.、SCHNEIDER, E. 和 PEA, R. 作為分佈式智能的 慕課：框架的維度和慕课的評估。中海集運，2013 年。

[30] TAWAFAK, R.M., ALFARSI, G. 和 JABBAR, J. 新冠肺炎大流行中圖形系統的創新智能手機學習系統。當代教育技術, 2021, 13(3): ep306。

[31] SHAKIR, M.、 ABOOD, R.、 SHEKER, M.、 ALNASERI, M.、AL-HASHIMI, M. 和 TAWAFAK, R.M. 用戶對電子個人綜合行為 的接受：一項探索性研究。技術接受模型和理論的最新進展，2021，509-520。

[32] TAWAFAK, R.M., MALIK, S.I., 和 ALFARSI, G. 使用慕課平台開發基於連續性意圖的自適應 TAM 框架。發展, 2020, 29(1): 1681-1691。

[33] ALFARSI, G., YUSOF, A.B.M., TAWAFAK, R.M., MALIK, S.I., MATHEW, R. 和 ASHFAQUE, M.W. 虛擬現實在電子學習環境中的教學使用。 2020 年 IEEE 多學科研究與創新趨勢國際會議，2020 年，1-5.

[34] IQBAL MALIK, S.、MATHEW, R.、TAWAFAK, R.M. 和 ALFARSI, G. 一種基於網絡的模型，可增強新手程序員的算法思維。電子學習與數字媒體，2021，20427530211026988。

[35] TAWAFAK, R.M.、ROMLI, A.M. 和 ALSINANI, M.J. 用於改進教學方法和發展學業成績的學生評估反饋有效性模型。國際信息與通信技術教育雜誌, 2019, 15(3): 75-88.

[36] UCAR, E., USTUNEL, H., CIVELEK, T., 和 UMUT, I. 使用力反饋觸覺增強模擬對天才學生在虛擬現實環境中研究化學鍵的態度的影響。行為與信息技術, 2017, 36(5): 540-547。

[37] BABY, B., SINGH, R., SURI, A., DHANAKSHIRUR, R.R., CHAKRABORTY, A., KUMAR, S. 和 BANERJEE, S. 神經內窺鏡虛擬現實模擬器綜述。神經外科評論, 2021, 43(5): 1255-1272.

[38] MALIK, S.、TAWAFAK, R.、ALFARSI, G.、AL-EMRAN, M. 和 MATHEW, R. 編程教育中電子學習、移動學習和基於遊戲的學習的比較——性別化分析。國際新興學習技術雜誌, 2020, 15(15): 133-146。

[39] TAWAFAK, R.M., ROMLI, A., MALIK, S.I., SHAKIR, M., ALFARSI, G. 個性化學習的系統回顧：阿曼電子學習和課程學習的比較。國際新興學習技術雜誌，2019 年，14(9)。

[40] MALIK, S.I.、ALFARSI, G. 和 TAWAFAK, R.M. 使用聚丙烯酰胺增強編程教育中算法思維的模型。國際交互式移動技術雜誌，2021，16：9.

[41] JABBAR, J., MALIK, S.I., ALFARSI, G. 和 TAWAFAK, R.M. 微信對高等教育員工的影響。智能係統和智能應用的最新進展，2020，639-651。

[42] TAWAFAK, R.M., ALFARSI, G., ROMLI, A., JABBAR, J., MALIK, S.I. 和 ALSIDEIRI, A. 關於學生-研究生諮詢專家系統的評論論文。2020 計算與信息技術國際會議, 2020, 1-5.

[43] ALFARSI, G. 和 YUSOF, A.B.M. 虛擬現實在教育領域的應用。2020 第 21 屆國際阿拉伯信息技術會議 , 2020, 1-7.

[44] BURDEA, G.C. 主題演講：虛擬現實的觸覺反饋。虛擬原型製作國際研討會論文集, 2020, 87-96.

[45] MALIK, S.I.、TAWAFAK, R.M. 和 SHAKIR, M. 在計算機編程課程中使用分類法調整和評估教學方法。國際信息與通信技術教育雜誌, 2021, 17(4): 1-15.

[46] TAWAFAK, R.M., ROMLI, A., AL SIDEIRI, A., MALIK, S.I. 和 JABBAR, J. 阿曼大學系統使用結果的電子學習性能概念。會議系列：材料科學與工程, 2021, 1088(1): 012008.

[47] AL FARSI, G., YUSOF, A.B.M., FAUZI, W.J.B., RUSLI, M.E.B., MALIK, S.I., TAWAFAK, R.M. 和 JABBAR, J. 虛擬現實教育應用的實用性：限制和建議。湖南大學自然科學學報, 2021, 48(7).

[48] ALFARSI, G.、TAWAFAK, R.M.、ELDOW, A.、MALIK, S.I.、JABBAR, J. 和 AL SIDEIRI, A. 關於基於遊戲的學習的一般觀點：文獻綜述。 文化遺產、教育、可持續旅遊和創新技術國際會議論文集, 2020 年, 139-145。

[49] ALFARSI, G.、TAWAFAK, R.M.、ELDOW, A.、MALIK, S.I.、JABBAR, J. 和 AL SIDEIRI, A. 人工智能中的智能課堂技術：評論論文。 文化遺產、教育、可持續旅遊和創新技術國際會議論文集, 2020, 229-235

[50] ALFARSI, G.、JABBAR, J.、TAWAFAK, R.M.、ALSIDIRI, A. 和 ALSINANI, M. 人臉驗證技術：文獻綜述。2019 國際阿拉伯信息技術會議, 2019, 107-112。