Interactive Design of a Virtual Classroom Simulation Model Based on Multimedia Applications to Improve the Teaching and Learning Process in the Tikrit University Environment

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Abstract

Iraqi higher education institutions use the virtual classroom platform to replace face-to-face teaching and online learning, and to overcome the challenges of traditional teaching. Therefore, this research aim was to use multimedia applications by using JavaScript programming to design a virtual classroom simulation model to improve the teaching and learning process in higher education. In same the context, virtual classrooms have emerged as an immersive alternative to face-to-face, hands-on classrooms. In addition, the possibility of using virtual classrooms opens new perspectives for Iraqi universities. The method of this work was based on the interaction design (Design, Development, Testing, Analysis, and Evaluation). Thus, was selected Tikrit university as a case study for different levels of students at university colleges, to conduct a thorough evaluation of the virtual classroom platform based on the Multimedia Criteria in Conole's Dimensions (12 criteria), which is considered as a general criteria evaluation for the proposed virtual classroom platform by experts' review from different Iraqi universities. In addition to the students' experience (first to the fourth year of the bachelor's degree) with the proposed virtual classroom platform from different colleges at Tikrit University. It can be a virtual platform for all Iraqi universities in the future. Finally, the results show that many students (200) are satisfied with the features of learning in the proposed model, with high performance and effectiveness in the learning process. Moreover, the results showed also that there is a strong need for the virtual classroom to process the difficult practical aspects of the learning process.

Keywords: Virtual Classroom; Multimedia Application; Learning Criteria; User Experience; Simulation

1. Introduction

Virtual classrooms provide many features to the students and teachers in the universities, such as simulation and videos, audio, and sound effects [1,2,3]. Besides, learning by virtual classrooms can be complementary to traditional learning. Moreover, the virtual classroom shows an interactive learning environment by integrating multimedia technology where learners and lecturers can collaborate, interact, discuss their ideas, and communicate through new teaching methods [1,4]. Thus, a virtual classroom has features that provide an interactive learning environment that shows simulation to increase the interaction with the subjects [5,6]. In addition, virtual classrooms allow students to participate in the features of learning from many places, by passing space constraints. The students can virtually view the lecture many times to overcome the restrictions of time in the learning process [7].

Therefore, many higher education institutions have chosen to continue offering use virtual learning or courses online pproaches [8]. Moreover, virtual learning based on the classroom has grown in demand and popularity in

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the higher education over the past decade [9,10], making it a pervasive educational phenomenon. [9] Despite the above, there is a growing interest in virtual learning. One of the most popular virtual learning programmes after the COVID-19 pandemic is virtual Classroom [11]. Virtual learning has become important for education as it provides true three or four-dimensional spaces that enable learners to interact and collaborate as well as it creates new opportunities for learning and teaching [11], [12]. In the same vein, virtual classrooms are supporting the traditional classroom through combining them with the traditional classroom to teach students and make them acquire the learning skills. Besides, it has a positive effect on the students [2]. As a new technology, the virtual classroom provides a powerful, comprehensive, and secure way to promote knowledge and learning and to remove the limitations of experiential learning [13]. Thus, virtual classrooms are based on the concept of remote access to simulations and virtual technology systems. Evidence from students' interactions with virtual classrooms shows improvement in students' problem-solving, critical thinking, experimentation, and cognitive skills [14]. Therefore, virtual classrooms are often used to provide users with a 3D or 4D environment to experience real or imagined information and allow them to interact with information in real time. In other words, it helps learners experience the real classroom environment in the virtual world, making them able to solve problems similar to the physical classroom.

However, virtual classrooms are still a new technology with few learning applications [15]. Also, there are many studies that focus solely on the design without focusing on learners' experience and analysis of students' needs during using virtual classrooms [13 , 16]. In other words, there are still open questions about how these virtual classroom models can meet the needs of the stakeholders (learners), such as understanding students' goals and motivations, learning emotions, and experiences during learning. These models focus only on the general design of the virtual classroom from the lecturer's side without focusing on the students' side. These problems in the virtual classroom show that the current education model does not have good features of learning such as flexibility, good knowledge, instructional design, and collaboration [17,18].

Higher education institutions are facing challenges to go rid of the factors such as time and location, especially in the practical laboratories, to improve flexibility in the learning process [4, 19]. More specifically, to achieve high interaction in the learning institutions, the alternative is to combine between the traditional and virtual classrooms [20]. Moreover, a limited number of studies focusing on how the virtual classroom platform can satisfy the students' needs by the user experience (UX) based on multimedia environment inside virtual classroom such as simulation, video, audio, image ...etc, during design phases of model [21, 22, 23]. Interestingly, using Multimedia applications in teaching has proved positive effective on students' interest in learning and in improving the quality of learning as well as the learning process for the students as a whole [22,23, 24], especially in the iraqi education environment. Thus, more in-depth investigation is needed in the multimedia criteria of virtual Classroom to understand the needs of students during the learning process [25,26].

2. Related Works

Many previous studies have addressed the virtual classrooms through research and experimentation. [27] by comparing them with the traditional classrooms according to the English undergraduate students. The results show that the students' performance in the virtual classroom is better than that performance of their counterparts in the traditional classroom, and the virtual classroom allows for more interaction between teachers and students. In addition, a study by [28], evaluated the perceptions of the English teachers and students about virtual classrooms and the results show that most teachers and students have a positive attitude toward the virtual classroom, and there is an improvement in the interaction skills as a result of using the virtual classroom. In other study, by [29] research examining the impact of virtual classrooms on practical subjects' proficiency among students compared to traditional practices. The results demonstrate the effectiveness of the virtual classroom in improving practical subjects, in terms of developing practical subject proficiency, which was shown by the achievement test of the practical subject. In addition, the Collaborate Ultra Experience LTI virtual classroom is a unique addition for students utilizing the virtual environment. Use it by integrating it with the Blackboard system. The application is designed to facilitate, real-time interaction between students and lecturers with the support of multimedia application technologies [30, 31].

3. METHOD

The method of this research consists of five steps: Design, Development, Testing, Analysis, and Evaluation as in Figure (1).

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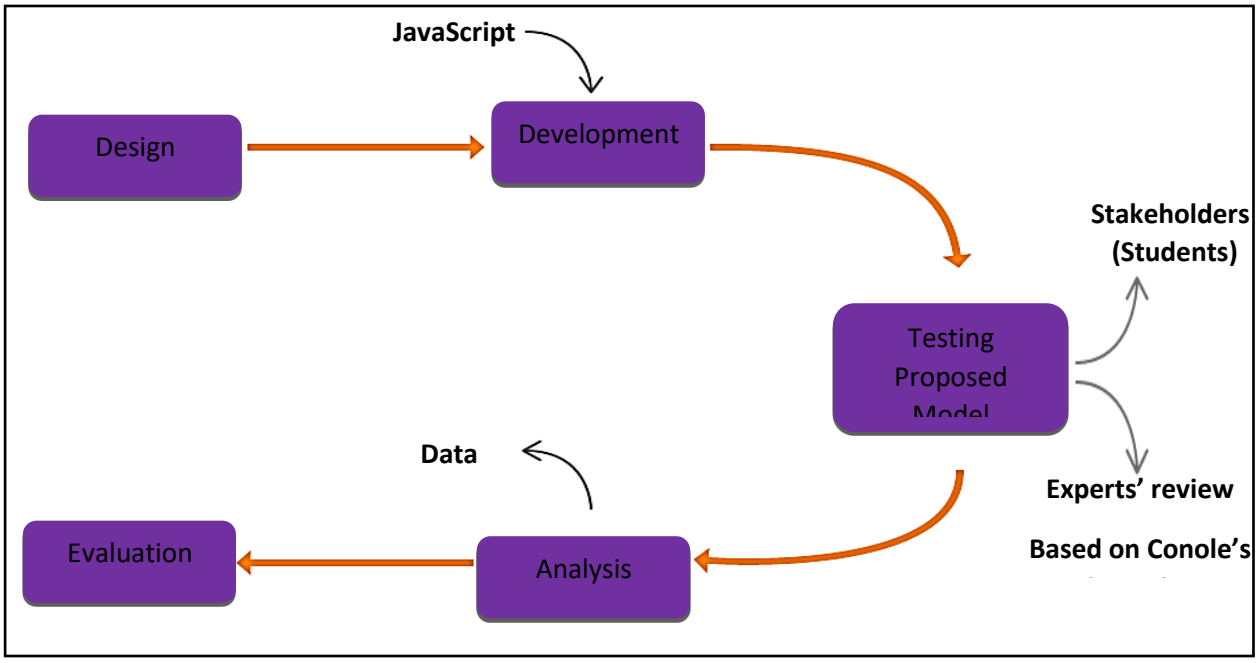

Figure 1: Proposed Research Method

Within this context, the appropriateness is evaluated for the proposed virtual classroom model based on Multimedia and Learning Criteria as a virtual learning platform for the learning environment for the tikrit university by two phases:

A. Phase One

This study examines various colleges of the Tikrit University in Iraq. The research population includes bachelor's students at different departments of colleges, with a total number of 200 participant, and a random sample of them is determined by adopting the Steven k. Thompson equation of the following formula (1):

$$n = \frac{N * p(p-1)}{[[N-1*(d^2 \div z^2)]+p(1-p)]} \ldots\ldots (1)$$

Where: N = total size, n = sample size, d = error percentage, P = letter objectivity and availability percentage, Z = corresponding standard significance class 95% = (1.96), n = 200

All undergraduates at Tikrit University receive a questionnaire at the end of the first semester. Because the students are stakeholders, they should be equivalent in education and age [32]. For the purpose of research validity, the selected learners and participants from the same specialties and classes from colleges (Computer Sciences, Engineering Sciences, Education Sciences, Biology Sciences Physics Science, Medicinal Sciences, Physical sport Sciences) as shown in Table (1).

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Table (1) Undergraduates' Level

Class (Years)	Colleges (Frequency)	Percent %
1	50	25%
2	50	25%
3	50	25%
4	50	25%
Total	200	100 %

Next, at each college, experimental groups are experimented with via the virtual learning criteria available in the proposed virtual Classroom platform such as (Multimedia Performance, Usability, Flexibility, Educational Quality Content, Interaction Design, Openness with Lifelong Learning, and Network Learning). This is done through filling the online questionnaire at each college. Each questionnaire item is examined using descriptive statistics after the data have been collected and the database has been coded in SPSS (version 24).

B. Phase Two

This phase evaluates learning criteria in the virtual Classroom based on Conole's Dimensions [33]. Ten experts review of academicians are involved from different Iraqi universities in this activity. Several experts who are qualified to review the Multimedia and Learning Criteria of the virtual classroom platform model are chosen based on their above 25 years of experience in teaching computer sciences (Multimedia, Deep Learning, Database, Information Security, Communication, Online learning, Networking, E-Learning, Information Technology). The expert's review is composed of five professors and five assistant professors, a total of 10 participants to evaluate the learning activities in the virtual classroom platform. The experts review numbers are considered adequate based on the conditions set by [34].

Table (2) shows the experts' demographic information in ten Iraqi universities. Their information related to gender, position, Academic Qualification, university, and experience are collected to support the trustworthiness of their evaluation of the virtual Classroom platform.

4. Proposed Model of Virtual Classroom Simulation

The Java Media Framework (JMF) is a Java library that facilitates the integration of audio, video, and other real-time media into Java applications and multimedia application. These add-on packs enhance the Java Platform, Standard Edition (Java SE) by providing the ability to capture, play, stream, and convert various media types. With JMF, developers can create compatible multimedia applications across multiple platforms. In addition, the Java Simulation Library (JSL) simplifies the model simulation process by processing a Java library that facilitates the creation of simulation models. Figure 2 shows the structure of the proposed virtual classroom model, which includes all learning activities (features, tools, and components) for the student and lecturer during a virtual lecture [35].

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Table 2: Experts Review Information

Expert Code	Gender	position	Academic Qualification	University	Experience
A	Male	Prof	PhD (Multimedia)	Bahgdad University	33
B	Male	Prof Prof	PhD(Deep Learning) PhD (Software Engineering)	Babylon University Tikrit University	28
C	Female	Prof Prof	PhD(Database) PhD(Communication)	Mosul University Alqadsia University	28
D	Male	Ass. Prof	PhD(Virtual Learning)	Basra University	31
E	Female	Ass. Prof	PhD (Networking) PhD(Multimedia)	Technology University Al-Qadisiyah University	28
F	Male	Ass. Prof	PhD(E- Learning) PhD(Information Technology)	Erbil University Kirkuk University	26
G	Female	Ass. Prof			29
H	Female	Ass. Prof			35
I	Male				31
J	Female				34

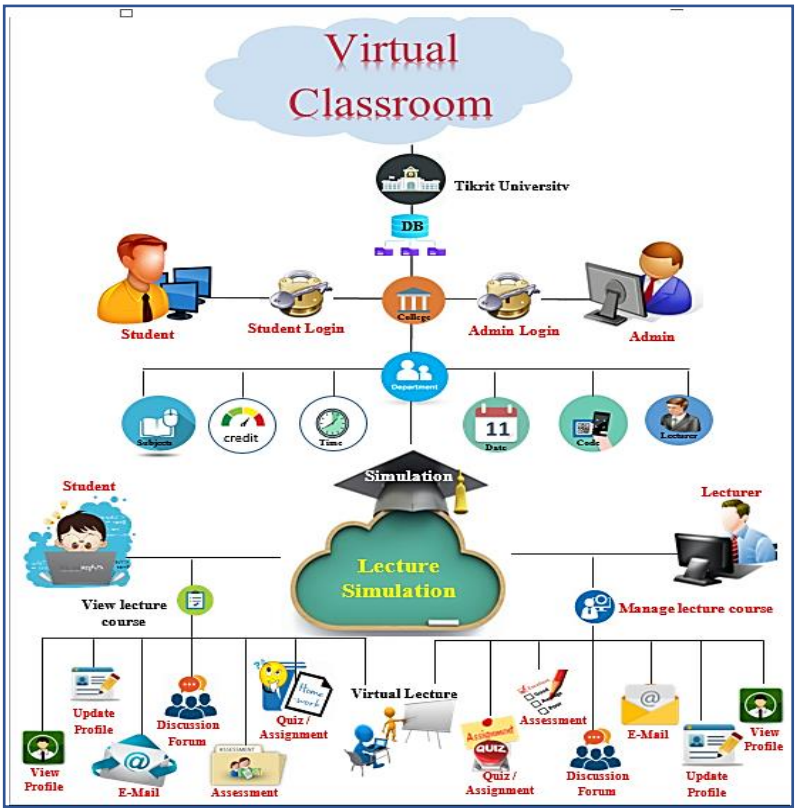

Figure 2: Structure of the proposed Model

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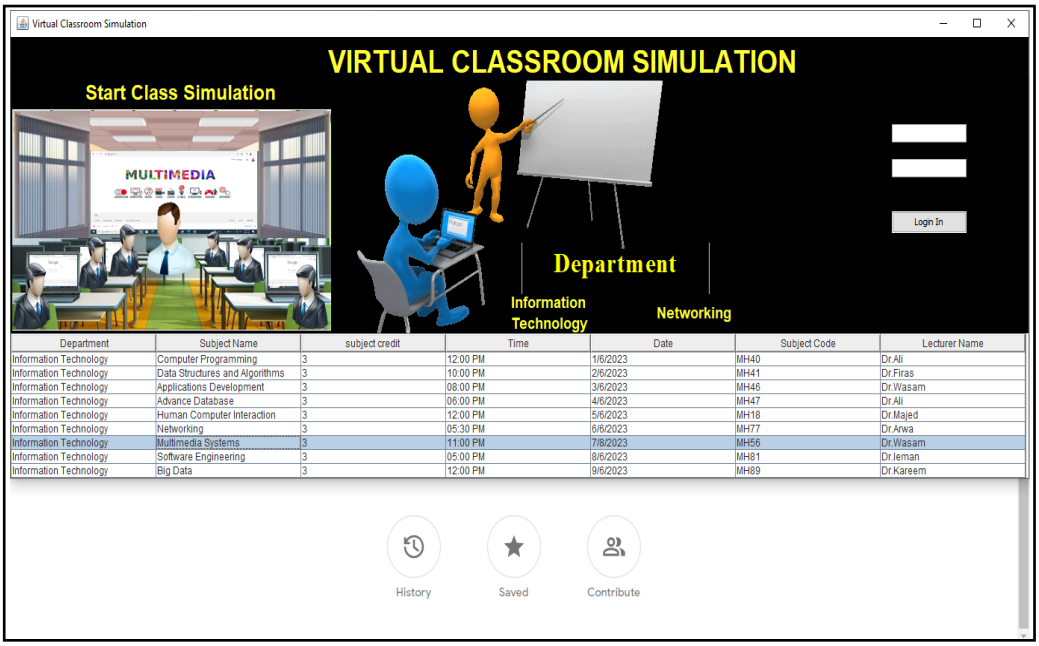
Figure (3), an example on a computer sciences college that includes two departments (IT and Networking), where after the student logged, the student has many features to start a lecture virtually such as (subject name, subject credit, Time, Date, Subject Code, and Lecturer name) based on database of proposed model.



Department	Subject Name	subject credit	Time	Date	Subject Code	Lecturer Name
Information Technology	Computer Programming	3	12:00 PM	1/6/2023	MH40	Dr.Ali
Information Technology	Data Structures and Algorithms	3	10:00 PM	2/6/2023	MH41	Dr.Firas
Information Technology	Applications Development	3	08:00 PM	3/6/2023	MH46	Dr.Wasam
Information Technology	Advance Database	3	06:00 PM	4/6/2023	MH47	Dr.Ali
Information Technology	Human Computer Interaction	3	12:00 PM	5/6/2023	MH18	Dr.Majed
Information Technology	Networking	3	05:30 PM	6/6/2023	MH77	Dr.Arwa
Information Technology	Multimedia Systems	3	11:00 PM	7/6/2023	MH56	Dr.Wasam
Information Technology	Software Engineering	3	05:00 PM	8/6/2023	MH81	Dr.Ieman
Information Technology	Big Data	3	12:00 PM	9/6/2023	MH89	Dr.Kareem

Figure 3: Features of the first interface of the virtual lecture

5. Results And Discussion

5.1. User Experience

The proposed virtual classroom platform is evaluated based on seven criteria (Multimedia Performance, , Usability, Flexibility, Educational Quality Content, Openness with Lifelong Learning, and Network Learning). Thus, the student-centered evaluation is a method to select tests of the platform of virtual classroom. The first one is the Multimedia performance which is a dimension to measure and evaluate the level of multimedia in virtual classroom which is allowed to students to raise their interaction with the subjects to develop their learning to experience traditional classroom. Then, Usability dimension is used to evaluate the level of effectiveness and efficiency in the virtual classroom during the learning process. In the same context, the flexibility evaluates how the virtual classroom is flexible with learning students. On the other hand, the educational quality content aspect evaluates whether the content of virtual classroom has high quality and is well built to empower and motivate the Iraqi students to engage them in the learning process. The Interaction Design aspects then measure its effect on developing the students' motivation and interaction in the learning process. Additionally, the network learning level evaluates the level of collaboration, discussion and exploring knowledge, and sharing ideas between the Iraqi students. Finally, the Openness & Lifelong Learning dimension describes and asses the level of virtual classroom to provide learning to many students at the same time, regardless of their location or educational level, as revealed in Table 3 and Figure 1.

Table 3: Descriptive Analysis of the Respondents' Opinions

Dimensions	Mean	Std. Deviation	Minimum	Maximum	Relative importance%	Severity of approval
Multimedia Performance	4.142	0.773	1.000	5	82.12%	High
Usability	4.095	0.637	1.000	5	81.9%	High
Flexibility	4.071	0.622	1.000	5	81.7%	High

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Educational Quality Content	4.041	0.471	1.000	5	81.3%	High
Interaction Design	4.056	0.533	1.900	5	81.5%	High
Simulation	4.071	0.722	1.000	5	81.7%	High
Openness with Lifelong Learning	4.043	0.837	1.000	5	80.9%	High
Total (Multimedia & Learning Criteria)	4.074	0.656	1.128	5	81.59%	High

Table (3) displays that the participants' awareness of the dimensions of multimedia performance and learning criteria in virtual classroom model is high based on the ratio of relative importance (80.9%-82.12%). For all learning dimensions, the mean value that was higher than the average was (4). There is a consensus by the participants have satisfied on the dimension of multimedia performance, and usability of the platform of virtual classroom based on the level of multimedia and learning Criteria, followed by the flexibility, Educational Quality Content, and interaction design while the dimension of Openness & Lifelong Learning came in the last place. Figures (4), (5), and (6) respectively, shows the means, standard deviation, and relative importance of the 7 dimensions with their combined values. It's also worth noting that the opinions of the sample members on the efficiency of the Multimedia and Learning Criteria depend on virtual classroom platform in terms of the standard deviation and the coefficient of variation. The proportion of all dimensions is less than 50%, which confirms the existence of consistency in the views about the efficiency of the Multimedia and Learning Criteria in virtual classroom.

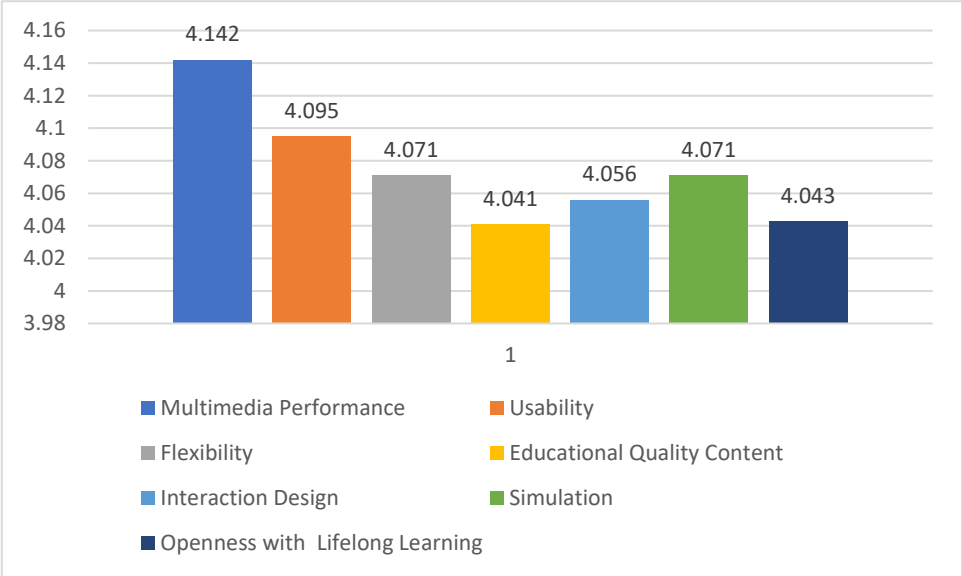

Figure 4 : Means of the Seven Dimensions

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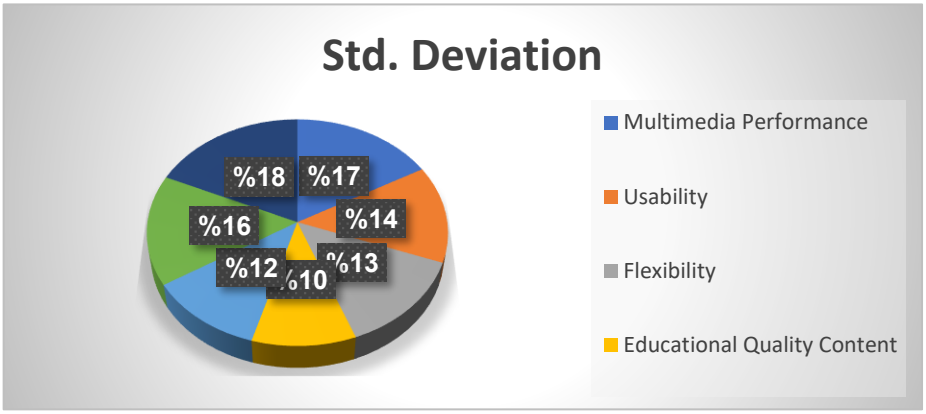

Figure 5 : Std. Deviation of the Seven Dimensions

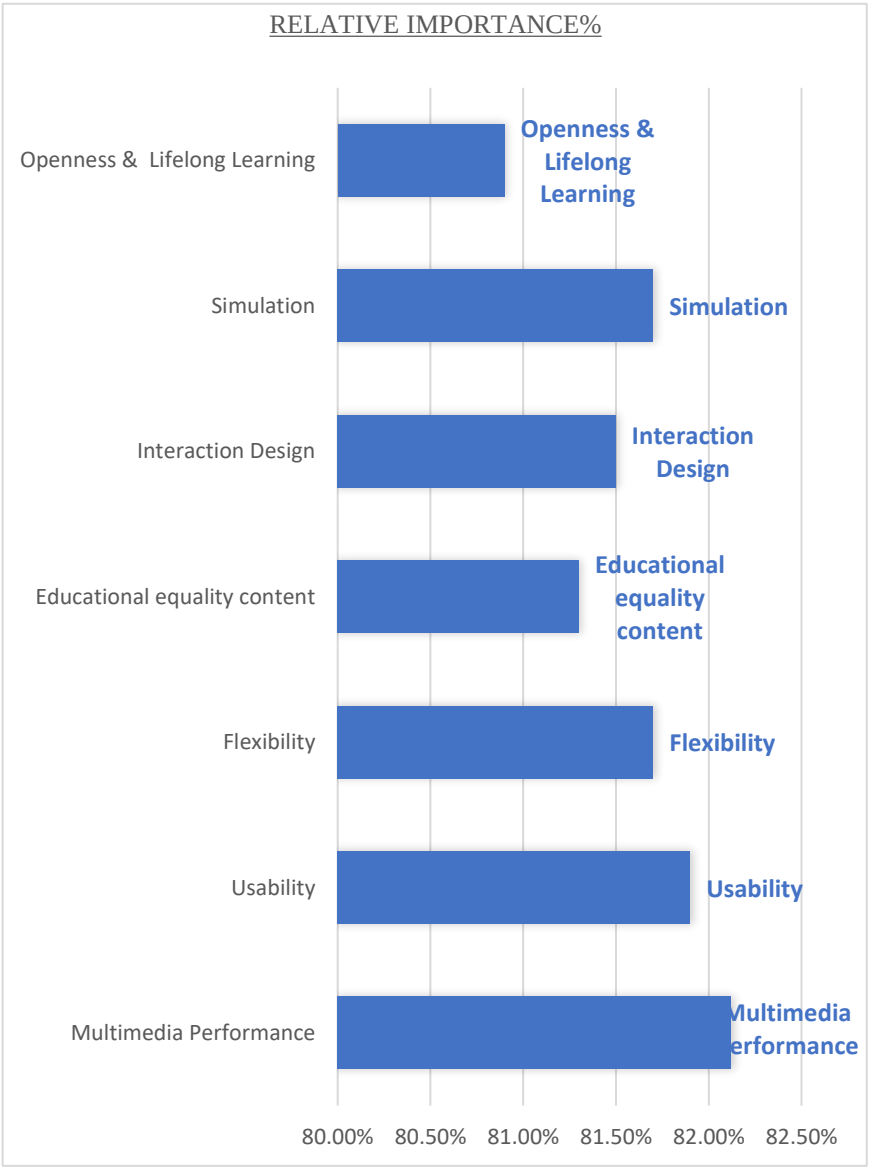

Figure 6 : Relative Importance %

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5.2. Conole's Dimensions

The second phase is the experts' review is the evaluation based on the Dimensions of Conole. Gráinne Conole developed and added a novel classification to virtual learning [36], can be used for evaluating virtual classroom platform Quality. Conole's evaluation includes 12 dimensions: (Level of multimedia, Openness, Massiveness, Communication Tools, Collaborative Learning, learner Path, Quality Assurance, Reflection, Assessment, Learning Model, Autonomy, and Diversity) [37-38]. The proposed virtual classroom platform is presented for the experts' review of professors & Asst. Professors from ten universities (Baghdad, Babylon, Tikrit, Mosul, Alqadsia, Basra, Technology, Al-Qadisiyah, Erbil, and Kirkuk), through a face-to-face interview with the researcher. The virtual classroom platform is evaluated based on these 12 dimensions (Conole's Dimensions) using a three levels scale (i.e. medium, high, low) as displayed in Figure 12.

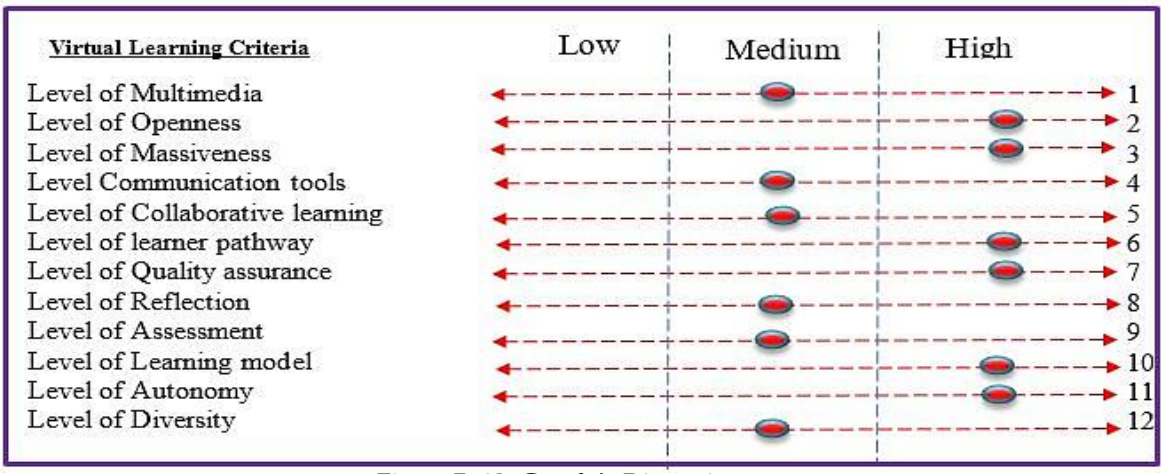

Figure 7: 12 Conole's Dimensions

6. Conclusion

This research uses quantitative and qualitative methods to find out whether Iraqi higher education institutions need the virtual Classroom platform to support traditional learning face to face. It gives a deep understanding of the virtual classroom platform multimedia performance and Learning Criteria based on the culture and experience of the university students in addition to the experts' review. Therefore, the results of this research are more useful for virtual learning via the virtual classroom platform by highlighting the learner's motivations, opportunities, challenges, learner behavior and concepts in the virtual classroom, and the problems and obstacles in the current virtual Classrooms models. Therefore, the results of this research reveal that the participants (students and experts review) are highly agreeable and satisfied with the multimedia performance and learning criteria in the virtual classroom platform model, and this model suitable for the Iraqi learning environment. Furthermore, it highlights that the Iraqi higher education institutions need to use virtual classrooms to support the traditional learning in the learning process.

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