Cloud-Based Virtual Learning Environment Model: A Delphi Study

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Abstract

[Purpose] With the recent technological advancement that the educational sector is facing nowadays, exploring, and evaluating the requirements of such technologies is becoming an important phase to ensure its usability, adaptability, and efficiency before official development and adoption. Thus, this study employed the Delphi technique to gather experts' opinions and reach a consensus on the critical requirements of a virtual learning environment (VLE) based on cloud computing technology. The output of this study proposes a validated cloud-based virtual learning environment (CBVLE) model for use within the teaching and learning environment in Saudi Arabia's higher education institutions (HEI).

[Methodology/Approach/Design] This study employed the Delphi technique to validate a CBVLE model by conducting three different questionnaire rounds for the same panel of 19 experts to reach a consensus of views on the ideal CBVLE model to be used within the targeted environment.

[Practical Implications] The paper highlights the main legal, educational, operational, and quality requirements and factors to consider before developing any CBVLE model, such as cultural influence. The results of this study are expected to provide valuable insights for educators and administrators, along with performing a guideline for researchers in designing and implementing effective, usable, and adoptable CBVLE.

Keywords: Cloud Computing. Virtual Learning Environment. Higher Educational Institutions. Delphi Technique. Requirement Elicitation.

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INTRODUCTION

In the context of higher education, Information and Communication Technologies (ICT) have significantly changed how teaching and learning are conducted during the past three decades (AL-MAMARY et al., 2022). One of the supportive teaching solutions increasingly used is the VLE approach. VLE platforms are spaces developed to teach groups of learners and interact with them remotely through online media (NUGURI et al., 2021), offering a smoother learning experience supported by several tools, such as administrative, assessments, resources, and communication ones (MUNAS and ARUN, 2020). However, due to the unexpected growth of services, users' demands, and networking (ALHAJRI, 2020), VLE faced several challenges (ALHAJRI, 2020; AL-HARTHI et al., 2018; AL-MADHAGY, 2018; ZAWACKI-RICHTER et al., 2019). Therefore, a growing paradigm called cloud computing emerged to cope with the rising demand for reliable, higher-performance, and cost-effective technology (AL-MADHAGY, 2018). Cloud computing is one of the trending solutions within the educational sector, leading to efficient VLE support and collaborative learning (ALHAJRI, 2020; BAANQUD et al., 2020). In cloud computing gaining knowledge and education occurs on the cloud instead of the learners' computing devices (AL-HARTHI et al., 2018) by offering massive data centers to utilize resources between HEIs via hosted applications (ALDOAYAN, 2020; SHARMA and KUMAR, 2017). Virtualization technologies, such as cloud computing, help utilize IT resources, increase IT equipment efficiency, and overcome technology's negative aspects like global warming, E-waste, pollution, toxic materials, and energy crisis (AL-MADHAGY, 2018). Furthermore, Aldiab et al. (2019) highlighted that by utilizing cloud computing to host VLEs, students could collaborate effectively by accessing their studying materials, exams, assignments, and projects via learning management systems or VLEs such as Moodle, Blackboard, and D2L (Desire2Learn). Therefore, several studies emphasize the urgency of integrating cloud computing with the educational sector's platforms for an effective experience (MUNAS and ARUN, 2020).

PROBLEM STATEMENT

As with any new technology, researchers indicated that cloud computing is facing several challenges in its adoption, such as security issues, sharing sensitive data (MUNAS and ARUN, 2020), lack of training while using technology (ALHAJRI, 2020; ZAWACKI-RICHTER et al., 2019), and lack of guidance and support (MUNAS and ARUN, 2020). Moreover, Hofstede (1984)

emphasized that any system designed for one culture may not be suitable for any other. Thus, there is a need to consider studying the cultural, social, and technological factors before developing the new technology and assessing it to ensure its performance, efficiency, and acceptance (ALHAJRI, 2020; HUANG, Yong Ming, 2016).

Furthermore, while cloud computing technology is widely used in education, there is still no agreement on the crucial requirements for the successful, efficient adoption of cloud-based VLE. The current platforms are either not being utilized to their full potential or do not cater to local needs (ALHAJRI, 2020; ALHARBI, Mafawez, 2017; KARIM and RAMPERSAD, 2017; MUNAS and ARUN, 2020). Hence, Hussein et al. (2021) highlighted that the fulfillment of any software or platform depends on users' satisfaction, which largely relies on the elicitation process of the requirements (HUSSEIN et al., 2021), playing a vital role in software development activities (ALFLEN et al., 2020). It is the primary phase in developing quality software (HUSSEIN et al., 2021). It is not just about writing requirements but also about discovering and understanding the real problem and local users' needs (ALFLEN et al., 2020; HUSSEIN et al., 2021). Therefore, the need arises for this study to elicit and gather the local users' needs and requirements to ensure that the developed CBVLE platform is within the needed quality to be an acceptable, usable, and sustainable platform within HEI's teaching and learning environment in Saudi Arabia.

Consequently, the above creates a need for a systematic and comprehensive approach to identify and highlight the requirements and factors to consider for a CBVLE model. This study aims to fill this gap using the Delphi technique to gather experts' opinions and reach a consensus on the critical requirements for a CBVLE model.

RELATED WORK

Using cloud computing in educational institutions along with the VLE offers numerous benefits that can enhance the quality of education (ALDOAYAN, 2020; ALHAJRI, 2020) and support the development of effective and efficient virtual learning environments (ALHAJRI, 2020). However, cloud computing is currently categorized as one of the four traditional utilities: water, telephone, electricity, and gas (MALKAWI et al., 2023). Thus, researchers classified cloud computing into deployment models and services (TAUFIQ-HAIL et al., 2021). Deployment models are four types: private cloud, public cloud, community cloud, and hybrid cloud (ALDOAYAN et al., 2020; ALHAJRI, 2020). On the other hand, Service model layers are infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) (ALHAJRI, 2020).

According to Alshanqiti (2021), cloud computing has proven to be a viable solution for many educational institutions facing financial challenges or struggling with technical complexity. Cloud computing operates on a "pay-as-you-go" model, allowing clients to only pay for their cloud services, resulting in lower operating costs during periods of low service demand (ALDOAYAN et al., 2019; ELMASRY and IBRAHIM, 2021). In addition, cloud computing provides numerous features that incentivize organizations to integrate it with their IT resources and systems (ALDOAYAN et al., 2020). For instance, managing software updates and monitoring has become more convenient. Cloud service providers automatically update systems on their end and replace damaged servers at no additional cost (AHMED and AHMED, 2019; ALDOAYAN et al., 2020).

Additionally, monitoring and security measures are more easily accessible with cloud computing. Service providers can monitor one central location instead of thousands of individual devices owned by the educational institution, simplifying the process of testing for security changes (AHMED and AHMED, 2019), concluding that users can choose the required capacity for their HEI based on factors like size, funding, and needs. Cloud computing enables virtual access to resources like storage, network, applications, and servers (ALHAJRI, 2020; KASSIM et al., 2018). Cloud computing implementation in HEIs improves IT quality and competency facilitation, allowing administrators to focus on the institution's objectives, research, and output (ALENEZI, 2019). Furthermore, it offers ample opportunities for sharing resources like scientific articles and research papers by utilizing cloud computing storage like Google Docs or Dropbox (AL-SAMARRAIE and SAEED, 2018). This creates a collaborative environment for HEIs to share experiences, expertise, and costs in the joint course and teaching material development(CHENG, 2020). Encouraging educators to share experiences and adopt new teaching approaches can train staff and increase student knowledge using forums as a discussion and sharing medium (ALDOAYAN et al., 2019).

In the literature, several studies proposed models or prototypes for the CBVLE, investigating their adoption, efficiency, or challenges. For example, Ahmed and Ahmed (2019) proposed an educational model for staff, students, and parents using cloud computing along with the VLE system to improve the challenges in teaching infrastructure. Also, El-attar et al. (2019) highlighted the challenge of “one size fits all” learning approaches. The study proposed a novel cloud-based self-adaptive learning framework, integrating different e-learning methods, such as social, collaborative, and personalized learning, to overcome the main challenges facing e-learning platforms. For testing purposes, they indicated two trends, one for students to measure the quality of learning services and the other to test the cloud computing usability via hosts. Moreover, Khan et al. (2021)

studied the challenges of the current educational system used in Bahrain. They proposed a model based on the results obtained from gathering 956 participants' data. The study aimed to understand the adaptability of recent technology using cloud-based computing services and artificial intelligence as quickly as it is adopted in the educational sector. The study discussed the main modules used in the system, the training module for all the institution members, the course development module, and the virtual computer lab module of the proposed cloud-based educational models. In the security context, Alghamdi (2018) proposed an integrated cloud model for an intelligent eLearning system to ensure availability and security. The model used web 4.0 and cloud service delivery model to enhance the system efficiency and avoid e-learning challenges. On the other hand, the literature included studies discussing the cultural factors and their created models. For instance, Alhajri (2020) developed a cloud-based collaborative VLE framework for Omani's HEI and provided guidelines for improving the technology's use and acceptance; the study also identified the cultural issues to be considered during the design and implementation process of the framework. Table 1 below summarizes the main requirements and factors to consider for a CBVLE model, gathered from the previous models from different sectors in the literature.

Items	(KHAN et al., 2021)	(ALHAJRI, 2020)	(FORSTER, 2021)	(ELMASRY and IBRAHIM, 2021)	(ALDOAYAN, May et al., 2020)	(ALGHUSHAMI et al., 2020)	(BACKIALAKSHMI and SUMALATHA, 2020)	(EL-ATTAR et al., 2019)	(RAUT et al., 2018)	(ALKHATER et al., 2018)	(ALGHAMDI, 2018)	(AHMED et al., 2018)	(SHYSHKINA, 2017)	(SHARMA and KUMAR, 2017)
Academic Standards					√									
Accreditation	√				√									
Quality Assurance	√				√			√		√				
Security		√		√	√	√	√		√	√	√	√		√
Contract Agreement					√									

Ownership					√			√						
Authentication					√			√						√
Confidentiality				√	√			√	√		√			
Technical Aspects		√			√		√				√			√
Cloud Services	√							√				√	√	
Internet Connection	√													
Staff Training	√				√							√	√	
Technical Support	√				√									√
Organization and Technology Readiness										√				
Student Enrolment					√			√						
Integration with Existing Systems	√													
Student Information System		√		√							√			
Collaboration Between HEI	√	√		√	√			√					√	√
Finance					√									
Teaching and Learning Methods					√									
Assessments				√	√		√	√				√		√
Collaborative Environment	√	√		√	√			√					√	√
Course Development					√			√					√	√
Course Administration					√			√						√
VLE Content							√	√					√	√
Traditions	√													
Trust	√		√						√	√				

Law and Policies						√				√				
Individualism	√													
Attitude	√													
Masculinity	√													
Commercial Advertisements	√													

Table 1 – Factors and Requirements of CBVLE Models in the Literature

METHODOLOGY

This study aims to elicit local requirements and needs to propose an ideal CBVLE model to be used and adopted within the HEIs in Saudi Arabia. Thus, to ensure the efficiency of the study output, three phases were conducted, as illustrated in Figure 1, which also clarifies the mapping of each phase to the related objective and the expected outcome.

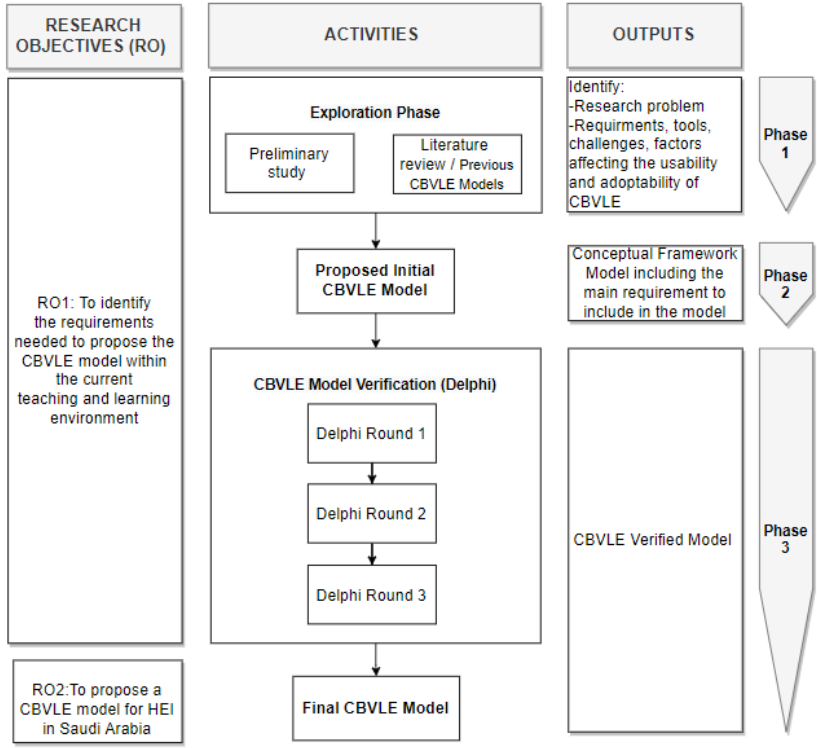

Figure 2 – Research Methodology

The phases are:

- **Phase 1:** Exploration phase, indicating a review of the literature and the previous CBVLE models used within HEIs worldwide. Also, in this phase, a preliminary study was conducted to investigate the local awareness, understanding, needs, challenges, and requirements of cloud computing and VLE from the perspective of HEI users as students, teachers, and administrators in Saudi Arabia. The preliminary study presents a value that supports the intervention assessment by enhancing the proficiency of the educational research and helping refine interventions before carrying out time-consuming and expensive full-scale research (MALKAWI et al., 2023). Hence, the output created a base for the next phase. Table 1 summarizes the requirements and factors gathered from the previous literature studies that helped the researcher in the exploration phase to create the initial model.
- **Phase 2:** Propose the initial CBVLE model from Phase 1 results analysis.
- **Phase 3:** Model verification using the Delphi technique to output the final CBVLE model.

Delphi Technique

The Delphi technique is reliable for collecting and synthesizing subjective judgments from a group of experts to reach a consensus (BOUAYNAYA, 2020; ELZAMLY et al., 2017; JALAMNEH and KHDER, 2021; NASA et al., 2021; NIEDERBERGER and SPRANGER, 2020; TRAVIS, 2021). In the case of this study, the Delphi technique will support eliciting requirements to propose a CBVLE model to be used and adopted efficiently within HEI in Saudi Arabia. The output came out via a group of rounds indicating the interaction between the researcher and a team of experts (panelists) to get over a collection of questionnaires, aiming for group consensus (AL-ARAIBI et al., 2019). The rounds include the same, altered, or expanded questions, depending on the previous round's results (FINK-HAFNER et al., 2019; SKULIMOWSKI, 2017). Delphi's privilege is based on its reliability, the diversity of experts' opinions, and how it can be managed remotely (KASSIM et al., 2018).

Several researchers have utilized the Delphi technique in the area of cloud computing and education. Such as Al-araibi et al. (2019) used the Delphi technique to investigate the students' readiness to accept and adopt e-learning

within HEI while identifying the gaps and redesigning used strategies for better adoption results. On the other hand, Jalamneh and Khder (2021) used Delphi to identify the challenges facing cloud computing implementation in information institutions and libraries within Arab environments. Also, Kassim et al. (2020) highlighted the benefits and limitations of implementing cloud computing within the HEI in Malaysia. Rezapour et al. (2023) proposed a model of a tendency for cloud computing use within education. Also, Leach (2021) developed and validated a framework for naturopathic education and practice using cloud computing. In the same context, Buzo-sánchez et al. (2022) identified the usability of cloud-based systems in Spanish geographic education. Moreover, Hsu and Chen (2019) Examined the teachers' technological pedagogical and content knowledge in the era of cloud computing pedagogy. On the other hand, other studies investigated cloud computing within different organizations, including education, as a part of the study but not a major, like Vareschi (2021), who presents the ranking of the most critical aspects affecting the adoption of cloud computing using the Delphi technique, following an investigation by Lang et al. (2018), identified factors for selecting the cloud service provider while ensuring the quality of services given to the customers. The study used the Delphi technique to guide providers and the cloud customers.

According to research, there are two ways to use the Delphi technique: classical or modified. Benson (2019) clarified the differences, mentioning that in the classical Delphi, the panelists usually design the first round by gathering their opinions via several open questions, where the output will design the questionnaire. While on the other hand, the modified Delphi technique allows the researcher to design the first questionnaire from different means, such as literature reviews. Also, the researcher decides how to run the investigation, meaning that the administration of a study can occur in any form deemed necessary by the researcher (BENSON, 2019; KASSIM et al., 2018). The researcher used the modified technique in this study, as explained later.

In this study, the researcher used the modified Delphi technique, as explained later, similar to (KASSIM et al., 2018; RAJHANS et al., 2020). According to research, the Delphi technique is a commonly used approach for developing proficiency frameworks in the educational sector (RAJHANS et al., 2020). This study has chosen the Delphi technique for several reasons. Firstly, Delphi is a reliable approach for finalizing a group of experts' consensuses about a specific problem or setting a plan or forecast regarding a particular area's future. It helps to confirm, discover, or eliminate the connection between trends, events, and variables, making it the most suitable approach for assessing and developing new products, as it is the most complicated available approach (KASSIM et al., 2018). Secondly, the Delphi technique helps to develop a framework, which is

considered one of its outcomes (ALMAIAH et al., 2022). Lastly, Delphi is most suitable when there is a lack of empirical evidence or any limitation or contradiction, which is the case of this study (HUMPHREY-MURTO et al., 2017). Based on these reasons, the Delphi method is suitable for this study as it will help researchers develop a comprehensive framework to capture the most appropriate requirements for CBVLE within the targeted area. This will be achieved through a consensus approach among experts.

Delphi Panelists

Several researchers indicated no standard number of members in Delphi studies (NASA et al., 2021). According to (MYAVA, 2019), the Delphi study could have 10 to 18 experts, and the choice should depend on the study's needs as long panelists are experts in the field. In this study, the panelists were selected according to their years of experience and knowledge of cloud computing within HEI's teaching and learning environment in Saudi Arabia. They were either known personally or recommended by a third party. They were contacted individually via phone call first to explain the research concept and get their initial approval to participate; after verbal approval, an official invitation letter was sent to each informing them of the process along with the link for the first-round survey. A panel of 13 male and 6 female experts agreed to join. Panelists gathered from 11 different institutions and educational backgrounds with more than three years of experience in cloud computing within the educational sector in Saudi Arabia. In addition, panelists were experts in their fields, as they were a mix of (professor, associate professor, application developers, business developer, cloud business planner, college research director, e-learning administrator, IT manager, and project manager).

Questionnaire Design

The Delphi technique can combine quantitative and qualitative methods or uses either (DE LUCA et al., 2021; VARESCHI, 2021). In this study, the researcher used a modified Delphi technique with three rounds of mixed questionnaires. The panelists were asked to rate the significance of items related to the teaching and learning environment for higher education institutions (HEIs) in Saudi Arabia using a 5-point Likert scale, with 5 indicating strong agreement and 1 indicating strong disagreement. Additionally, the panelists were given the opportunity to provide comments in each round, and the researcher made modifications to the model based on the feedback received. Prior studies defined consensus as the agreement percentage based on central tendency, predefined cut-off, or a mix of both (NASA et al., 2021). However, in this study, consensus was measured using a benchmark of 70% agreement or higher, based on the majority

of previous studies, utilizing the Delphi technique within education, presented in Table 2.

The Delphi study took place between October 2022 and February 2023. The researcher used the modified Delphi technique in this study; the first round (R1) questionnaire was designed from the initial CBVLE model's factors, mentioned in Table 1 above, which is a result of the exploration phase; each question was followed by an open-ended question allowing panelists freedom to bring fresh views; some items were relocated while others were added or removed. Then, the model was restructured in the second round (R2), depending on the panelist's views and comments. And in the third round (R3), the stability of the results took place to ensure the group stability of opinions, as achieving response consensus and stability should be an appropriate closing criterion for Delphi studies (NASA et al., 2021).

Percentage	Article
80%	(AMBREEN ANSAR et al.., 2022; MULU and NYONI, 2023; PITTER, 2022)
90%	(NASRI et al., 2020)
75%	(IFTIKHAR and colab., 2023; MORRIS et al., 2022; NOR et al., 2022; RAJHANS et al., 2020)
70%	(DELANEY, 2021; FERREIRA et al., 2022; HUANG et al., 2022; RAO et al., 2020; LEACH, 2021; MIRATA et al., 2020; OLMOS-GÓMEZ et al., 2020; RICHARDS, 2021; WANG and LU, 2021)
60%	(DE LUCA et al., 2021; SHAH et al., 2020)

Table 2 – Consensus Percentage Review

Data Analysis

The agreement percentage of the experts was presented using descriptive statistics in R1 and R2. Qualitative data from comments were analyzed before preparing the next round of questionnaires. According to the literature, consensus and inter-round stability were considered appropriate termination aspects (ADJE et al., 2023). In R3, the inter-round stability of factors was investigated by determining the degree to which panelists' answers changed. If there was no significant difference in the median of responses from all participants between rounds, the statement was considered stable. The Wilcoxon matched-pairs signed-ranks test was used to evaluate the stability of the responses, as in prior Delphi research (ADJE et al., 2023). The consensus was determined using percentage agreement, considering (strongly agree and agree) responses above 70%, as recommended by previous studies (DELANEY, 2021; FERREIRA et al., 2022; HUANG et al., 2022; RAO et al., 2020; LEACH, 2021; MIRATA et al., 2020; OLMOS-GÓMEZ et al., 2020; RICHARDS, 2021; WANG and LU, 2021). All

factors were determined by percentage agreement, as it was more convenient for the study (ADJE et al., 2023; Schmalz et al., 2021). Adequate Delphi rounds were concluded based on the study by Schmalz et al. (2021). Table 3 displays the factors of the CBVLE model, starting from R1 and ending with R3, which ensures the stability of panelists' opinions through consensus (ADJE et al., 2023).

RESULTS AND DISCUSSION

In R1, the researcher designed a questionnaire asking the panelists to rate the initial proposed model gathered from the exploration phase. The questionnaire started with gathering the participants' general information. The second section combined 28 questions, each asking about an item representing a factor or a requirement in the model while opening the door for comments and views after each question. The results indicated that some items need to be eliminated (consensus below 70%) as the student's attitude and enrolment, indicating their irrelevance to the model. While on the other hand, after analyzing the comments, the following items were added (law and policies, religion, geographic area, language, trust, and gender). Consequently, experts mentioned the reason to include each, as explained further in the discussion. Also, more than one panelist highlighted the need for ISO/IEC 25010 Software Quality Model factors. Thus, they were added to the quality section. Also, sustainability and flexibility, and customization were added. After analyzing the output and the comments, the researcher modified the model and prepared it for R2.

In R2, the questionnaire included 7 sections with a total of 45 questions in the survey; the researcher added more declarations of each factor and related subfactors with the illustrated section in the model. Consequently, the panelists rated the significance of each along with adding comments. Moreover, the panelists were asked to rate even the factor that did not get all the consensus from R1 to give a chance if any want to change their feedback. Overall, student attitude and enrolment kept eliminated since they didn't get a consensus, adding to them from R2 the geographical area as an influencing factor and finance. However, panelists agreed on its importance in the previous round. Thus, the concept of Delphi gives the participants the chance to change their feedback.

The closing round, as mentioned earlier, R3, took place to ensure the group opinions and results stability. For each item where the agreement percentage was below 70%, Wilcoxon's matched-pairs signed-rank test shows no significant difference between the rounds, as the alpha level is set at $p < 0.05$. and in our case, all the results, as shown in Table 3, illustrated values (>.05), highlighting no significant differences in panelists' opinions. Overall, the round ensured stability as all the items got the accepted consensus percentage as R2. And therefore, giving the researcher the final version of the model. The consensus in Delphi

rounds concludes that cultural factors influence the use and acceptance of CBVLE. For instance, the language factor, where the official spoken language in Saudi Arabia is Arabic; although most of the teaching and educational material is in English, users still prefer to deal with their native language while using the learning platforms (ALHAJRI, 2020). Moreover, cultural law is highly connected and related to religion (Islam). In Saudi Arabia, Islam is not only a belief; it is a conceptual framework, a collection of practices and regulations guiding law, education, entertainment, media, and the daily lives of the Saudi people. In turn, Islamic disciplines influence people's communication with each other and personal behavior. For example, they include a prescribed dress code for men and women and gender-segregated spaces, as the education of females needs to be separated from males, either for students or educators (FARAHAT, 2022). Also, most female institutions do not allow opening cameras or recording during online sessions. Therefore, this gender segregation is the crucial factor distinguishing Saudi society from other societies worldwide (ALDIAB, 2022; ALHARBI, 2018). In the same context, considering the educational laws and policies of Saudi Arabia are essential. Saudi Arabia's educational law differs from other nearby countries, especially regarding gender segregation and religious constraints (ALSUBAIE, 2022). Moreover, trust is highlighted as a factor to consider, related to the privacy of saving personal information, especially with females, as customs and traditions prevent them from exposing information.

Items	Rounds	Agreement (%)	Stability Wilcoxon
Cultural Influences			
Customs & Traditions	R2	69.3	
Customs & Traditions	R3	69.3	.317
VLE Content	R2	61.6	
VLE Content	R3	53.9	.059
Commercial Advertisement	R2	53.9	
Commercial Advertisement	R3	38.5	.083
Masculinity vs. Femininity	R2	46.2	
Masculinity vs. Femininity	R3	38.5	.564
Individualism & Collectivism	R2	61.6	
Individualism & Collectivism	R3	46.2	.157
Geographical Area	R2	61.6	
Geographical Area	R3	53.9	.180
Language	R2	92.3	
Users Prefer Language Delivering	R2	84.6	
Religion	R2	84.6	
Communicating with Other Gender	R2	77	

Law and Political	R2	92.3	
Recording Online Sessions for Females	R2	77	
Trust	R2	76.9	
Assigning Lecturers vs. Gender	R2	76.9	
Operational and Services			
Student Information System	R2	84.6	
Finance	R2	69.3	
Finance	R3	69.3	.157
Technical Support	R2	100	
Organization and Technology readiness	R2	84.7	
Sustainability	R2	100	
Ability to Customize, Flexible Design	R2	76.9	
Cloud Computing Services	R2	100	
Collaboration between HEI in terms of VLE	R2	76.9	
Internet Connection	R2	100	
Integration & Compatibility with In-House and Existing Systems	R2	84.7	
Collaborative Environment with Industries and HEI	R2	84.6	
Educational			
Teaching and Learning Methods	R2	100	
Teaching and Learning Culture	R2	100	
Assessments	R2	84.7	
Course Development & Delivery	R2	100	
Course Administration & Management	R2	92.4	
Legal			
Contract Agreement	R2	84.6	
Rights/ Ownership	R2	92.3	
Quality			
Academic Standards	R2	77	
Accreditation	R2	84.6	
Quality Assurance	R2	92.3	
Functionality	R2	84.6	
Performance Efficiency	R2	92.3	
Compatibility	R2	100	
Usability	R2	100	
Reliability	R2	100	
Portability	R2	84.6	
Security	R2	100	

Table 3 – Delphi Study Results

On the other hand, all the other factors are significant to add to any ideal VLE hosted by cloud computing technology. Factors and requirements as follow:

operation and services include the following: sustainability factors of the CBVLE, Student Information System (SIS), and Organization and Technology readiness, including the readiness of the ICT infrastructure and the readiness of the resources. Technical support and maintenance include assisting the staff, students and technically maintaining the resources. Cloud computing services may be considered the most appropriate, ensuring trust, flexibility, and accessibility. Integration and compatibility with in-house and existing systems such as the SIS, human resources, finance, and library resources, and managing the overall VLE. Internet connection indicates the service provider's choice. Collaboration between different HEIs around the kingdom in terms of VLE. Customization and flexible design. Moreover, the educational factors include Assessments, Course administration, Course development and delivery, and Collaborative environment with industries and HEIs to prepare students for employability, teaching and learning methods, and teaching and learning culture, which need to be considered as cultural influences the educational environment. Furthermore, the legal factors include rights, ownership, and contract agreements with universities and countries. Finally, the quality factors include academic standards, accreditation, quality assurance, functionality, performance efficiency, compatibility, usability, reliability, portability, and security.

In conclusion of the study, the Delphi Rs identified a set of factors and requirements that should be considered when developing a CBVLE model for use in Saudi Arabia, as illustrated in Figure 2 below. The model consists of five main factors, with several subfactors under each. These factors are quality, legal, educational, operational and services, and cultural influences. It is important to note that cultural influences vary between countries, so the factors identified in this study may not apply universally.

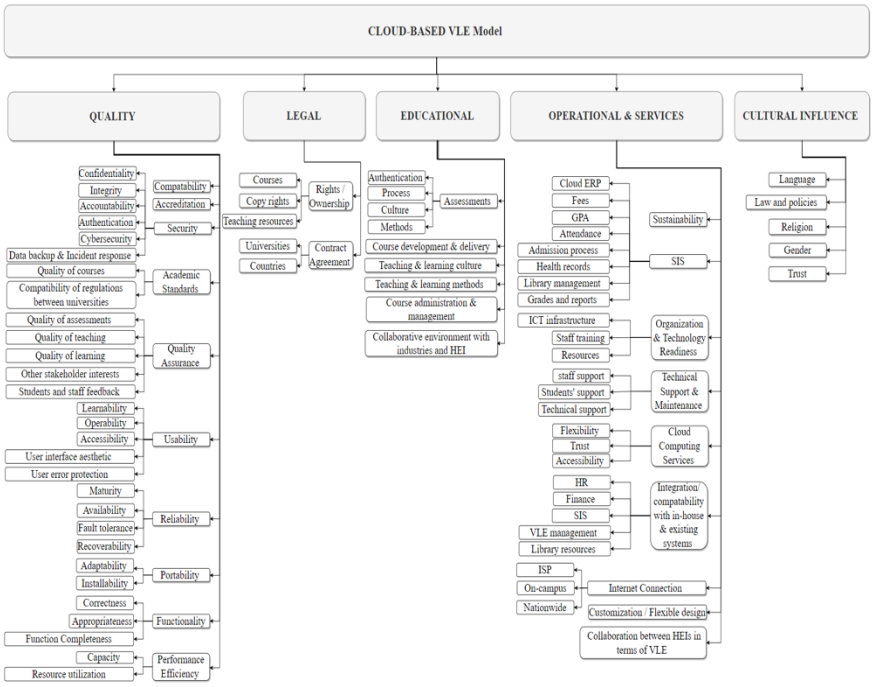

Figure 2 – The Proposed Model

CONCLUSION

In conclusion, a Delphi study is a valuable tool for requirement elicitation for cloud-based VLE model development. The method helps to gather and analyze the opinions of experts in the field, which can result in a comprehensive and well-rounded set of requirements for the VLE. Using a Delphi study in the VLE development process can help ensure that the final product meets the needs of all stakeholders and is well-suited to support online learning. After three rounds of data collection, there was consensus about the significant factors to consider while developing a CBVLE model. The results of this study will provide valuable insights for educators, administrators, and researchers in developing effective and efficient cloud-based VLEs. Further study could develop and verify a platform from the proposed model by investigating students' and teachers' satisfaction.

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