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Retraction

Retracted: Implementation of Cloud Computing Protocol in E-Learning for Future Wireless Systems

Wireless Communications and Mobile Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] L. Hou, Q. Liu, J. Nebhen, M. Uddin, and A. Chaudhary, "Implementation of Cloud Computing Protocol in E-Learning for Future Wireless Systems," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1954111, 12 pages, 2022.

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Research Article

Implementation of Cloud Computing Protocol in E-Learning for Future Wireless Systems

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Schooling system is rapidly shifting according to time. The 4G and 5G machineries are engineered to work flawlessly in heterogeneous platforms unlike 2G, 3G, and 4G wireless networks. New educational techniques are introduced for different environmental needs and E-learning, which is getting popular around the world, and wireless networking plays the vital role in it. E-learning is the requirement of every educational institute. There are a number of problems in the existing prototypes which need to be addressed and improved. This study provides the prototype for E-learning to make the higher education system more efficient. Especially, for the students who need distance learning and an online learning system, this research proposes a user-friendly cloud network infrastructure environment. Machine learning and cloud have strong relation in cloud computing; we store big amount of customer data but to analyze the data and create chatbots, we need machine learning algorithms. We need to enhance the existing prototype for the betterment of the higher education system in rural areas such a time of this COVID-19 pandemic. For this purpose, the existing prototype is critically examined. To achieve this factor why and how E-learning is familiar to the students of rural areas in developing countries, it was analyzed, as the method of education using a platform and interpreting the results. The researcher tried to discover the reason why E-learning is not being applied in higher education. Furthermore, attempts were made to change the existing model by adding the component "Cloud-based structure" that complements and fits the environment of the education system and benefits the long-term sustainability of higher education.

1. Introduction

The Internet brought a revolution in the education system by improving data availability everywhere resulting in economic education. But huge revolution and boom came when, for the first time, in 1996 the "Internet-Based Training" workshop was held at American Society for Training and Development. That brought the trend of accessing online facilities constantly anytime, anywhere [1]. A decade ago, for the first time, an E-learning system appeared, and after that, various universities added the facility as a supple-

ment to online coaching. The author has found some researchers who claim that Semantic Web has capable tools for building an E-learning system [2].

E-learning is electronic learning for educators; in this system, you do not need to meet students physically [3–6]. You just need to verify the E-learning websites. When you will be part of these websites, you will be able to identify your object evidently. When you start your framework, you need basic trainers who know how to practice in school life. This web page should be freely available, and the display of this website should be attractive for the students; there

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should be lectures in PowerPoint, and audio and video lectures should be included. You also need to give some handwritten work to the students. Course and books should be uploaded to this website publicly and free of cost.

E-learning is one of the economical, efficient, progressive, and modern ways of any kind of learning. As improvement is required in the education system of rural areas, Elearning is very important, and to provide an E-learning platform, this research is developing the prototype for an E-learning expert system, especially, for higher education. This module of E-learning requires the infrastructure for students and teacher/lectures which are very costly to establish using the traditional means, so it shifted over to the cloud to facilitate. Necessary financial requirements for the cloud infrastructure are studied so that it may be adjusted in the budget of higher education. The higher education system involves several academic processes such as the design of syllabus, course, and study material which is very difficult to handle using the traditional means of the educational system. However, if these procedures are integrated using a centralized cloud-based system, they would be easily accessible to each and every stakeholder of the system. The research has been conducted to answer the following question. Whether educational institutions are equipped with Elearning tools and technologies or not? Whether E-learning technology is feasible for rural areas? Whether literacy rate in rural areas of developing countries can be enhanced through E-learning Mode?

2. Related Work

The rapid development of Information and Communication Technology (ICT) has changed all aspects of human life including the way people work, learn, and teach [7–13]. Distance education is an education undertaken by students in a setting remote from the physical campus of the educational institution. It suggests a geographical separation between the teacher and the student. Earlier, distance learning was delivered by "Broadcasting courses" such as TV and radio broadcast but generally, this type of learning did not provide any type of feedback or communication among other members of the educational process. Nowadays, the learning materials could be delivered to learners through Internetbased courses or E-learning. This type of distance education could be developed in the current Internet environment with the help of interactive web-based textbooks, e-mails, mailing lists, chats, asynchronous forums, computer modeling and reproduction programs, and others. It can also lead to better results while decreasing costs and improving performance [14-17].

The authors in [18] discuss that E-learning is essentially the computer and network-enabled transfer of skills and knowledge. E-learning applications and procedures include web-based learning, computer-based learning, virtual education opportunities, and digital collaboration. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video, and audio. The author says that almost at all levels in educational institu-

tions E-learning will become a vital part of different functions.

Three international benchmarking developments are E-excellence, the E-learning Benchmarking Exercise 2009, and the First Dual-Mode Distance Learning Benchmarking Club. A comparison of these models reveals a rather high level of correspondence. From this finding and from desktop studies of the current discourse regarding E-learning, a conceptual framework, based on a range of critical success factors, for E-learning has emerged. This model could be used as a foundation for future E-learning and as an inspiration to develop, implement, evaluate, and internalize E-learning [19].

The rapid growth of E-learning over the last 15 years [20–25] and its increasing acceptance present educators with an opportunity to transform education and meet the needs of a much broader, diverse group of learners as compared to the past. Students across the world are earning diplomas, taking courses in subjects not previously available to them, connecting with students in faraway places, and increasing their control over the path and pace of their education [26].

3. Methods

3.1. Questionnaire. A questionnaire has been generated for this research and has been delivered to different educational institutes of rural areas, where the education system is really weak and the COVID-19 pandemic made it really difficult to get quality education. The educational institutes are closed, and students have lost a lot of time due to the unavailability of regular classes. We have modified a prototype of cloud computing in the previous model of E-learning and asked to implement it, and we got the respondent's responses after applying this prototype, and the questionnaire can be seen in Table 1. It is based upon 12 questions.

3.2. Statistical Testing. We have applied descriptive statistics which summarises data such as mean, mode, and median. There are four different answers for every question, so we have made different statistical tables for (a), (b), (c), and (d) answers from questionnaire, and we have shown the results in Tables 1–4. Table 2 shows the descriptive statistics of the results of (a) answers from questionnaire, Table 3 shows the answers of (b), Table 4 shows the (c), and Table 5 shows (d) as well.

$$\begin{aligned} \text{Mean} &= \frac{\epsilon F1X1}{\epsilon F1} = \frac{6.90}{12} = 0.575, \\ \text{Median} &= L_1 + \frac{i}{f} \left(\frac{n}{2} - cf \right) = 0.4 + \frac{0.1}{4} \left(\frac{12}{2} - 6 \right) = 0.4, \\ \text{Mode} &= L_1 + i \left(\frac{fm - f1}{2fm - f1 - f2} \right) = 0.4 + 0.1 \left(\frac{4 - 0}{2 \times 4 - 0 - 0} \right) = 0.45, \\ \text{Variance} &= \frac{\epsilon \left(X1 - \dot{X} \right) 2}{n - 1} = \frac{0.605625}{12 - 1} = 0.055, \\ \text{Standard Deviation} &= \sqrt{0.055} = 0.2346. \end{aligned}$$

Table 1: Questionnaire with prototypes.

Question	(a)	(b)	(c)	(d)
What is E-learning?	Is a networking programming	Is a learning program	Is a sharing program	None of above
Does the material illustrate the content in a helpful way and is the use of the material adequate to the content?	Very appropriate	Good	Inappropriate	_
Is assessment or feedback given to exercise and tests?	Satisfied	Dissatisfied	No feedback	
Does the content design contribute to comprehensibility and are pleasant in general?	Highly effective	Good	Poor	-
How do you rate in overall this E-learning application?	Very effective	Good	Ineffective	_
Will you recommend this E-learning application to other students/professionals?	Strongly recommended	Recommended	Not recommended	7
Do you think your institute has awareness about E-learning?	Nil	Good	Satisfactory	High
E-learning requirements?	Experts	Tools	Platform	Team
Do you know about E-learning prototype?	Yes	No	_	_
E-learning prototype is?	Good	Bad	Effective	None of them
Do you think modified prototype will increase the level of E-learning?	Agree	Strongly agree	Disagree	_
Uploads and downloads in the cloud is?	Very easy	Difficult	Authentication based	Unsecure

Table 2: Descriptive statistics of (a) answers.

Class limit	F_1	CF	X_1	F_1X_1	$(X_1 - \dot{X})^2$
0.10-0.20	2	2	0.15	0.3	0.180625
0.20 - 0.30	0	2	0.25	0	0.105625
0.30 - 0.40	0	2	0.35	0	0.050625
0.40 - 0.50	4	6	0.45	1.8	0.015625
0.50 - 0.60	0	6	0.55	0	0.000625
0.60-0.70	2	8	0.65	1.3	0.005625
0.70 - 0.80	1	9	0.75	0.75	0.030625
0.80 - 0.90	1	10	0.85	0.85	0.075625
0.90-1.00	2	12	0.95	1.9	0.140625
	ϵ 12			€ 6.90	ϵ 0.605625

Table 4: Descriptive statistics of (c) answers.

Class limit	F_1	CF	X_1	F_1X_1	$(X_1 - \dot{X})^2$
0.00-0.05	3	3	0.025	0.075	0.008281
0.05-0.10	6	9	0.075	0.45	0.001681
0.10-0.15	0	9	0.125	0	0.000081
0.15-0.20	0	9	0.175	0	0.003481
0.20 - 0.25	0	9	0.225	0	0.011881
0.25-0.30	1	10	0.275	0.275	0.025281
0.30 - 0.35	0	10	0.325	0	0.043681
0.35 - 0.40	0	10	0.375	0	0.067081
0.40 - 0.45	0	10	0.425	0	0.095481
0.45 - 0.50	1	11	0.475	0.475	0.128881
	ϵ 11			ϵ 1.275	ϵ 0.38581

TABLE 3: Descriptive statistics of (b) answers.

Class limit	F_1	CF	X_1	F_1X_1	$(X_1 - \dot{X})^2$
0.05-0.10	3	3	0.075	0.225	0.041616
0.10-0.15	2	5	0.125	0.25	0.023716
0.15-0.20	0	5	0.175	0	0.010816
0.20 - 0.25	0	5	0.225	0	0.002916
0.25-0.30	1	6	0.275	0.275	0.000016
0.30 - 0.35	1	7	0.325	0.325	0.002116
0.35 - 0.40	1	8	0.375	0.375	0.009216
0.40 - 0.45	0	8	0.425	0	0.021316
0.45 - 0.50	4	12	0.475	1.9	0.038416
	<i>€</i> 12			€ 3.35	€ 0.150144

Mean =
$$\frac{\epsilon F1X1}{\epsilon F1} = \frac{3.35}{12} = 0.279$$
,

Median =
$$L_1 + \frac{i}{f} \left(\frac{n}{2} - cf \right) = 0.25 + \frac{0.05}{1} \left(\frac{12}{2} - 6 \right) = 0.25,$$

$$Mode = L_1 + i \left(\frac{fm - f1}{2fm - f1 - f2} \right) = 0.45 + 0.05 \left(\frac{4 - 0}{2 \times 4 - 0 - 0} \right) = 0.475,$$

Variance =
$$\frac{\epsilon (X1 - \dot{X})2}{n - 1} = \frac{0.150144}{12 - 1} = 0.0136$$
,

Standard Deviation =
$$\sqrt{0.0136} = 0.1168$$
. (2)

		•			
Class limit	F_1	CF	X_1	F_1X_1	$(X_1 - \dot{X})^2$
0.00-0.01	0	0	0.005	0	0.0036
0.01-0.02	0	0	0.015	0	0.0025
0.02-0.03	1	1	0.025	0.025	0.0016
0.03-0.04	0	1	0.035	0	0.0009
0.04 - 0.05	0	1	0.045	0	0.0004
0.05 - 0.06	0	1	0.055	0	0.0001
0.06 - 0.07	1	2	0.065	0.065	0.0000
0.07 - 0.08	1	3	0.075	0.075	0.0001
0.08 - 0.09	0	3	0.085	0	0.0004
0.09-0.10	1	4	0.095	0.095	0.0009
	ϵ 4			ϵ 0.26	ϵ 0.0105

Table 5: Descriptive statistics of (d) answers.

$$\begin{aligned} \text{Mean} &= \frac{\epsilon F1X1}{\epsilon F1} = \frac{1.275}{11} = 0.116, \\ \text{Median} &= L_1 + \frac{i}{f} \left(\frac{n}{2} - cf \right) = 0.05 + \frac{0.05}{6} \left(\frac{11}{2} - 9 \right) = 0.047, \\ \text{Mode} &= L_1 + i \left(\frac{fm - f1}{2fm - f1 - f2} \right) = 0.05 + 0.05 \left(\frac{6 - 3}{2 \times 4 - 0 - 3} \right) = 0.08, \\ \text{Variance} &= \frac{\epsilon \left(X1 - \dot{X} \right) 2}{n - 1} = \frac{0.38581}{11 - 1} = 0.038581, \\ \text{Standard Deviation} &= \sqrt{0.038581} = 0.1964. \end{aligned}$$

$$Mean = \frac{\epsilon F1X1}{\epsilon F1} = \frac{0.26}{4} = 0.065,$$

$$Median = L1 + \frac{i}{f} \left(\frac{n}{2} - cf\right) = 0.06 + \frac{0.01}{1} \left(\frac{4}{2} - 2\right) = 0.06,$$

$$Mode = L1 + i \left(\frac{fm - f1}{2fm - f1 - f2}\right) = 0.02 + 0.01 \left(\frac{1 - 0}{2 \times 1 - 0 - 0}\right) = 0.02,$$

$$Variance = \frac{\epsilon \left(X1 - \dot{X}\right)2}{n - 1} = \frac{0.0105}{4 - 1} = 0.035,$$

$$Standard Deviation = \sqrt{0.0035} = 0.0592. \tag{4}$$

3.3. Research Methodology. Research brings enhancement in every field; it is a continuous process that never stops. The methodology is the significant variable of research, we need a proper methodology to do something efficiently. Using proper methodology can generate proper, correct, and meaningful results. In this research, a prototype has been developed for E-learning, for which learning paths are defined; contextual description is given for the learning environment and learning objects. Individual sessions for assessment are designed and information stored. The expert system will recognize and authenticate the user by using a questioner, and also, goals of learning would be questioned. Learning materials would be located; the expert system will

monitor the learning process and progress. To get satisfactory advice for learning communication means would be explored. After completion of the learning session checkpoints will help for enhancement of service. The conceptual model will contain a system model and learning process. In short, the required work in this research claims to adopt a hybrid methodology which means qualitative and quantitative approaches. The nature of this study belongs to an accurate, timely, and correct efficiency of materials, and the sources can be qualified by using hybrid research methodology, and it can be seen in Figure 1.

4. Results

Rural areas of developing countries are far away from the modern techniques of education even they do not have enough awareness about E-learning as it can be seen in Figure 2 that people answered in a survey that E-learning is networking programing.

We knew that the content which is provided in the material illustrates has very important rules for the implementation of any project, so to know about our proposed model and its material, a survey is being conducted; in survey, 53% of respondents said that it is very appropriate, and others said that it is very good as results can be seen in Figure 3.

The assessment is critical and is an important phase in the academic cycle that cannot be ignored. So, the researcher also asked the respondent to give the assessment or feedback conclusion of the survey shows that maximum people answered that they are satisfied as it can be seen in Figure 4.

The content design delivery contributes a lot to the development of E-learning. We conducted a survey for both previous and modified prototypes, and the results of the survey showed that maximum people approved its effectiveness which can be seen in Figure 5.

The application of E-learning is very effective, and it is good enough for the learning process as it can be seen in Figure 6 that 60% of respondents agree that it is very effective for the learning process.

As we know, the recommendation of anything is very important for awareness and acceptance. The researcher asked about the recommendation of the application, and 93% of respondents said that they will recommend this application which can be seen in Figure 7.

Developing countries are unaware of advanced technologies to use and implement in institutes, and it is important to have enough awareness about the technology. For this purpose, a survey is being conducted, and the survey reveals that maximum respondent has good knowledge as results can be seen in Figure 8.

The key factor in any field of development is the presence of expertise in its domain area. The major and key requirement of E-learning is the expert knowledge, tools being used for E-learning; platform and team are the most important requirement for the establishment of an E-learning environment. The results of the survey can be seen in Figure 9.

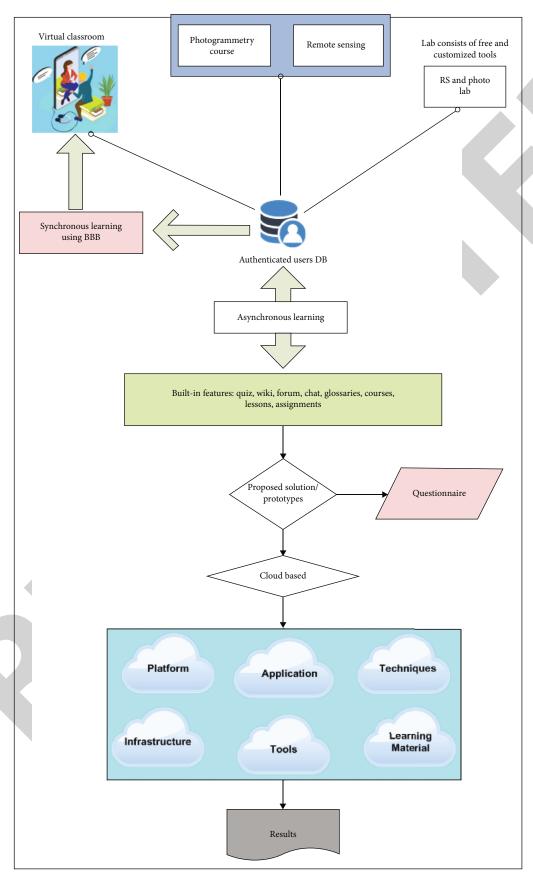


FIGURE 1: Methodology.

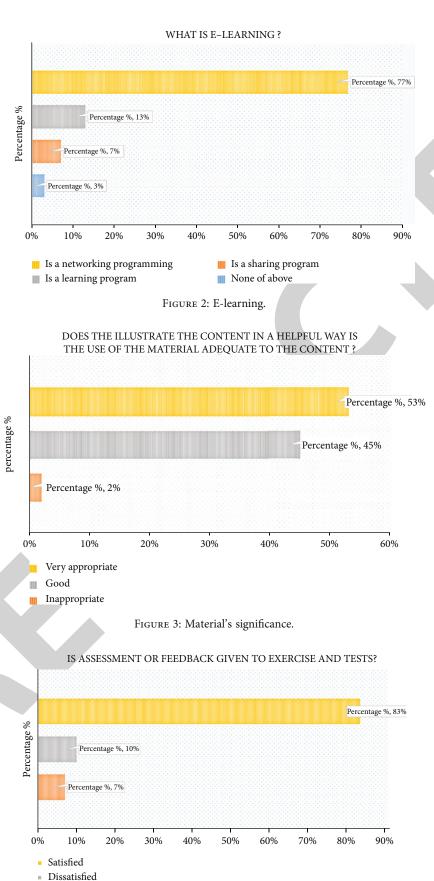


FIGURE 4: Assessment about the questionnaire.

No feedback



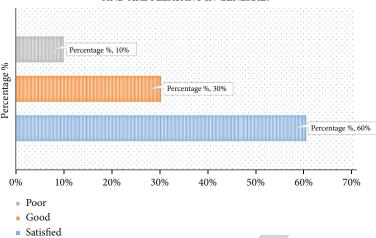


FIGURE 5: Effectiveness of content.

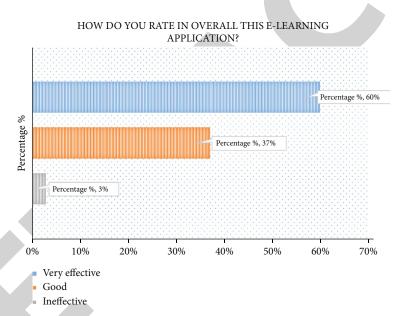


FIGURE 6: Feedback of E-learning application.

To implement the E-learning and success of the prototype and its importance, a survey was conducted, and the results of the survey show that maximum people have awareness about E-learning which can be seen in Figure 10.

The main drivers are the first and most important factors in any organization. There are people who are highly educated and have a lot of knowledge, and they know what their goals are. We have received responses that the E-learning prototype is good, as can be seen in Figure 11.

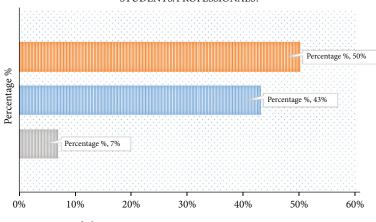
Choosing between the various learning models will help to optimize the learning abilities in the study, and anyone can use them to improve their learning process for the sake of the outcome survey was insane; the results show that half of the respondents strongly agree, and the remaining half agree that it will increase the level of E-learning as can be seen in Figure 12. Simple uploads and downloads are essential for learning, but privacy and security are indeed key parameters. The cloud is reliable, and uploading and downloading for authorized individuals are easy. After this research, we came to know that maximum respondents think that data is secure in the cloud. Figure 13 reveals the results.

This research is aimed at providing an E-learning expert system prototype for higher education environment, and the prototype modifications have been sent to different rural area educational institutes, and the respondent responses can be seen in Table 6.

5. Discussion

Next generation cloud computing technology is gradually increasing the attention of organizations [26–30]. It is





- Recommended
- Strongly recommended
- Not recommended

FIGURE 7: Recommendation of modified prototype.

DO YOU THINK YOUR INSTITUTE HAS AWARENESS ABOUT E-LEARNING?

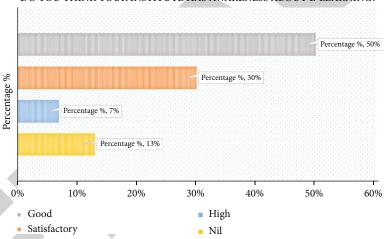


FIGURE 8: Awareness about E-learning.

E-LEARNING REQUIREMENTS?

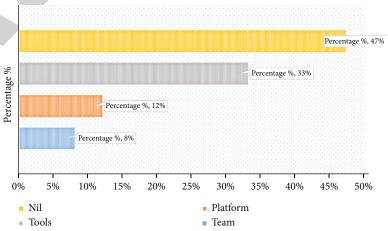


FIGURE 9: Requirements of E-learning.

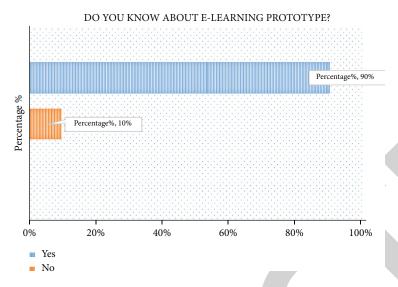


FIGURE 10: E-learning prototype awareness.

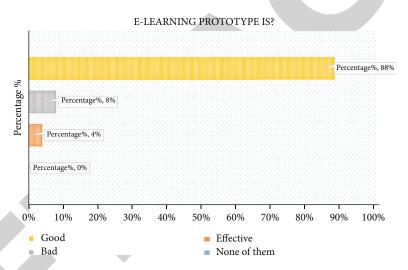


FIGURE 11: Effectiveness of proposed prototype.

basically involving a variety of independent technologies like hardware virtualization, utility computing, network system, web services, display place as a service, and software as a service [31–35].

The proposed modified prototype carries the solutions for problems in the education sector of rural areas, and the proposed prototype provides the platform for the Elearning environment of higher education. On the other hand, this platform will open the door to the international market, and it also diagnosed the cons that make it difficult to educate the population.

In comparison, to the existing prototype and proposed prototype, a survey was conducted. The survey indicates that 77 percent of respondents replied that E-learning is a networking programming, 49 percent said that it is very appropriate, while 83% percent of respondents showed satisfaction

about the proposed prototype. From the study, the researcher found that 60 percent of individuals said that it is highly effective, while 43 percent said that they will recommend it. In another survey question, 90% of the respondents responded that they knew about E-learning. It was found that 50 percent of respondents believe that do you think your institute has awareness about E-learning, 88 percent said that people who know that E-learning is a prototype, and 50 percent strongly agree that modified prototype will increase the level of E-learning, and another question was asked about uploading and downloading in cloud; 50 percent said that it should be authentication based.

Cloud is getting popular day by day as cloud computing is very attractive due to the capabilities and properties it contains. With the proposed methodology and enhancement in design, it seems easy to establish a highly equipped E-



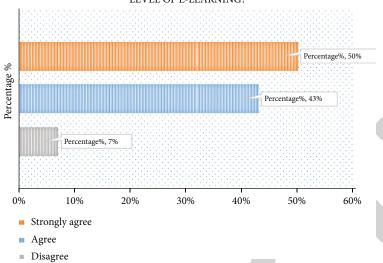


FIGURE 12: Effectiveness of prototype in E-learning.

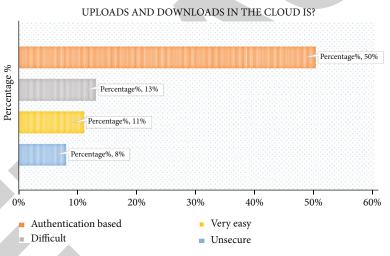


FIGURE 13: Trust of users in cloud.

Table 6: Response of educational institutes.

Questions	Answers
What is E-learning?	Is a networking programming
Does the material illustrate the content in a helpful way and is the use of the material adequate to the content?	Very appropriate
Is assessment or feedback given to exercise and tests?	Satisfied
Does the content design contribute to comprehensibility and are pleasant in general?	Highly effective
How do you rate in overall this E-learning application?	Very effective
Will you recommend this E-learning application to other students/professionals?	Strongly recommended
Do you think your institute has awareness about E-learning?	Nil
E-learning requirements?	Experts
Do you know about E-learning prototype?	Yes
E-learning prototype is?	Good
Do you think modified prototype will increase the level of E-learning?	Agree
Uploads and downloads in the cloud is?	Very easy

learning environment. In short, the required processes for education are incorporated in the proposed cloud-based E-learning for higher education. Learning material of high cost could be provided to the teachers and students as free online resources in the system. For example, data will be shared through the web, mobile SMS, and mail, and also, online lectures will be delivered.

6. Conclusion

The lifestyle of maximum popularity is that they live in mountain and desert houses are far away from one another, and they are not able to access institutions of higher education easily. Moreover, the weather in rural areas also affects their education. E-learning is going to make sure the access to learning materials in extreme weather, anywhere, anytime. E-learning is the need for today's modern education system. This research is developing a prototype for E-learning, which is a remarkable step to the future of higher education and advanced study methodology, which will provide good education. To accomplish these factors, a questionnaire with prototype was developed for the previous models to enhance the capability of E-learning. Due to this implementation, researcher concluded that how the people of rural areas in developing countries can get education and responsiveness of E-learning. Most of the educational institutes have the facility of E-learning, and after this research, the institutes implemented the modified prototype, and it enhanced the capability of E-learning in rural areas of developing countries like Pakistan, India, Bangladesh, Sri Lanka, and Nepal. This system has analyzed the method of education by using a policy and construes the results. After all, for these reasons, we will be successful to modify the existing model by adding the component "Cloud-based" which matches and suits the environment of the education system.

Data Availability

The data set can be acquired from the correspondence upon request.

Conflicts of Interest

The authors declared no conflict of interest.

Authors' Contributions

Li Hou and Qi Liu wrote the article. Jamel, Mueen Uddin, and Atika Chaudhary performed the visualization and proofread it.

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References

- [1] W. Huang, D. Webster, D. Wood, and T. Ishaya, "An intelligent semantic e-learning framework using context-aware Semantic Web technologies," *British Journal of Educational Technology*, vol. 37, no. 3, pp. 351–373, 2006.
- [2] J. R. Huamani, J. C. Sequera, J. M. Cañamero, F. P. Mansilla, and G. B. Quispe, "A proposal of an E-learning interoperable platform based on semantic web," *Creative Education*, vol. 6, no. 8, pp. 738–744, 2015.
- [3] M. Janelli, "E-learning in theory, practice, and research," Вопросы образования, vol. 4, pp. 81–98, 2018.
- [4] K. H. Lau, T. Lam, B. H. Kam, M. Nkhoma, J. Richardson, and S. Thomas, "The role of textbook learning resources in e-learning: a taxonomic study," *Computers & Education*, vol. 118, pp. 10–24, 2018.
- [5] S. Hubalovsky, M. Hubalovska, and M. Musilek, "Assessment of the influence of adaptive E-learning on learning effectiveness of primary school pupils," *Computers in Human Behavior*, vol. 92, pp. 691–705, 2019.
- [6] M. Uddin, A. Khalique, A. K. Jumani, S. S. Ullah, and S. Hussain, "Next-generation blockchain-enabled virtualized cloud security solutions: review and open challenges," *Electronics*, vol. 10, no. 20, p. 2493, 2021.
- [7] M. T. Majeed and T. Ayub, "Information and communication technology (ICT) and economic growth nexus: a comparative global analysis," *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, vol. 12, no. 2, pp. 443–476, 2018.
- [8] S. Sarkar, "The role of information and communication technology (ICT) in higher education for the 21st century," *Science*, vol. 1, no. 1, pp. 30–41, 2012.
- [9] A. While and G. Dewsbury, "Nursing and information and communication technology (ICT): a discussion of trends and future directions," *International Journal of Nursing Studies*, vol. 48, no. 10, pp. 1302–1310, 2011.
- [10] P. Agbetuyi and J. Oluwatayo, "Information and communication technology (ICT) in Nigerian educational system," *Medi*terranean Journal of Social Sciences, vol. 3, no. 3, article 41, 2012.
- [11] K. M. Vu, "Information and communication technology (ICT) and Singapore's economic growth," *Information Economics and Policy*, vol. 25, no. 4, pp. 284–300, 2013.
- [12] D. E. Krubu and K. E. Osawaru, "The impact of information and communication technology (ICT) in Nigerian university libraries," *Library Philosophy and Practice*, vol. 2011, pp. 9– 18, 2011.
- [13] L. Hou, Q. Liu, K. Saeed, S. Ali Haidery, M. I. Uddin, and H. Khattak, "Enhancement of the capability maturity model for improving the quality of software projects in developing countries," *Scientific Programming*, vol. 2021, 10 pages, 2021.
- [14] B. O. Ogange, Activity Report on E-Learning Needs Assessment and Strategy, Gulu university uganda, Gulu Uganda, 2017.
- [15] E. T. Welsh, C. R. Wanberg, K. G. Brown, and M. J. Simmering, "E-learning: emerging uses, empirical results and future directions," *International Journal of Training and Development*, vol. 7, no. 4, pp. 245–258, 2003.
- [16] D. R. Garrison, E-learning in the 21st century: a framework for research and practice, Routledge, London, United Kingdom, 2011
- [17] M. Hussain, W. Zhu, W. Zhang, and S. M. R. Abidi, "Student engagement predictions in an e-learning system and their

- impact on student course assessment scores," Computational Intelligence and Neuroscience, vol. 2018, 21 pages, 2018.
- [18] M. Zuvic-Butorac, Z. Nebic, D. Nemcanin, T. Mikac, and P. Lucin, "Establishing an institutional framework for an elearning implementation-experiences from the University of Rijeka, Croatia," *Journal of Information Technology Education*, vol. 10, pp. 43–56, 2011.
- [19] K. L. Schwirzke, "Online learning in California K-12 schools: status and perceptions of administrators," *Argosy University/ Phoenix.*, 2011.
- [20] M. Alkhattabi, "Augmented reality as E-learning tool in primary schools' education: barriers to teachers' adoption," *Inter*national Journal of Emerging Technologies in Learning, vol. 12, no. 2, 2017.
- [21] C.-T. Chang, J. Hajiyev, and C.-R. Su, "Examining the students' behavioral intention to use e-learning in Azerbaijan? The General Extended Technology Acceptance Model for E-learning approach," *Computers & Education*, vol. 111, pp. 128–143, 2017.
- [22] R. Moore, R. Purvis, C. Bogulski et al., "Learning during COVID-19: rapid E-learning transition at a regional medical school campus," *Journal of Regional Medical Campuses*, vol. 4, no. 2, 2021.
- [23] H. Rodrigues, F. Almeida, V. Figueiredo, and S. L. Lopes, "Tracking e-learning through published papers: a systematic review," *Computers & Education*, vol. 136, pp. 87–98, 2019.
- [24] S. Okai, M. Uddin, A. Arshad, R. Alsaqour, and A. Shah, "Cloud computing adoption model for universities to increase ICT proficiency," *SAGE Open*, vol. 4, no. 3, p. 215824401454646, 2014.
- [25] L. Hou, Q. Liu, J. Nebhen, M. Uddin, M. Ullah, and N. U. Khan, "Analyzing the check-in behavior of visitors through machine learning model by mining social network's big data," Computational and Mathematical Methods in Medicine, vol. 2021, 11 pages, 2021.
- [26] S. B. Aher and L. Lobo, "A framework for recommendation of courses in E-learning system," *International Journal of Computer Applications*, vol. 35, no. 4, pp. 21–28, 2011.
- [27] B. Varghese and R. Buyya, "Next generation cloud computing: new trends and research directions," *Future Generation Computer Systems*, vol. 79, pp. 849–861, 2018.
- [28] N. Subramanian and A. Jeyaraj, "Recent security challenges in cloud computing," Computers & Electrical Engineering, vol. 71, pp. 28–42, 2018.
- [29] A. Sunyaev and A. Sunyaev, "Cloud computing," in *Internet Computing*, pp. 195–236, Springer, Switzerland, 2020.
- [30] A. Arunarani, D. Manjula, and V. Sugumaran, "Task scheduling techniques in cloud computing: a literature survey," *Future Generation Computer Systems*, vol. 91, pp. 407–415, 2019.
- [31] N. Ahmad, "Cloud computing: technology, security issues and solutions," in 2017 2nd International Conference on Anti-Cyber Crimes (ICACC), pp. 30–35, London Uk, March 2017.
- [32] G. Gangadharan, "Open source solutions for cloud computing," *Computer*, vol. 50, no. 1, pp. 66–70, 2017.
- [33] H. A. S. Ahmed, M. H. Ali, L. M. Kadhum, M. F. Zolkipli, and Y. A. Alsariera, "A review of challenges and security risks of cloud computing," *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, vol. 9, no. 1-2, pp. 87–91, 2017.

- [34] C. Chandgude and G. Gadekar, "Core of cloud computing," *International Journal of Engineering Research and Application*, vol. 7, no. 4, pp. 76–81, 2017.
- [35] S. Bele, "A comprehensive study on cloud computing," *International Journal of Information Research and Review*, vol. 5, pp. 5310–5313, 2018.