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Research Article

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Ranking of Barriers for the Internet of Things (IoT) Implementation in E-Learning Platform

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Abstract
Learning through the Web or training via e-learning is rising exponentially and is gradually preferred by conventional ways of education and training. This massive change is directly related to the digital computer technological advancement. The transformation driven by innovation in computer technology has enhanced the reach of e-learning and education, making the process of sharing knowledge easy, clear, and efficient. The E-learning system relies on various success factors from several viewpoints, such as framework, organizational alignment, instructor, and student support. This paper aims to identify the critical barriers to Internet of Thing implementation in e-learning and to establish a relational relationship between identified barriers using the Interpretive Structural Modelling approach. This paper has established some primary barriers that are useful for Internet of Things implementation in E-learning by research scholars and industrial practitioners. For the study of driving force and dependency power of the E-learning barrier, Interpretive Structural Modelling methodology used to classify interrelationships between barriers for improved understanding and relation between these barriers, and Management Cross Impact Multiplications Applied to Classification analysis use for analysing driving power and dependence power of E-learning barrier.

Keywords: Internet of Thing (IoT), Interpretive Structural Modelling (ISM), E-learning, Management Cross Impact Multiplications Applied to Classification (MICMAC)

Introduction
E-learning is a state-of-the-art learning and teaching approach in an online environment that improve education and learning processes [1, 2]. E-learning platforms, which are except in time and place, provide training and learning opportunities and play a key role in promoting new methods of teaching [3]. It is noted that numerous developing nations have introduced and implemented e-learning for education. It can involve a full focus on the learning platform, integrated e-learning, or conventional blackboard classroom with e-learning.

Despite its benefits, the complete and effective implementation of E-learning has yet to be achieved [4]. If E-learning is effectively incorporated in the education sector, several potential advantages can be seen. Previous research has shown that critical success factors (CSFs) play a key role in the successful implementation of e-learning. Besides, it's also been shown that essential factors of different dimensions can have different effects on the e-learning system [5-7]. Thus, it is important that the analysis and resource allocation of the E-learning CSFs be specifically examined and that a proposed framework of the success factors of E-learning is presented.

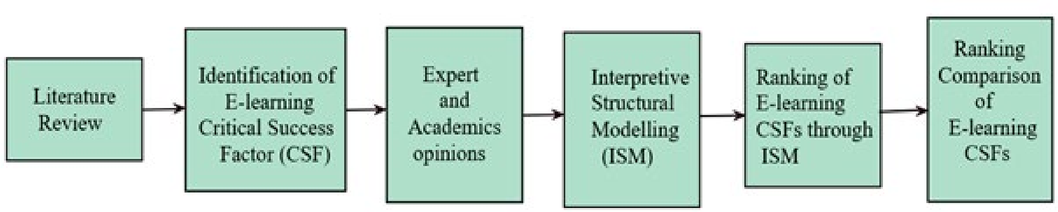

Figure 1: ISM Based Framework for Ranking CSFs of E-learning System

In figure 1 shows the basic framework of this research. The e-learning system relies on various success factors from several viewpoints, such as framework, organizational alignment, instructor, and student support. Therefore, to make it more competitive and efficient, the effects of critical success factors (CSFs) on the E-learning system must be critically evaluated. The Interpretive Structural Modelling (ISM) was used in this current paper to study the diversified aspects from various dimensions of the web-based E-learning system. Through the literature review, the current paper quantified the CSFs along with their 8 factors associated with the web-based e-learning framework and was further analysed. Besides, each factor's effect was successfully derived. From the literature review, eight key E-learning barriers are identified which curb the efficiency of the E-learning system. After identifying the barrier, the influencing power of each barrier in the E-learning is found based on driving and depending power calculated in the MICMAC analysis. There are different techniques available such as The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and Analytical Hierarchical Process (AHP) for providing a structure-based relationship of the enablers but could not provide the quantified view of the inter-relationships. Hence, for the quantification of the interrelationships for any sophisticated system, integrated MICMAC based ISM approach may be applied. Therefore, based on the expert and academics opinions, the ISM technique is used for developing contextual relations between the variables. Based on this a complex relation is converted into simpler relation. Further, this paper is organized as a literature review in section 2, research methodology and numerical illustration in section 3, discussion of finding in section 4, and finally conclusion in section 5.

Literature Review

In the literature review eight critical success factor for IoT implementation in E-learning platform have been identified as given below:

Table 1: Critical Success Factor for IoT Implementation in E-Learning System

Barriers No.	Barriers	Briefs Description	References
B1	Cloud Data Security	This aspect focuses on the risks and problems involved with the introduction of cloud computing. Using e-Learning by Cloud is more about conventional eLearning, this is easy to manage security upgrades, data protection, and user knowledge, which can not only improve device conviction but also decrease total costs for users.	[8]
B2	Ineffective data sharing	Authority's staff and dealer's relationship can efficiently implement IoT in E-learning by giving proper instruction and guidelines to get suitable data and technique by conducting a presentation and various training plan to resolve barrier.	[5, 9]
B3	Internet of Thing	This aspect focuses on the IT framework to provide teaching materials and strategies. Which covers reliability, performance, ease of practice, safety and security, privacy, and knowledge.	[9-13]
B4	Level of Collaboration	This aspect explores the extent of coordination between academic staff. Which involves a lack of social involvement, oversight of the project staff, and management assistance.	[5, 9, 11, 14]
B5	Technology Knowledge	This aspect focuses on the experience of the use of technology for both students and teachers. Which involves the practice of computer machines, the use of applications software, and the interaction of communication.	[5, 11, 14]
B6	Learning Environment	It observes the learning environment and the services offered to both teachers and students. This includes a blended learning model, a network bandwidth, digital learning, and connectivity and navigation.	[5, 11, 14]
B7	Knowledge Management	This aspect refers to the management expertise of faculty members and administration within the educational institution. This covers the executive team, distribution and maintenance management, management skills, critical thinking, and execution skills.	[5, 9, 12, 14]
B8	Instructional Design	This aspect focuses on the educational system to fulfil the goals of the university. It involves the quality of content, conceptual insight, instructional methods, and learning strategies.	[5, 11, 12]

The above barriers have been identified based on the literature review for implementing IoT in E-learning system. For developing a relationship for identified critical success factors ISM methodology has been applied. ISM methodology has been implemented in several areas as given below in Table 2.

Table 2: Literature Review of ISM

Author Name	Description
Rupesh Tiwari,2013	ISM approach is implemented in transportation for solving the complicated condition for fulfilling consumer's need [14].
George pramod,2014	Identified all barriers in the milling industry based on ISM approach [15].
Ravi Kant,2015	Identified relationship between SCM barriers based on the ISM and MICAMAC [16].
R Dubey and T Singh,2015	Linked barriers of the lean based industry by using ISM and MICMAC [17].

ISM Methodology

ISM technique is a model-based process for generating a systematic structure between interlinked entities. This technique is mainly used when the variables are interdependent. This method converts the complicated relationship between the variables into a simple level-based structure, which is easy to understand. This method consists of three steps as discussed below:

Step I

Develop Structural Self-Interaction Matrix (SSIM) between the identified entities as shown in Table 3 and Table 4. In this step, the initial reachable matrix has been obtained.

Table 3: SSIM

	B1	B2	B3	B4	B5	B6	B7	B8
B1	-	O	O	A	V	A	V	X
B2		-	O	O	V	A	V	A
B3			-	O	V	V	V	V
B4				-	O	V	O	V
B5					-	O	O	V
B6						-	O	O
B7							-	O
B8								-

Table 4: Initial Reachability Matrix

	B1	B2	B3	B4	B5	B6	B7	B8
B1	1	0	0	0	1	0	1	1
B2	0	1	0	0	1	0	1	0
B3	0	0	1	0	1	1	1	1
B4	1	0	0	1	0	1	0	1
B5	0	0	0	0	1	0	0	1
B6	1	1	0	0	0	1	0	0
B7	0	0	0	0	0	0	1	0
B8	1	1	0	0	0	0	0	1

Step II

In this step using the transitive rule finale reachable matrix (FRM) has been obtained. Based on this matrix driving power and dependence power have calculated as shown in Table 5. By using this table MICMAC analysis has been done for finding out different cluster categories for the barriers as shown in Figure 2.

Table 5: FRM

	B1	B2	B3	B4	B5	B6	B7	B8	Driving power
B1	1	1*	0	0	1	0	1	1	5
B2	0	1	0	0	1	0	1	1*	4
B3	1*	1*	1	0	1	1	1	1	7
B4	1	1*	0	1	1*	1	1*	1	7
B5	1*	1*	0	0	1	0	0	1	4
B6	1	1	0	0	1*	1	1*	1*	6
B7	0	0	0	0	0	0	1	0	1
B8	1	1	0	0	1*	0	1*	1	5
Dependence power	6	7	1	1	7	3	7	7	39/39

Step III

In this step by using Iteration different levels have been identified for making a systematic digraph model as shown in Table 6,7, and 8. Based on this Iteration Figure 3 has been obtained.

Table 6: Initial Iteration

S no.	Reachability set	Antecedent set	Intersection set	Levels
01	1,2,5,7,8	1,3,4,5,6,8	1,5,8	
02	2,5,7,8	1,2,3,4,5,6,8	2,5,8	
03	1,2,3,5,6,7,8	3	3	
04	1,2,4,5,6,7,8	4	4	
05	1,2,5,8	1,2,3,4,5,6,8	1,2,5,8	Level 1
06	1,2,5,6,7,8	3,4,6	6	
07	7	1,2,3,4,6,7,8	7	Level 1
08	1,2,5,7,8	1,2,3,4,5,6,8	1,2,5,8	

Table 7: 1st Iteration

S no.	Reachability set	Antecedent set	Intersection set	Levels
01	3,6	3	3	
02	4,6	4	4	
03	6	3,4,6	6	Level 2

Table 8: 2nd Iteration

S no.	Reachability set	Antecedent set	Intersection set	Levels
01	3	3	3	Level 3
02	4	4	4	Level 3

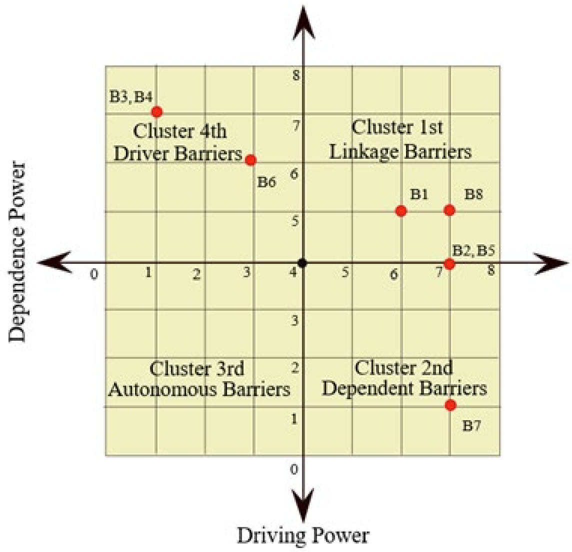

Figure 2: MICMAC Analysis

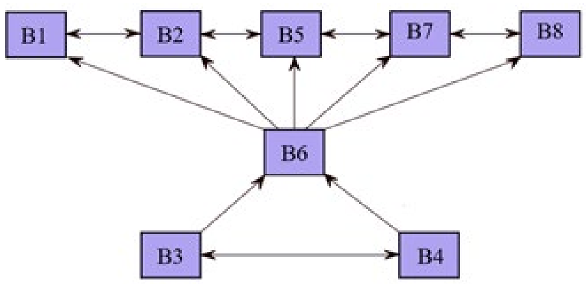

Figure 3: ISM Model

Discussion

This paper has identified eight barriers in implementing IoT technology in E-learning platform namely, Cloud Data Security, Ineffective data sharing, Internet of thing (IoT), Level of Collaboration, Technology Knowledge, Learning Environment, Knowledge Management, and Instructional Design. For effective IoT implementation in E-learning. This paper also develops an interrelationship between the identified barrier using ISM approach. Based on ISM approach and MICMAC analysis it has been found that B3, B4 and B6 acts as the main driver barrier. B1, B2, B5, and B8 are the linkage barrier. These barriers act as a linking point between driver and dependent barrier. Finally, the B2, B5,B7 barrier has been found as a dependent barrier. There has been no barrier found in the autonomous quadrant. The interrelationship developed by this paper may help managers of the organisation in identifying and analysing the barrier for IoT implementation in E-learning.

Conclusion

This paper has identified different barriers namely, Cloud data security, Ineffective data sharing, Internet of thing (IoT), Level of Collaboration, Technology Knowledge, Learning Environment, Knowledge Management, and Instructional Design. Based on ISM and MICMAC analysis, identified barriers are categorised into four clusters like linkage cluster, driver cluster, autonomous and dependent cluster. Further based on the ISM a model of the interdependent barrier has to develop. In this model, B1,B2,B5,B7,B8 are found at level 1st and comes under the dependent and linkage cluster Similarly, B6, come under the second level and driver cluster. Finally, B3 and B4 are at level 3 and comes under driver cluster. In the future, this study may guide the manager as well as researcher to implement this research in other E-learning organizations (Chegg) to achieve more competitiveness and sustainable goal. But this research has limitations of taking only a limited number of factors. Also, this research not considered the extent of dependency between the identified variables.

References

1. Zare, M., Pahl, C., Rahnama, H., Nilashi, M., Mardani, A., Ibrahim, O., & Ahmadi, H. (2016). Multi-criteria decision making approach in E-learning: A systematic review and classification. Applied Soft Computing, 45, 108-128.
2. Samsudeen, S. N., & Mohamed, R. (2019). University students' intention to use e-learning systems: A study of higher educational institutions in Sri Lanka. Interactive Technology and Smart Education, 16(3), 219-238.
3. Alhabeeb, A., & Rowley, J. (2018). E-learning critical success factors: Comparing perspectives from academic staff and students. Computers & Education, 127, 1-12.
4. Al Gamdi, M. A., & Samarji, A. (2016). Perceived barriers towards e-Learning by faculty members at a recently established university in Saudi Arabia. International Journal of Information and Education Technology, 6(1), 23.
5. Naveed, Q. N., Muhammad, A., Sanober, S., Qureshi, M. R. N., & Shah, A. (2017). A mixed method study for investigating critical success factors (CSFs) of e-learning in Saudi Arabian universities. International Journal of Advanced Computer Science and Applications, 8(5).
6. Ahmad, N., Quadri, N. N., Qureshi, M. R. N., & Alam, M. M. (2018). Relationship modeling of critical success factors for enhancing sustainability and performance in e-learning. Sustainability, 10(12), 4776.
7. Naveed, Q. N., Qureshi, M. R. N., Alsayed, A. O., Ahmad, N., Sanober, S., & Shah, A. (2017, November). Assimilating E-Learning barriers using an interpretive structural modeling (ISM). In 2017 4th IEEE International Conference on Engineering Technologies and Applied Sciences (ICETAS) (pp. 1-7). IEEE.
8. El Mhouti, A., Erradi, M., & Nasseh, A. (2018). Using cloud computing services in e-learning process: Benefits and challenges. Education and Information Technologies, 23(2), 893-909.
9. Anggrainingsih, R., Umam, M. Z., & Setiadi, H. (2018). Determining e-learning success factor in higher education based on user perspective using Fuzzy AHP. In MATEC web of conferences (Vol. 154, p. 03011). EDP Sciences.
10. Tan, B. S., & Wong, S. L. (2020). Learning principles of accounting in ICT-supported learning environments of Malaysian secondary schools: future-oriented approach. Research and Practice in Technology Enhanced Learning, 15(1), 1-23.

11. Priatna, T., Maylawati, D., Sugilar, H., & Ramdhani, M. (2020). Key success factors of e-learning implementation in higher education. International Journal of Emerging Technologies in Learning (iJET), 15(17), 101-114.
12. Alhabeeb, A., & Rowley, J. (2017). Critical success factors for eLearning in Saudi Arabian universities. International Journal of Educational Management, 31(2), 131-147.
13. Behzadian, M., Otaghsara, S. K., Yazdani, M., & Ignatius, J. (2012). A state-of the-art survey of TOPSIS applications. Expert Systems with applications, 39(17), 13051-13069.
14. Tiwari, R. (2013). Identification of factors affecting reverse chain performance in relation to customer satisfaction using ISM modelling & MICMAC analysis. Uncertain Supply Chain Management, 1(4), 237-252.
15. George, J. P., & Pramod, V. R. (2014). An interpretive structural model (ISM) analysis approach in steel re rolling mills (SRRMS). International Journal of Research in Engineering & Technology, 2(4), 161-174.
16. Ravi, V. (2015). Analysis of interactions among barriers of eco-efficiency in electronics packaging industry. Journal of Cleaner Production, 101, 16-25.
17. Dubey, R., & Singh, T. (2015). Understanding complex relationship among JIT, lean behaviour, TQM and their antecedents using interpretive structural modelling and fuzzy MICMAC analysis. The TQM Journal, 27(1), 42-62.