AHP BASED EVALUATION OF THE FACTORS AFFECTING THE TRANSITION OF EDUCATIONAL SERVICES FROM OFFLINE TO ONLINE– MCDM APPROACH

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Abstract:
Purpose: The purpose of this paper is to identify the factors affecting the online education, and then evaluating those factors using the MCDM methodology. This paper will provide some recommendations upon the factors which are critical to be evaluated and analyzed to improve the online education environment.
Design/methodology/approach: AHP (Analytic Hierarchy Process) given by Satty, is being used in the paper for development of a hierarchical model of factors and ranking the factors. After a comprehensive literature survey and opinions of experts, the critical factors affecting online education were identified. 15 experts from the academic field were approached to fill the pair wise comparison matrix.
Findings: The results of the study shows that all the factors are not equally weighted. Security and Risk associated with online platform, financial constraints and trialability and observability of the system are the top three factors among all identified factors.

Key Words: Online Education, Multi-criteria decision making (MCDM), Analytic hierarchy process (AHP), Factor Analysis, India

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1. Introduction:

Education is considered to be one of the most critical factor in any individual's growth and development. By entering into the pre-school in the early childhood, a child get an introduction to the professional world. He starts learning from the scratch and creativity starts to bloom inside. As he grows from a child to an adult, he come across a lot of different learning opportunities which lays down the path of his professional career. But these experiences are not same for all the generations. The Gurukuls, Aashrams are converted into a fully air condition building called as school and college. The chalk and black boards are now replaced by the smart classes, with more detailed and practical learning. Hence Education system today is not same as it used to be 15 years back. The thing which has not changed was the meeting and the face to face contact between the professor and the students. Going to a place on a daily basis and sitting in a room with many other students following a fixed schedule. All these things were too normal and accepted universally till the 2019. In first quarter of 2020, this normal scheduled is being challenged and disturbed by pandemic Covid 19. Students were asked to stay at home, Colleges and schools were closed for an uncertain duration, but learning is a continuous process, so institutions had to find the other ways to get connected with the students and keep the teaching and learning on track. This thing has given rise to the introduction of online education.

It is not the fact that online education came into existence during the covid era only, rather this pandemic era has given the chance to the masses to accept it as a substitute to the classroom teaching learning. Colleges have started opening up virtually and gradually the learning system has come on the track. Meeting the teachers using the online platforms, taking classes, asking doubts, submitting assignments, giving examinations, attending convocation virtually, all these things have become the part of daily routine of the students. In country like India, such things were not that easy to implement by the colleges and accept by the students. Lack of internet connectivity in remote areas, lack of financial resources to shift on the online mode, lack of technical skills, inclination towards physical classes were among the major challenges which were faced by institutions as well as the students. Human beings once get settled to a particular system, become habitual to it and don't want to come out of the comfort zone[1]. But the pandemic has ignited the need for change and switching from traditional methods and processes to the online tools and techniques. Students were not provided enough time to accept the online digital education[2]. In some cases it was accepted, only because it was made mandatory by the institutes[3] whereas many students have shifted to the online education platform, without any compulsion being enforced[4]. This mix of willingness and mandate, has made it important to identify and study the factors affecting the adoption of online education and as a substitute of traditional offline education system.

The teaching methods can be classified in four categories on the basis of the extent to which online tools are being used to deliver the lectures. First one is the traditional type of course where there is no use of technology in delivering the course. Entire content is delivered either in writing or orally. The second category can be the web facilitated course, which used the internet based technology to facilitate the face to face delivery of the content. Web pages or any other course management systems can be used to post the syllabus, home works and assignments. Third one can be the hybrid model which has a reduced number of face to face lectures. A good proportion of content is delivered online. The last one is online type of course, where there is no face to face interaction at all. Complete content is delivered virtually using online education tools. Online learning facilitates the students in many ways like, they can learn or discuss their doubts with the instructors who are miles away from them [5] ; indulge into the productive discussion with the peer students throughout the world, self-evaluation can be done through online assessments, more flexible study time. It also facilitates the instructors or teachers in many ways, they can reach to a large portion of audience and share the knowledge and experience, flexible teaching learning schedule through collaborative tools, more advanced techniques and content can be used to make lectures more interesting. 2.35 million students enrolled in online courses during 2004 in United States[6], which has increased to nearly three million during 2014[7]. In order to remain at par with the global competition, universities and institutions have to introduce online courses with a strategy to attract more and more enrollments from across the world. More number of students can be attracted through e-learning system. This has also introduced a new category of learners who are interested in part time learning. These are the working people over the traditional age of 25 years. Rapidly they are becoming the largest audience of online learning[8]–[10][11]. Online education system has both synchronous and asynchronous

ways of delivery. If teaching and learning are happening at same time, it is referred as synchronous and if teaching and learning are not talking place at the same time then it is asynchronous learning[12]. The learning through MOOCs, Coursera, Edex, etc. are the example of asynchronous learning. Live teaching through online meeting tools like google meet, zoom, cisco webex, microsoft meetings are the example of synchronous learning where teaching through teacher and learning by learners is taking place simultaneously. Because of the massively open online course (MOOC) launched in 2008, has increased the accessibility of higher education to a larger segment of public. This is being supported by the introduction of eduMOOC in 2011, edX and coursera in 2012. The open and free accessibility of wide range of courses on these platforms has drawn attention of large chunk of learners towards online education.

2. Theoretical background of the study:

Over the years, many models have been developed and tested to explain the acceptance of technology. "TAM (Technology Acceptance Model)" is one of the most widely used frameworks in the context of online education. As per this model, an individual's attitude towards using (ATU) and behavioral intention (BI) to use a technology is mainly affected by two factors PU and PEU[13]. Where, PU stands for perceived usefulness and PEU stands for perceived ease of use. Behavioral intention to adopt and use a particular technology is influenced by performance expectancy, effort expectancy, social influence and facilitating condition[14]. The switch to online education platform can be explored by using interactivity, quality of course content and course design as an attribute[15]. PPM (Push, Pull and Mooring) is another framework that can be used to explore the intention of consumers towards switching to online education[16]. "Push factors" are all those factors that are responsible for consumers' resistance to accept and use the current technology while "pull factors" on the other side motivates the consumers to accept and use the newer technology[17]. "Mooring factors" are the factors which either support or restrict the consumers from adopting a newer technology[18].

In this study, the author attempted to identify and evaluate the various factors that affects the online education system. Although in the Indian context, a lot of literature is available in the online education area. But not much work is being done in the online education area, especially using the "MCDM (Multi Criteria Decision Making)" methodologies. After reviewing the literatures related to the online education, author has found that present study is unique in a way to focus upon adoption and implementation of online education system using "AHP (Analytic Hierarchy Process)" for development of a hierarchical model of factors and ranking the factors. Objective of the developed "AHP" model is to assist the decision makers to work upon the factors for the best implementation and adoption of online education system.

3. Critical factors affecting Online education

After a comprehensive literature survey and opinions of experts, the critical factors affecting online education were identified and are represented as "F1", "F2", "F3" and so on. An explanation of all factors is given below-

1. Level of available technology (F1): The level and reach of the available technology affects the adoption of anything in virtual form. Availability of internet should be supported by the ease of access and navigation along with interface design. Network availability should be sound enough to develop an uninterrupted and continuous learning environment [19].

2. Technical skills and behavioral aspects of instructors (F2): Attitude and behavior of instructor/teacher towards students affects the environment of virtual classroom. Instructors should properly be trained in terms of handling the online education tools and platforms. A frequent and constructive interaction supported by valued and dynamic discussions with students should be highly encouraged in order to maintain the interest in online class [19], [20].

3. A well designed online course delivery system (F3): A well designed online course delivery system will bring the homogeneity in the teaching learning process. Students and teachers will always be on the same frequency while delivering and receiving the content [21].

4. Student's technical skills and readiness (F4): In a country like India, uneven spread of computer literacy is a big challenge in adopting online education. Until and unless the student is equipped with basic knowledge of computer, internet and online tools, nothing can be implemented. Student's readiness to accept the online mode of education will depend on how comfortable and user friendly he/she is with the online platforms [22].

5. Perceived Usefulness (F5): In case of online education, students and parents feel that online education content will not increase the academic productivity and learning performance will not be improved. Institutions along with instructors need to design their strategies in such a way so that such thoughts perceived usefulness can be improved by eliminating such thoughts from the minds of students and guardians [23].

6. Security and Risk associated with online platform (F6): whenever there is an involvement of technology, the security issues are always the matter of concerns. The threats of malicious software, threats of personal information being misused, students exposure to unnecessary content and applications via internet are the biggest challenges that need to be addressed in order to implement a safe and secure virtual teaching learning system [23].

7. Competitive pressure (F7): During the pandemic, many state universities and schools have temporarily shut down and no online classes, examinations were being conducted. However the private institutions, schools and universities were proactive in adopting the online mode of education and ensured the continuous learning to the students. This can be attributed to the competitive pressure among the private schools, colleges and universities which is not a matter of concern for government institutions [24].

8. Participation Intention (F8): If students are truly interested in learning a given content and they are confident about their ability to complete a course within the normal time duration, their participation intention will increase. An increased participation intention will facilitate the adoption of online education system [25].

9. Trialability and Observability of System (F9): Trialability is the ease with which one can experiment with something new and innovative on a limited basis before full actual use. Students and guardians would always try to adopt the online learning ways, now it depends on the institutions and instructors how they can capitalize this and convert this trial into a full time use. Similarly observability stands for the ability to measure the usefulness of a system by examining its outputs. Institutions need to show the productive outputs in order to instill the confidence among students about the online ways of learning [26].

10. Financial Constraint (F10): Adoption of online education system requires financial investment from both the parties, institutions as well as students. Institutions with high budget allocation and revenue manage this comfortably, but there are many institutions which are running with a relatively low budget and revenue intake. It becomes difficult for them to go for paid subscription of online education tools, high bandwidth internet connections and smart boards. Similarly a big portion of Indian guardians find it almost impossible to buy Smartphone, laptop, PC and internet connectivity for their children.

4. Research Methodology

The analytic hierarchy process (AHP) is the most widely used ranking tools in almost all the areas of MCDM. AHP, developed by Saaty [27] is a decision making method which aims at quantifying relative priorities for a set of alternatives on a ratio scale, based on the judgment of the decision maker and stresses the importance of the intuitive judgments of a decision maker [28]. The best advantage of using AHP is that it organizes tangible and well as intangible factors in a very simple but systematic way and provides a simple solution to the decision maker [29]. Belton [30] has compared AHP and MAV (Multi Attribute Value), as two of the multi criteria decision making approach. She found that greatest weakness of MAV is that it fails to incorporate systematic checks on the consistency of judgments [28].

AHP is a simple, flexible and easy to use approach[31], [32]. Each factor of a given problem is evaluated through a hierarchical structure and facilitates the decision maker to identify problem objectives[33]. This approach can quantify both subjective and objective judgments. It uses the consistency ratio for tracking the inconsistent decisions. Author is intended to propose a hierarchical structural model of critical factors affecting the adoption of online education in Indian context. Adoption of online education is affected by many factors, hence modeling of critical factors affecting adoption of online education is a multi criteria problem. AHP technique is applied to identify the most significant factor, so that institutions improve upon the same in order to have a more effective online teaching learning environment.

A simple hierarchical structure for the purpose of the study is shown in the Fig. 1.

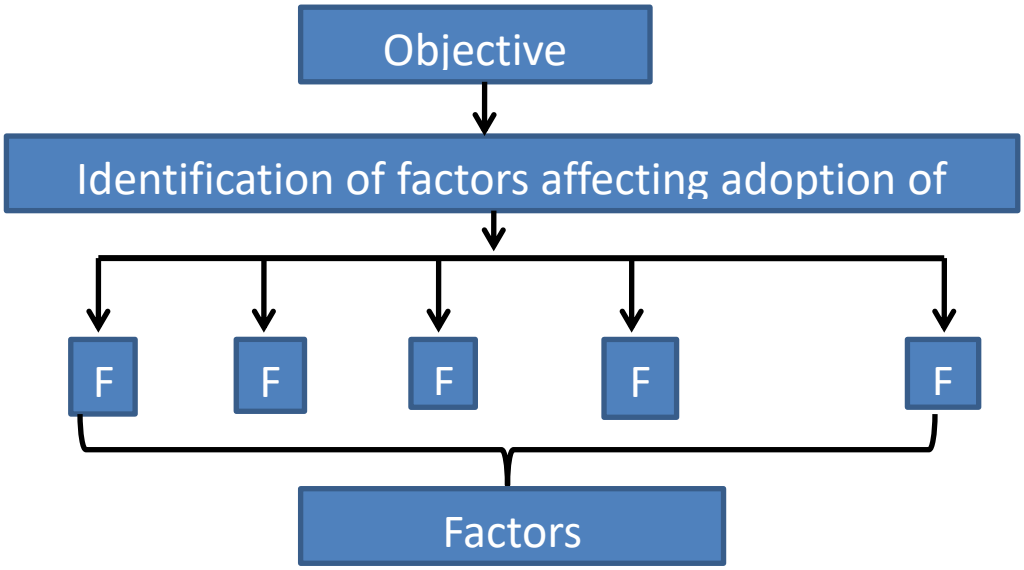

Fig. 1: Hierarchy of AHP

As per [34] for getting more precise results the maximum number of factors is nine, but it can be extended up to any number of factors above this. For the purpose of the present study, author has identified 14 factors through literature review, which is further reduced to ten. The expert opinions have been sought for reducing the criteria from 14 to 10. After short listing the factors "AHP" analysis is being carried out using MS-excel.

Saaty [27], [35]–[37] has developed following steps for applying the AHP, which is being used in the following way :

1. Identifying the factors affecting the adoption of online education, through literature survey.
2. Experts were asked to give the input based on Saaty's scale (Table 1). 15 experts from the academic field were approached to fill the pair wise comparison matrix.

Table 1 Pair-wise comparison scale for AHP preferences [34]–[38].

Numerical rating	Verbal judgments of Preferences
9	Extremely important
8	Very, very strongly important
7	Very strongly important
6	Strong plus
5	Strongly important
4	Moderate plus
3	Moderately important
2	Weak
1	Equally important

3. Formulation of a group decision matrix was done on the basis of 15 matrices from experts. The geometric mean method is used for aggregation of individual judgments [38]. For assigning the respective weights to the factors, priority vectors were calculated, which are the normalized Eigen vector of the matrix.

Table 2 Pair-wise comparison of the factors

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
F1	1	3	1	0.167	3	0.25	0.125	0.111	0.143	3
F2	0.33	1	7	0.333	0.333	0.111	0.5	1	8	0.125
F3	1	0.143	1	0.143	2	0.2	0.333	1	6	0.333
F4	6	3	7	1	4	0.167	0.333	0.333	4	3
F5	0.33	3	0.5	0.25	1	0.167	0.2	0.25	2	0.333
F6	4	9	5	6	6	1	0.5	0.2	0.167	7
F7	8	2	3	3	5	2	1	0.333	0.167	0.333
F8	9	1	1	3	4	5	3	1	0.111	5
F9	7	0.125	0.167	0.25	0.5	6	6	9	1	4
F10	0.33	8	3	0.333	3	0.143	3	0.2	0.25	1

4. After making all the pair-wise comparisons, the next task is to determine consistency index (CI) using the maximum Eigen value λ_{max} , through the relation

$CI = \frac{\lambda \max - n}{n-1}$ Where n is the size of matrix.

5. Judgment consistency can be checked by using the consistency ratio (CR) calculated as

$$CR = \frac{CI}{RI}$$

Where, value for RI for corresponding value of n can be taken from random consistency index Table 3. For the present analysis n = 10 for which corresponding RI = 1.49. CR is acceptable if it does not exceed 0.10.

Table 3 Random consistency (RI) (Saaty TL, 1980,1985,1990,1991).

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

In the present analysis, λ_{max} is 10.66409 and n is 10 which results into the CI value of 0.073788. The consistency ratio is 0.049522, which is less than the maximum accepted value 0.10 hence judgments of the experts are consistent and can be accepted. Now all the factors are ranked on the basis of their respective weights (Table 4).

Table 4 Relative weights and ranks of the factors

S.No.	Factors	weights	Ranking
F1	Level of available technology	0.085448	6
F2	Technical skills and behavioral aspects of instructors	0.063174	9
F3	A well designed online course delivery system	0.079006	7
F4	Student's technical skills and readiness	0.117564	5
F5	Perceived Usefulness	0.060455	10
F6	Security and Risk associated with online platform	0.143835	1
F7	Competitive pressure	0.063238	8
F8	Participation Intention	0.117575	4
F9	Trialability and Observability of System	0.127520	3
F10	Financial Constraint	0.142185	2

5. Results and discussion

As shown in table 4, all the ten factors are ranked in accordance to their relative weights, as calculated by the AHP tool. The five significant factors that topped the list in terms of their rankings are Security and Risk associated with online platform (F6), Financial Constraint (F10), Trialability and obesrvability of System (F9), Participation Intention (F8), Student's technical skills and readiness (F4) with relative weights of 0.143835, 0.142185, 0.127520, 0.117575, 0.117564 respectively. As per the analysis these five factors are the most important factors, which requires the immediate attention of the policy makers and decision makers in order to improve the acceptance and adoption rate of online education system.

The security and risk associated with online platform, is always a matter of concern for the guardians as, the children are exposed to the ocean of World Wide Web, which also include the content, not appropriate for a child. Apart from this, personal information being misused is also important issue to be addressed. Such issues develop a doubt in the mind of guardians and they become resistant to allow their ward for the online education platform. In a country like India, a large portion of the population is still living below poverty line, hence their financial conditions are not sound enough to buy the online education tools like, pc, laptops, smart phones, internet facility etc. lack of financial resources is also a problem for many self financed institutions, whose budget and revenue parts are not allowing them to switch on to the online education mode.

Low ranking factors, whose ranks are from six to ten and have a low impact on the adoption of online education, as compared to the top five factors, include level of available technology (F1), a well designed online course delivery system (F3), competitive pressure (F7), technical skills and behavioral aspects of instructors (F2), and Perceived usefulness (F5). The relative weights of these factors are 0.085448, 0.079006, 0.063238, 0.063174, 0.060455 respectively.

6. Recommendations and implications

Results of the study has shown that security and risk associated with online platform is the most significant factor affecting the adoption of online education in India. This indicates that service providers and the institutions have to work in an integrated manner to instill the trust in the minds of stakeholders. In India, a large portion of population is still not accepting the internet banking over branch banking. The reason is similar to that of the

study that they have fear of losing their confidential information. There are a lot of security features being introduced by the online meeting and education platforms to ensure that students and teachers feel safe while using such platforms. Many of the security features are there in the tool, but students are not using them because of lack of awareness about the features. The institutions, universities, schools need to conduct demo sessions regularly related to any security feature being updated in the system.

The recently launched NPTEL, SWAYAM, eduMOOC, edX, coursera portals can be promoted and used without any threat to the data security. The another point of concern is the exposure of the immature minds to the dark side of the internet. Students are using online education as an excuse to get expensive gadgets and using them for other unproductive purpose like online gaming, watching web-series etc. Such misuses are inviting many health related issues like depression, anxiety, violent behavior, high blood pressure, obesity, poor sleeping, cognitive problem etc. Such risks can be minimized by integrating efforts of instructors, institutions, guardians and students. Online education can be used to create a critical learning space where students can improve upon their analytical skills, imaginations, creativity, critical synthesis and self awareness. Teachers teaching online are not consider only as a teacher, rather they are viewed as facilitators who induce learners for blended learning of diverse theories and live experiences [39]–[43]. Online education can be used as a tool for hybrid learning, where students can relate all their classroom learning with their own experiences.

7. Conclusion

In this study 10 factors were found from the data collected from experts in education sector. Further "AHP methodology" is used to analyse the factors affecting adoption of online education system. Factors were ranked on the basis of the normalized weights assigned to each factor. Security and Risk associated with online platform, factor F6 is found most significant among all the factors. Perceived usefulness F5 was very least affecting factor among all. This study was conducted mostly in the urban areas of state capital. It can further be extended to the rural as well as other urban areas of country for the identification of factors affecting adoption of online education.

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