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Service Quality Analysis of Mobile Learning (M-Learning) Application

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ABSTRACT

It is universally accepted that E – Learning market is growing significantly fast and the trend continues. Research has shown that E – Learning proves to be an excellent way to achieve quality results in a short time frame (Docebo report, March 2014).The worldwide market for self – paced E – Learning reached $35.6 Bn in 2011 and is expected to reach $51.5 Bn by 2016. E – Learning tools are software applications developed to run on electronic devises like PCs, Laptops, Smart phones and Tablet PCs. Quality of such learning solutions plays an important role in delivering tangible results to the learners. An effort has been made to understand the quality of the service provided by the E – learning tool using gap analysis. Current study is focused on the gap between expected and perceived quality of M – Learning solution (E – learning application embedded in a mobile device), developed by a Hyderabad based IT organization. The solution is aimed at the students aspiring to crack the Joint Entrance Examination (JEE aspirants) conducted by Central Board for Secondary Education (CBSE). Gap analysis was conducted on the data collected from 300 students using mobile M – Learning tool for IIT entrance examination preparation besides regular class room coaching. Perceived and expected ratings at characteristic level of each attribute of eight characteristics were obtained from 300 respondents. Applying paired t – test, to test the significant difference between the average expected and perceived quality. The attributes with 't' value > 1.645 (at 5% level of significance), are perceived to be not in line with the expected quality. Gaps are identified accordingly to analyze the quality of M-Learning application.

1.0 Introduction

It is universally accepted that E – Learning market is growing significantly fast and the trend continues. Research has shown that E – Learning proves to be an excellent way to achieve quality results in a short time frame (Docebo report, March 2014). According to Dr Ruben Puentedura's "Substitution, Augmentation, Modification and Redefinition (SAMR)" model of the Technology adoption life cycle, innovation and development goes through four phases viz. substitution, augmentation, modification and redefinition. Any learning tool inevitably passes through all these four stages to be conceived as a final product. Learning tools based on Information Technology (IT) comprise of a learning application (software) loaded in a device known as educational hardware. Software applications developed is primarily focused on collaborative and co-operative educational experience.

1.1 Joint Entrance Examination (JEE)

After completion of class 10, students join coaching classes to prepare for Joint Entrance Examination (JEE) conducted by Central Board of Secondary Education (CBSE)for admission into Indian Institutes of Technology (IIT) and National Institutes of Technology (NIT). According to the information collected by the technical colleges 50% students admitted to IIT are preparing on their own besides joining a coaching class. More than 1,000,000 students have appeared in JEE 2014 main exam, as against over 500,000 appeared in 2012 which shows an increase in the number of JEE aspirants.

Plethora of coaching services by numerous coaching institutes (both organized and unorganized) are helping the students crack JEE. Leveraging Information Technology (IT) in offering value addition to their class room teaching, some of these institutes are providing M – learning opportunity to the students to reinforce the learning in the

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class room. These M–learning devices comprise of a Tablet PC embedded with the course content in the form of video lectures, additional reading material in word, ppt and pdf formats and self-assessment tests and mock tests. The service offered by the M-learning device is aimed at enhancing the learning of a student.

1.2 Service Provider

The M-learning solution under current study was developed by a Hyderabad based IT organization (name is camouflaged for confidentiality) which is in to designing and developing customized IT solutions and delivering them (either as an embedder hardware device or as a standalone solution to be installed in hardware with suitable specifications. The solution was targeted at the students aspiring to crack the Joint Entrance Examination (JEE aspirants) conducted by Central Board for Secondary Education (CBSE), as its potential and focused market.

1.3 Quality of Service

For any business to succeed, consumer is considered at the center of all processes forming focal point around which the business revolves. The firm creates products and services keeping the needs and wants of the consumers in mind, without a thorough understanding of which no firm can survive or compete in the market. In fact the marketing strategy starts with the identification and evaluation of product or service opportunities, determining the significant needs and preferences of the consumer and extent to which these needs are satisfied. Therefore it needs to determine the significant attributes in a product or service which are considered important by the consumer. These attributes could be evaluated or checked if they are getting satisfied in the industry. This is known as Gap analysis.

Customer gap*:* Customer gap is the difference between customer expectations and perceptions. Customer expectations are standards or reference points that customers bring into the service experience. Customer perceptions are subjective assessments of actual service experience. Expectations consist of what a customer believes should happen.

Current study is focused on the quality of M – Learning solution developed by a Hyderabad based IT organization. Gap analysis was conducted on the data collected from 300 JEE aspirants.

1. **Literature Review:**

Georgive (2006) presented a paper, "A comparison Analysis of mobile learning systems" at international conference on computer system and technologies where in, he identified two types of M – Learning systems offline and online. Data is loaded in the devise memory in offline systems before the system is used. This type of system is independent of network connectivity. Learning environment at any instance of time can be accessed using web services in online systems.

In 2008, S. Kamin, M. Hines, C. Peiper and B. Capitanu presented a paper on "A System for Developing Tablet PC Applications for Education," in Proceedings of the 39th Special Interest Group on Computer Science Education **(**SIGCSE) technical symposium on Computer science education. The framework suggested in the paper specifically provides functionality to create pen- and touch-enabled applications focused on active and collaborative learning.

In recent years, a number of researchers have studied the effectiveness of active and collaborative learning technology in classrooms. Modern classroom is filled with cell phones, tablets, laptop computers, and other intelligent devices (M. Nakakuni, M. Okumura and S. Fujimura, 2011).

According to Catalin Boja and Lorena Batangan (2009) there are four main reasons that could be invoked in support of mobile learning (figure 1). They are i) Flexibility, ii) Collaboration, iii) Motivation, iv) Accessibility and v) Portability. Flexibility refers to learning taking place any time, collaboration is about every learner using the same content, multimedia resources can make learning fun there by, motivating learners and finally accessibility is all about accessing different learning material virtually from anywhere and portability enables learners to take the learning experience outside of confines of the class room.

Abdallaha Ali, Ouda & Capretz (2012) have developed a conceptual framework for measuring quality of M – Learning. It consists of structural factors and integrates dimensions of learning contexts. The framework addresses three issues of design namely usability, communication and interactivity.

David Parsons, Hokyoung Ryu, in their work titled " A framework for assessing the quality of mobile learning, propounded that quality of learning experience is not solely based on the software but also on the conceptual basis upon which the learning experience is constructed. Precisely the quality of M – Learning solution equally depends on technical quality and the contextual quality. Wagner attributed the success of mobile learning to a combination of rich and converged experiences (2005)

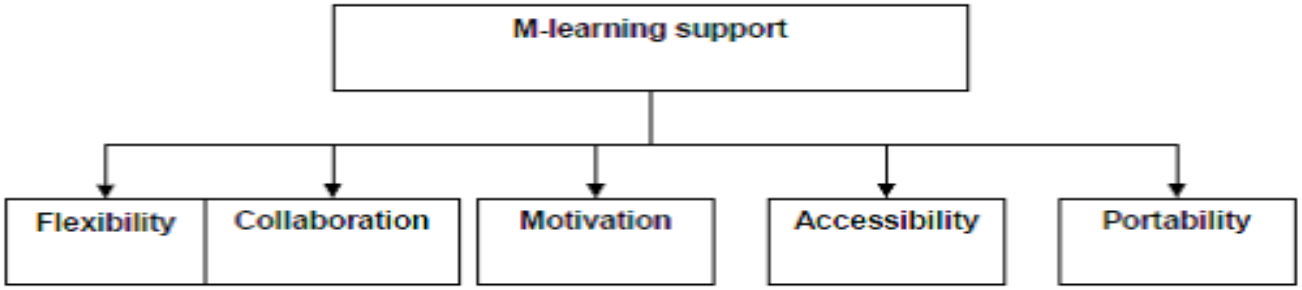


Fig 1: Support of Mobile Learning

Source: WSEAS Transactions on Computers Volume 8 Issue 5, May 2009

Mobile learning offers several advantages over other forms of learning like ubiquity and idle time utilization which are to be properly addressed by enabling check on the system quality. Quality estimation in M-learning systems can be broadly classified into two categories: software system quality and learning characteristics quality. The first and foremost advantage of M-learning over traditional class room learning is, it enables anytime anyplace learning (Anal Acharya, Devadatta Sinha, 2013). Framework suggested by them illustrates several advantages of M-learning application, namely ubiquity, personalized and collaborative learning, enhanced student satisfaction. The framework proposed suggests that quality in M-learning systems can be measured at two ways. One way is to measure software and system quality from the technical point of view. Another way is to measure the quality of learning characteristics.

Work of Anal Acharya and Devadatta Sinha (2013) evaluated a M-learning framework with the help of ISO/IEC 25010 model1. The evaluation was done purely from the technical point of view. In their view ISO/IEC 25010 model alone is insufficient to measure M-Learning quality because it measures the software and system quality only and does not measure the learning characteristics like the effectiveness of the learning objects in learner's context, personal and collaborative learning and the learning outcome. Current study focuses on the quality of learning characteristics of M-learning solution.

As services are intangible their effectiveness will be envisaged based on the satisfaction of the customer. Customer's satisfaction is a function of perceived value of the service by the customer. In the gap analysis model propounded by Bery, Parasuraman and Zeithmal, emphasized five gaps in the service value delivery process. Gaps of the SERVQUAL model are:

a) Gap between customer expectations and management perceptions about customer expectations
b) Gap between management perceptions of customer expectations and service quality specification gap
c) Gap between service quality specifications
d) Gap between customer's expectations and perceived value

While it is essential to measure the quality of service by measuring the gaps as suggested in servqual model, it is primarily required to assure the overall satisfaction of the customer to ascertain perceived quality.

3.0 Objectives of study:

i) To understand the expectations of M – Learning customers.
ii) To understand the Gap between customer expectations and perceptions with respect to M – Learning solutions.
iii) To construct an analytical model through identifying significant attributes as experienced by customer upon use of M – Learning solution.

4.0 Methodology

The Research design used in this study was Descriptive research design and, is conducted in two phases:

i) Organizing focused group discussions and structured interviews with experts in the M – Learning domain and,
ii) Analyzing the gap between the expected and perceived quality of M – Learning solution

In the first phase, to assess the quality of M – learning solution, researchers organized in depth interviews and focused group discussions with customers – users and service providers. Though the data collected from focused group discussions and structured interviews has indicated that the perceptions of service provider are in line with customer expectations some of the characteristic-level expectations are found to differ from the perceptions of solution provider. Summary of the outcomes of focused group interviews and structured interviews is given in Annexure – 1.

In the second phase researchers investigated the gap between the perceptions and expectations of the customer by collecting data through a structured questionnaire and performed paired t – test, to test the significant difference between the expected and perceived qualities. To assess the overall quality of the product in terms of customer expectations vis-à-vis their perceptions, researchers distributed structured questionnaire to identify the gaps in 8 characteristics viz, Quality of Content, Availability, Quality of Testing and Monitoring, Mobility, Accessibility, Value Addition, Price Points and Overall Satisfaction, which are the key characteristics of M-Learning solution. Perceived and expected ratings on over all service quality and on each attribute of eight characteristics were obtained from a sample of 500 respondents (users of M-Learning solution) Parasuraman, Valarie Zeithaml and Len Berry (1988) identified five Gaps that may cause customers to experience poor service quality.

Perceived and expected ratings on each attribute of eight characteristics were obtained from 300 respondents. Applied paired t – test, to test the significant difference between the average, expected and perceived quality ratings. The attributes whose't' value > 1.645 (at 5% level of significance), are perceived to be not in line with the expected quality

Using the insights obtained from the above procedures a structured questionnaire is prepared, which forms the foundation of gap analysis which is in the form of a typical UAI (Usage, Attitude, Image) questionnaire, containing questions on demographic variables, usage habits, and comprehensive list of the product attributes or services offered. Respondents were requested to rate the expected and perceived quality on five point Likert scale. Students of corporate and non-corporate colleges and users of the product constitute population of the study. List of users is obtained from the solution provider (Name of the solution provider was not disclosed to maintain anonymity).

Data was collected from 500 users using simple random sampling. Descriptive statistics and paired t- test have been used to analyze the data. Validity of the questionnaire was tested by circulation the same to the experts in the functional domain of M – Learning. Cronbach's alpha (0.952) test conducted on the questionnaire indicated the reliability of the questionnaire.

The entire questionnaire is divided into eight sections focusing on each segment of characteristics. They are Quality of Content, Availability, Quality of Testing and Monitoring, Mobility, Accessibility, Value Addition, Price Points and Overall Satisfaction. Further each segment consists of different attributes to measure the quality.

5.0 Data Analysis

5.1 Attributes pertaining to "Quality of Content" are

i. Video Quality

[1] ISO/IEC 25010 was prepared by Joint Technical Committee ISO/IEC JTC 1, Information technology, Subcommittee SC 7, Software and systems engineering. It defines well known quality factors and will serve as the basis for many quality management approaches.

ii. Structure of Study Material
iii. Clarity of the Concepts,
iv. Reinforcement of Classroom Lectures
v. Innovative Approach
vi. Sufficiency with respect to the content
vii. Faculty Eminence.

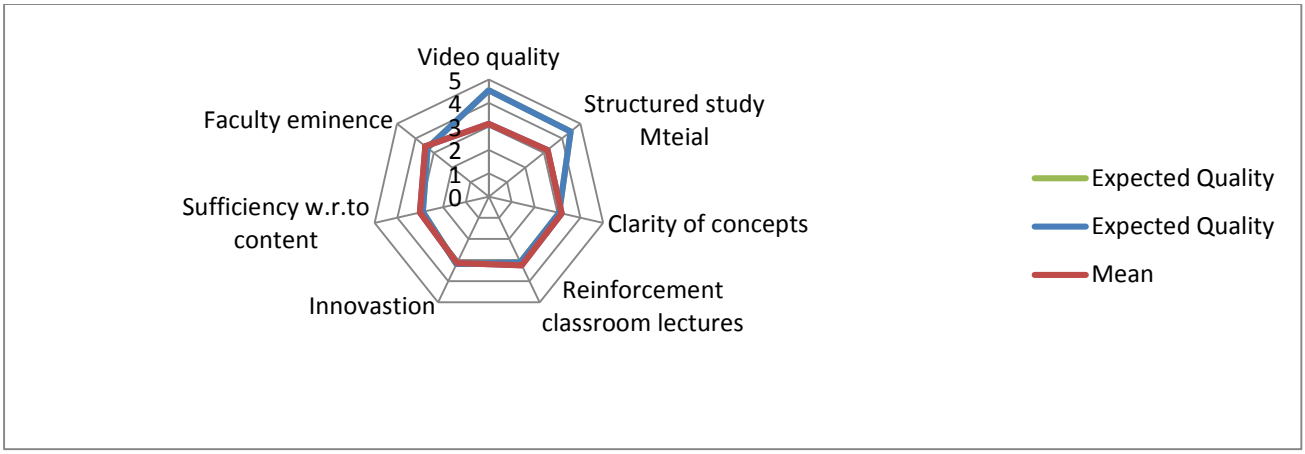
Table-1: Average Expected and Perceived Quality Ratings on the Attributes Associated with Content Quality

Content Quality Attributes	Expected Quality		Perceived Quality		T Value
	Mean	SD	Mean	SD	
Video quality	4.5467	0.0302989	3.1067	0.06305	22.92483*
Structured study Material	4.4667	0.04043612	3.2	0.062643	16.98844*
Clarity of concepts	3.08	0.06988444	3.1867	0.059499	-1.43941
Reinforcement of classroom lectures	3.1067	0.06444919	3.24	0.06532	-2.0308
Innovation	3.1867	0.06589971	3.1333	0.070881	0.706516
Sufficiency w.r.to content	2.8933	0.06912308	3.0133	0.066439	-1.57656
Faculty eminence	3.3467	0.0722274	3.4533	0.070224	-1.2824

From Table1 it is evident that the perceived quality of the attributes viz, Clarity of the Concepts, Reinforcement of Class room Lectures, Innovative Teaching Methods, Sufficiency of Content and Faculty Eminence is higher than the expected quality. Gap exists between the expected and perceived qualities of the attributes namely Video Quality(*) and Structure of the Study Material (*).

Average quality ratings were also presented diagrammatically in fig: 2. The chart shows the gaps between expected and perceived service quality ratings of all seven attributes of the Content Quality. There exist significant gaps between expected and perceived quality levels of Video Quality and Structure of the Study Material

Fig.-2: Gap Analysis Showing Average Expected and Perceived Quality Ratings



5.2. Attributes pertaining to Quality of Testing and Monitoring are

i. Level of difficulty
ii. Performance Monitoring
iii. Online Testing,
iv. Ranking
v. Test Structure

Table-2: Average Expected and Perceived Quality Ratings on the Attributes Associated with "Quality of Testing"

Testing attributes	Expected Quality		Perceived quality		t – value
	Mean	SD	Mean	SD	
Level of difficulty	3.8533	0.9772	2.8267	1.195	13.8091*
Performance Monitoring	4.04	0.8086	2.8267	0.88651	27.21096*
Online Testing	3.1333	1.2493	3.2	1.202	-0.949
Ranking	3.2	1.2775	3.1733	1.1724	0.328309
Test structure	3.72	0.9189	2.88	1.07215	14.0567*

From Table 2 it is evident that perceived quality of the attributes viz, Ranking, Test structure higher than the expected quality. Gap exists between the expected and perceived quality ratings of the attributes namely Level of Difficulty (*), Performance Monitoring (*), Test Structure (*).

Average quality ratings were also presented diagrammatically in Figure 3. The chart shows the gaps between expected and perceived service quality ratings of all five attributes of the Quality of Testing. There exist significant gaps between expected and perceived quality levels of Level of Difficulty, Performance Monitoring, Test Structure.

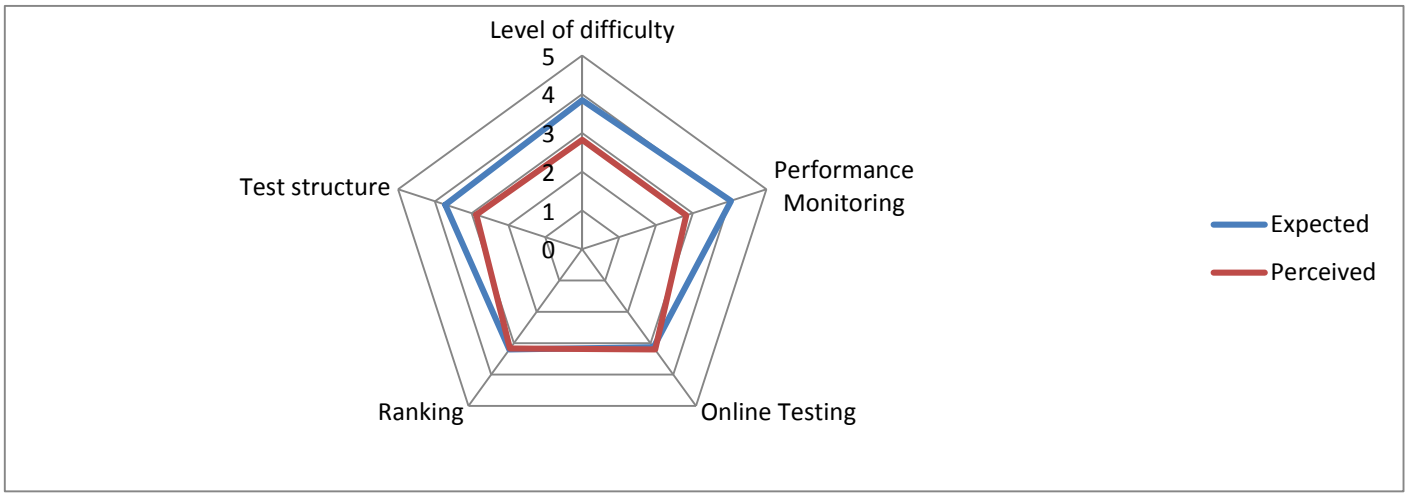


Fig.3. Gap Analysis Showing Average Expected and Perceived Quality Ratings of "Quality of Testing"

5.3. Attributes pertaining to "Availability" are

i. Key availability
ii. Clarification of Doubts
iii. Syncing with Class
iv. Clarification of Doubts at Random
v. Self-Correction

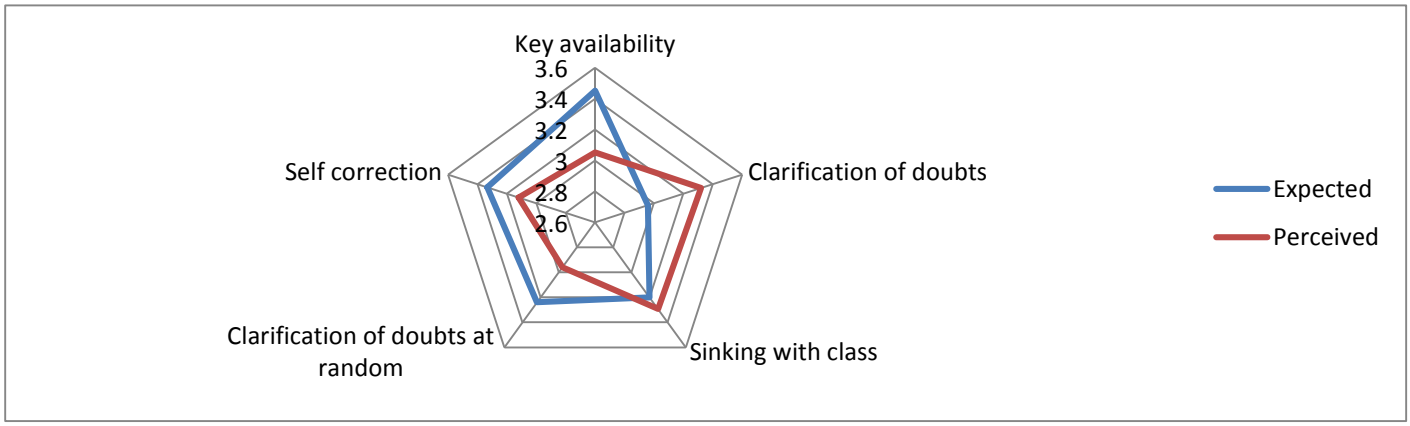
Table-3: Average Expected and Perceived Quality Ratings on the Attributes Associated with "Availability"

Availability	Expected Quality		Perceived quality		t - value
	Mean	SD	Mean	SD	
Key availability	3.4533	1.1008	3.0533	1.1201	5.136375(*)
Clarification of doubts	2.96	1.2925	3.32	1.1926	-4.41233(*)
Syncing with class	3.2	1.2775	3.2933	1.1187	-1.17147
Clarification of doubts at random	3.24	1.1431	2.96	1.1026	4.492265(*)
Self-correction	3.3333	1.1604	3.12	1.1445	2.774438(*)

From Table 3 it is evident that the perceived quality of the attributes viz, Clarification of Doubts, Sinking with Class higher than the expected quality. Gap exists between the expected and perceived quality ratings of the attributes namely Key Availability (*), Clarification of Doubts (*), Clarification doubts at Random(*) and Self Correction(*).

Average quality ratings were also presented diagrammatically in Figure 4. The chart shows the gaps between expected and perceived service quality ratings of all five attributes of the Quality of Testing. There exist significant gaps between expected and perceived quality levels of Key Availability, Clarification of Doubts at Random and Self Correction.

Fig.4: Gap Analysis Showing Average Expected and Perceived Quality Ratings of "Availability"

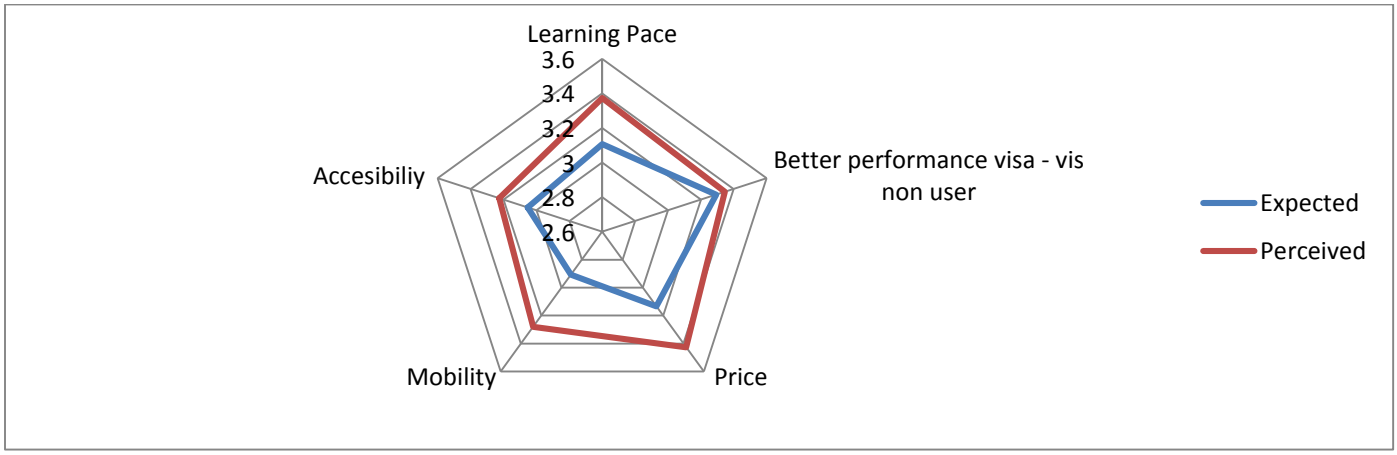


5.4. Value Addition, Mobility, Accessibility, Price Points

Table-4: Average Expected and Perceived Quality Ratings on the Attributes Associated with "Value Addition, Mobility, Accessibility, and Price Points"

Attribute	Expected	SD	Perceived	SD	t – value
Learning Pace	3.1067	1.1747	3.3733	1.1306	-3.2974(*)
Better performance vis-a -vis non user	3.2933	1.3466	3.3467	1.0663	-0.7422
Price	3.1333	1.6578	3.4267	1.1128	-1.79905
Mobility	2.9067	1.43711	3.28	1.3665	-2.7876(*)
Accesibiliy	3.0533	1.5377	3.2267	1.3668	-1.0963

Fig.5: Gap Analysis Showing Average Expected and Perceived Quality Ratings of "Availability"



5.5. Overall Quality of M-Learning Solution.

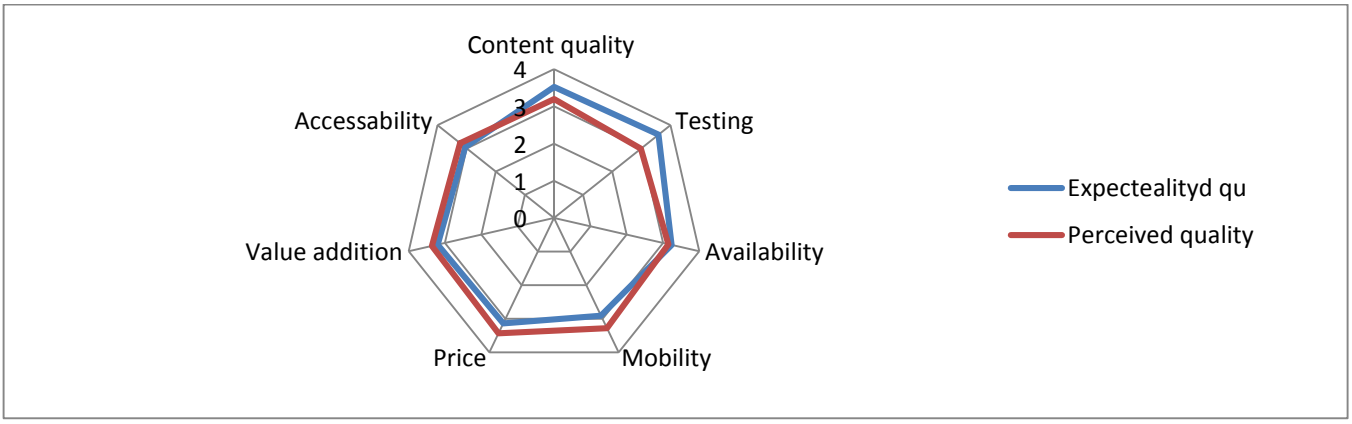
Following table indicates the gap between the expected quality rating and perceived quality rating of the characteristics of the M-Learning devise. While arriving at the expected rankings and the perceived rankings the average of the rankings of all the components of each characteristic is calculated. Hence the radar diagram given in Figure 6 is the diagrammatic representation of all the gaps identified between perceived and the expected quality of the characteristics of the M-Learning solutions.

Table-5: Average Expected and Perceived Quality Ratings on the Attributes Associated with "Overall Quality Of M-Learning Solution."

	Expected quality	Perceived quality
Content quality	3.51811	3.19047
Testing	3.58932	2.98134
Availability	3.2372	3.14932
Mobility	2.9067	3.28
Price	3.1333	3.4267
Value addition	3.2	3.36
Accessibility	3.05333	3.2267

Table 5 represents the expected and perceived quality ratings of the attributes viz, Value Addition, Mobility and Accessibility. From the Figure 6 it is evident that the gap exists between the expected and perceived quality ratings of the attribute content quality and testing

Fig.6: Gap Analysis Showing Average Expected and Perceived Quality Ratings of "Overall Quality of M-Learning Solution"



5.6 Overall Satisfaction

The difference between the averages of overall expected quality and overall perceived quality ratings is given in the table no: 5. While collecting the responses on Quality of Content, Availability, Quality of Testing and Monitoring, Mobility, Accessibility, Value Addition, Price Points which are the attributes of M – learning solutions, a question was posed to the respondent to rate their perceptions on the overall quality of the solution.

Table-6: Average expected and Perceived quality ratings on the attributes associated with "Overall Quality of M-Learning solution."

	Expected	*perceived*	t-value
Mean	3.266666667	3.506666667	-1.50212
Variance	1.306306306	1.253333333	

It is evident that the overall satisfaction with respect to perceived quality of the M – learning solution is more than the expected service quality.

6.0 Findings &Conclusions:

Following are the findings of the research:

i) There exists, significant gaps between expected and perceived quality levels of Video Quality and Structure of the Study Material.

ii) There exists, significant gaps between expected and perceived quality levels of Level of Difficulty, Performance Monitoring, Test Structure.

iii) There exists, significant gaps between expected and perceived quality levels of Key Availability, Clarification of Doubts at Random and Self Correction.

iv) Perceived quality is found to be higher in characteristics viz, Value Addition, Mobility and Accessibility.

v) There exists significant gap between expectation and perception in the characteristic 'Price' alone.

vi) While conducting the gap analysis on the overall service quality of the M – Learning solution it is found that the perceptions of the customers are exceeding the expectations. However at the level of each characteristic the test revealed that the gaps at characteristic level do not have a significant impact on the overall perception. A detailed analysis of the gaps observed at the level of characteristics leading to a possibility of variations in customer perceptions during long run. Detailed study of the attributes of these characteristics revealed that they constitute the drivers of quality.

vii) Though the research indicated the scope of the improvement in various attributes of M – learning solution, it is clearly evident that the perceptions on the overall quality exceeded the expectations of the customers

7.0 Suggestions:

Having analyzed the data collected from the customers and having drawn the above conclusions researchers have summarized their suggestions to the M-Learning developer as follows:

i. As the M-learning solution reinforces the class room learning, the content developed should contain good quality pictures, videos besides near-to hi-fi sound quality.

ii. In the teaching and learning process concepts in the applications are to be elaborated starting with simple examples and there by proceeding to complex applications with varying difficulty. It is suggested to include concepts in applications of different levels of difficulty in M-Learning content.

iii. Monitoring and reporting of progress should be recorded and communicated to the learner in such a way that the learning will be much more object oriented. Module wise and concept wise monitoring and reporting mechanism should be incorporated in the M – learning solution.

iv. M-Learning solutions should focus on the current and expected future changes in the testing patterns of JEE examinations and corresponding updates and upgrades are to be provided to a learner

v. M-Learning solution should be featuring the discussion dashboard and supported by frequent webinars to address the gap related to clarification of doubts and self-correction.

vi. As the perception of learners regarding the price of the product is not in line with their expectations, it is suggested to strengthen the communication process by the service provider. Precisely the value points of the product with reference to its effectiveness, mobility and accessibility are to be clearly communicated by including users' endorsements and sharing the experiences of earlier successful learners.

vii. Though the perceptions on the overall quality of M – learning solution exceeded the expectations of the customers the service provider should investigate into the possibility of adding value at attribute levels which means the thorough evaluation with respect to all the deliverables of the solution. While it is important to measure the satisfaction levels of the customers on the product as a whole a detailed investigation into the facts presented by the customers on the available features of the product will enable to enhance i) acceptability in the market and ii) positive word of mouth from the customer thereby, leading to the market growth.

8.0 Conclusion:

M-Learning is identified as a learning delivery medium worldwide. Though a few barriers exists to the distribution of course content in digital form, availability of media devises capable of handling large volume of information, is enabling the emergence of M – learning as a new paradigm in learning. Current research identified gaps in the quality of an M – learning solution which is developed by a Hyderabad based software solution provider as a supportive tool to the aspirants of IIT – JEE. While the research proved that customers are satisfied with the overall quality of M-learning solution, attribute level analysis revealed scope for improvement in quality of the solution. M-Learning is identified to be a credible supportive educational platform to Face-To-Face learning (FTF). Current study has not attempted test the effectiveness of M – learning solution in terms of "Learners' Perspective" and "Outcome" which can be taken up as subjects of future research.

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Annexure – 1

Summary of the Outcomes of Focused Group Interviews and Structured Interviews

Perceptions of Service Provider	Customer Expectations
Content	
• Application should provide complete solution • Syllabus shall be completely covered • Inclusion of JEE advanced syllabus • Conceptual clarity about the content delivered • All lectures and tests are designed in a structured way • Top quality lectures by IIT lecturers	• New way of learning • Syllabus shall be covered • Lectures to be delivered by eminent professors • Learning approach shall be flexible solution in terms of time and space • Content should be structured • Facility for clarification of doubts shall be availabl
Flexibility	
• Flexibility in learning in terms of time, space and access • Place of learning is not a constraint • 24/7 access is needed. • Application to be installed on a tablet PC	• Availability of online tests facility • Good quality videos and animations • Continuous monitoring of progress through periodical tests • Continuous access of content • Flexibility to carry anywhere • Application installed on a mobile device
Testing & Monitoring	
• Online tests shall be provided • Answers for tests taken shall be displayed at the end of the test • Monitoring the test scores and progress • Comparing with previous scores	• Online tests at different difficulty levels • Answers to the test questions to be explained • Comparison of previous scores
Quality	
• Good quality videos and animations to support the content • Learning should improve test scores • Success of the student is the real measure of quality • Self-demo feature shall be available • Off-line help shall be available	• Content (audio and video)should be of good quality • Detailed instruction manual shall be provided • Product demos to be arranged at coaching centers • Detailed brochures explaining the features of the solution shall be available • Self-demo of features of the product
Price	
• Value for money' product	• Affordable pricing