

Impact of Outcome Quality Dimension on Service Quality of Digital Learning Solutions in Schools

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Abstract

Poor infrastructure and lack of qualified teachers are problems that are plaguing the Indian primary and high schools. While the government schools are grappling with this problem, the private schools are trying to overcome these problems through digital learning solutions. 'Digital Learning Solutions (DLS)' or 'Smart Classroom Solutions' are being implemented by several organisations in private schools. Though DLS has been widely implemented in private schools, the service quality and the consequent impact have to be assessed. DLS's service quality assessment is not simple since it is dependent on information quality, functional quality apart from technical or outcome quality. The factors of outcome quality are key since they relate to the learning outcome and teaching effectiveness. The objectives of this paper are (a) to validate the factors that contribute to

outcome quality of DLS and (b) to study the impact of outcome quality on service quality assessment of DLS in private schools.

Keywords: *digital learning, e-learning, service quality, Indian school education*

Introduction

India has the highest population of school going children in the world. It is estimated that India has 300 million school going children who are being catered to by 1,425,564 schools (Educational Statistics – At a glance 2014 - Government of India, 2014). The report also says that the GER (gross enrolment ratio) drops from 87.4% in upper primary to 49.1% in senior secondary education and further to 21.1% in higher education. The abysmally low starting salary of teachers is responsible for attracting only mediocre talent. This coupled with high teacher-student ratio has resulted in poor learning outcome.

When it comes to learning outcome, though private schools fare better than government schools, it is in no way near the global benchmark. This is because, still the private schools catering to low/ lower middle income are not able to attract talented teachers. This gap in talent of teachers has given rise to a growing industry that provides education through multi-media content. The private schools have adopted 'Digital Learning Solutions' as a way to overcome lack of qualified teachers and ensuring better learning outcome.

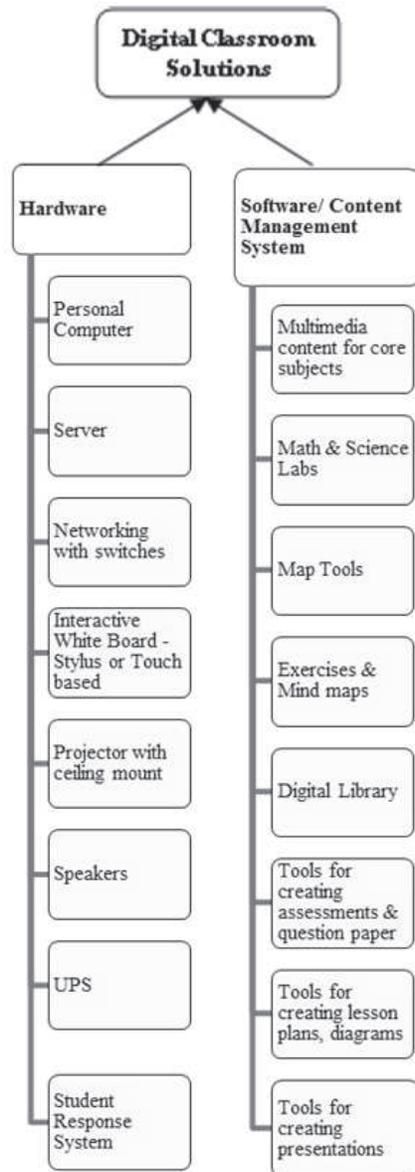
There are a host of companies that provide learning enabled through technology and their target market is

‘private unaided schools’. The number of private unaided schools are about 200,000 (Educomp Annual Report 2013-14). Educomp Ltd. is the market leader in this space with a presence in 14,500 schools followed by other players Next Education, Tata Interactive, Pearson Education etc. About 30,000 schools have adopted ‘Digital learning Solutions’.

Digital Learning Solutions

Digital Learning Solutions comprises three components-(1) Hardware (2) Multimedia content/ Content management system and (3) Delivery infrastructure. The constituents of these components (Sugant and Anvekar 2014a) are shown in Figure 1.

The hardware component consists of personal computer, interactive white board, projector, UPS, speakers, student response system (optional) etc. that are installed in the classroom. In addition, it also includes server and networking switches. The multimedia content consists of audio-visual lessons – normally for all subjects except languages. Also, the multi-media content consists of tools that add value to the curriculum and learning like virtual science and math labs, tools for maps, quizzes and exercises, digital library, tools for creating lesson plans, question banks, diagrams and presentations etc. The teachers access the content from the classroom through the personal computer that is linked to the server that has the repository of multi-media content through the local area network, that acts as the delivery infrastructure.



Delivery Infrastructure

Figure 1

Digital Learning Solutions (DLS) is essentially a teaching aid for the teachers that enables better learning by children. It also helps in enhancing quality of teaching and effective knowledge delivery (Sugant & Anvekar 2014b). Though DLS has been implemented in over 30,000 schools across India, not many studies have been undertaken to assess the service quality of DLS.

The service quality of DLS can be a function of multiple dimensions – like (a) information quality which encompasses the features of the multimedia content (b) functional quality that comprises of reliability, responsiveness etc. of the service provider and (c) technical or outcome quality that covers the learning outcome and teaching effectiveness. The technical quality and outcome quality are terms that are used interchangeably in this study. The purpose of this study is to assess the factors that contribute to outcome quality and the impact of outcome quality on service quality of DLS.

Literature Review

Parasuraman (1985, 1988) was among the earliest to profess that service quality is a key driver of service satisfaction. He also formulated 'SERVQUAL', a tool that can be used to measure service quality. SERVQUAL was further studied for its effectiveness and while it has been implemented in several industries, there are many who have criticised the approach of SERVQUAL. While SERVQUAL measured

the expectations and perceptions of customers with two sets of same questionnaire, SERVPERF (Taylor S A 1992) was proposed as an alternate model that uses only one set of questionnaire and evaluates service performance. Fogarty G et al (2000) confirmed the efficacy of SERVPERF as a tool to measure service quality. However, SERVQUAL stood its test of time till nineties. But with the onset of explosive growth of e-services in this millennium, at least three factors – tangibles, empathy and responsiveness of SERVQUAL lost its relevance. Parasuraman et al proposed a tool 'E-S-QUAL (2005)' to measure service quality of on-line shopping. This model consists of dimensions like fulfilment, efficiency, system availability and safety and privacy. These dimensions are suited only for on-line shopping and hence E-S-QUAL cannot be used for measuring service quality of other e-services. Specifically for e-learning, E-S-QUAL cannot be applied.

Though 'digital learning solutions', the focus of our research is not on-line, but an off-line service, it has a high component of technology and technology enabled learning, which is seen to align more with e-learning or on-line learning. Hence the focus of the literature review was on research on service quality of IT services and e-learning.

For software products, the antecedents of service quality are information quality and system quality (Pitt L F et. al. 1995). Xu et. al. (2013) explains that for an e-service

system quality, information quality and service are not independent. As per Samaarasinghe and Tretiakov (2009), system quality, content quality and service quality determine the success of e-learning. They refer to instructor and technical support as service quality. For evaluating quality of higher education e-learning, Jung (2010) proposed an empirical framework that included institutional quality assurance system, institutional credibility, information and publicity, learner support, learning tasks, staff interaction and support as determinants of quality. In corporate e-learning information quality, system quality, service quality and perceived usefulness affect the effectiveness of e-learning (Wong and Huang, 2011).

Jia & Reich (2011) suggest that IT service climate is internal to the organization and is explained as shared perceptions and behaviour employees. IT service climate acts as an antecedent to IT service quality which includes service vision, service leadership and service evaluation.

For software services, quality of service and experience constitute service quality (Kritikos et al 2013). With respect to service quality and effectiveness of e-government services, service delivery and service content play a deciding role (Tan C W et al, 2013). For SaaS (software as a service), the key dimensions of service quality are flexibility, efficiency, fulfilment, system availability, privacy and security (Benlian A et al 2012).

SERVCESS, an instrument to measure service quality in a library was proposed by Landrum et al (2008). SERVCESS was based on SERVQUAL and information success variables. They suggested that system quality, information quality, service quality and usefulness are variables that contribute to information success and user satisfaction.

Mustafa Suliman (2013) defines e-learning content quality as system quality. Further system quality consists of four dimensions - reliability, usability, stability and accessibility and these dimensions are helpful in evaluating the e - learning efficiency. Further he found that the strongest dimension affecting system quality is 'usability'.

Cho (2009) propounded thirty seven factors to evaluate e-learning quality, the factors being classified under six categories viz., course content, usability, instructional design, evaluation, learning support and refinement and improvement.

A research by Chen and Kuob (2011) showed that the key determinants to attracting users to avail on-line e-learning are useful and relevant content and user interface.

For digital learning solutions, it has been established that information quality is positively associated with service quality (Sugant and Anvekar 2015). Also, the study proved that information quality for digital learning solution consists of four factors – accuracy, relevance, comprehensiveness and value added features as shown in figure below:

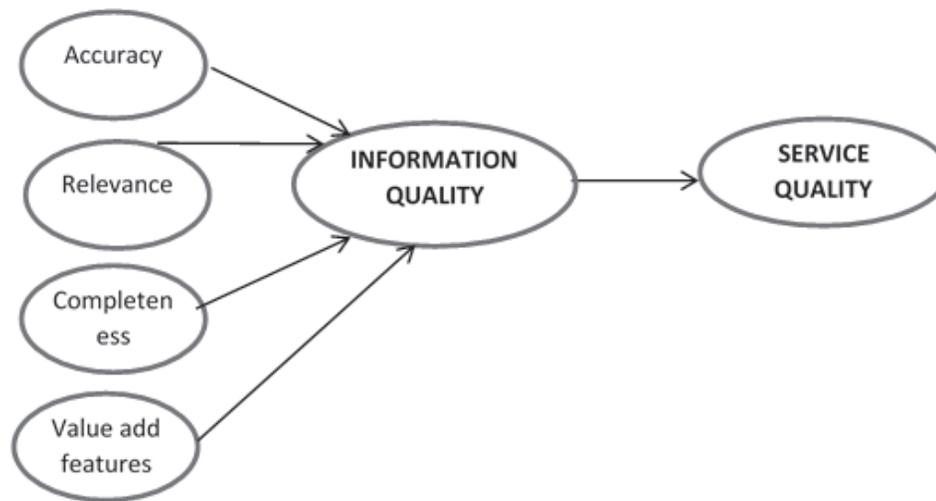


Figure 2

The literature review on e-learning provided a host of dimensions that constitute service quality —like system quality, information quality, technical quality, outcome quality, functional quality, content quality, perceived utility etc. The focus of our research is not e-learning, but digital classroom solutions in schools. Basis the dimensions of service quality of e-learning of different research studies and given the context of digital classroom solutions, further exploratory study with the teachers is proposed to arrive at the dimensions of service quality.

Research Design

Statement of Problem

Service quality of e-learning and on-line learning have been the subject of many research studies across the world. Corporate e-learning and higher education e-learning have been researched fairly extensively. But all these pertain to on-line learning. Also not many research studies have been conducted on e-learning in schools. Specifically, no research on service quality of digital learning solutions in the context of Indian schools is evident. This research specifically covers this aspect, the results of which can help the industry to provide appropriate service. We define the service quality of digital learning solutions as consisting of three dimensions – information quality, functional quality and technical or outcome quality. The dimension of ‘outcome quality’ is a key determinant in the assessment of service quality of DLS since the learning outcome and teaching effectiveness is key for the adoption of DLS. This research will study and validate the factors that constitute

outcome quality. The research will also evaluate the impact of outcome quality on service quality assessment. The service quality is an assessment of perception by customers and hence the research focusses on perceptual responses by the teachers of private, unaided CBSE schools, who are customers of DLS.

Research Question

The key research question is “what is the role of outcome quality in the assessment of service quality of digital classroom solutions in CBSE schools in Karnataka?”

Research Objectives

The objectives of this research are:

- To evaluate the relationship between outcome quality and service quality of digital learning solutions
- To assess and validate the factors that constitute outcome quality of digital learning solutions
- To assess the impact of outcome quality on service quality of digital learning solutions

Hypotheses

H1: Service quality of digital learning solutions is positively associated with outcome quality experienced by the teachers of private CBSE schools.

H2: The contribution from each factor that constitutes outcome quality to outcome quality is equal in terms of proportion.

Exploratory Study

These dimensions of e-learning service quality from the research done earlier have been taken as the basis to develop the framework for evaluating service quality of digital learning solutions. To arrive at the final dimensions, extensive exploratory research was conducted with service providers and customers. Focus group interviews were conducted with the teachers (customers) who have been using digital learning solutions. Also exhaustive interviews were conducted with executives of service providers (from three leading companies that provide digital learning solutions).

Based on the above exploratory study, three dimensions, viz. functional quality, information quality and outcome (or technical) quality emerged as the key dimensions of service quality of DLS. The focus of this study, being outcome quality, the conceptual framework of outcome quality was constructed with the factors of learning outcome and teaching effectiveness as per the table 1 below:

Table 1

Items Code	Item Description	Factors
VAR00001	Improvement of interest in the subject	Learning outcome
VAR00002	Enhancement of focus and concentration	
VAR00003	Simplicity in understanding concepts	
VAR00004	Retention and recall of knowledge	
VAR00005	Betterment of academic performance	
VAR00006	Enhancing teaching ability	Teaching Effectiveness
VAR00007	Updation of knowledge area	
VAR00008	Interactive and participative teaching	
VAR00009	Enhancement of Confidence	
VAR00010	Effective teaching	
VAR00011	Creation of positive impact	

Descriptive Research

Basis the factors and the framework (ref. Table 1), a descriptive quantitative research with a detailed questionnaire was conducted.

Sampling

The respondents are teachers who use digital learning solutions and are from un-aided private CBSE schools in Karnataka. The participants of the survey was chosen through convenience sampling. Assistance from heads of school was taken to identify 5-6 most active users (teachers) of digital learning solutions in each school. The samples were collected from 20 CBSE schools that have implemented digital learning solutions in Karnataka, resulting in a total of 109 responses.

Data Analysis

Factor Analysis

Factor analysis is done (a) to identify the most relevant variables/ constructs and eliminate the irrelevant variables and (b) to ascertain constructs that make up the respective factors.

In this study, there was a need to identify the constructs that contribute to the factors, viz., learning outcome and teaching effectiveness and further group them into the appropriate factors, which can be further utilised to understand the different dimensions that influence service quality of digital learning solutions. Hence, factor analysis

was used. As was indicated, the two factors considered for the analysis for this research are learning outcome and teaching effectiveness (shown in figure 3).



Figure 3

In factor analysis, Kaiser-Meyer-Olkin (KMO) value, communalities and factor loadings will be our major focus measures. KMO and Bartlett's Test are suggested to test the sampling adequacy by checking the case to variable ratio of the analysis that is being conducted. The KMO value must be ≥ 0.5 for consideration for further analysis.

Communality is the proportion of a variable's variance and is explained by a factor structure. It should be minimum 0.5. Factor loadings specify the importance of the item to a factor. It should be above 0.40 (can be negative or positive). Towards enabling grouping the items to factors, factor loadings must be considered. Both factors that constitute outcome quality dimension were considered and the results are as below:

Learning Outcome

Learning outcome is one of the factors that influences outcome quality dimension which in turn influences

service quality of digital learning solutions. Learning outcome is represented by five items in the questionnaire– (1) Improvement of interest in the subject, (2) Enhancement of focus and concentration, (3) Simplicity in understanding concepts, (4) Retention and recall of knowledge and (5) Betterment of academic performance

KMO value and Bartlett’s Test must be considered prior to further analysis.

Table 2: KMO and Bartlett’s Test – Learning outcome

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.756
Bartlett's Test of Sphericity	Approx. Chi-Square	227.599
	Df	10
	Sig.	.000

As seen in Table 2, the KMO value is 0.756, which is more than 0.5, that is the minimum prescribed, hence further analysis is possible.

Table 3: Communalities- Learning Outcome

	Initial	Extraction
VAR00001	1.000	.507
VAR00002	1.000	.786
VAR00003	1.000	.465
VAR00004	1.000	.660
VAR00005	1.000	.558

Extraction Method: Principal Component Analysis.

The communality value of variable should be > 0.5 for it to be retained. As shown in the table above (Table 3), the communality value of four variables are > 5. One variable has a communality value of 0.465. However this variable is retained since this is a key variable (Simplicity in understanding concepts) in 'learning outcome'.

Table 4 : Total Variance Explained – Learning Outcome

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.976	59.530	59.530	2.976	59.530	59.530
2	.729	14.583	74.113			
3	.656	13.113	87.226			
4	.415	8.290	95.516			
5	.224	4.484	100.000			

As shown in Table 4, the total variance explained is 59.53%. Though, the total variance explained has to be greater than 60% to be accepted, we accept the variables since the slightly low total variance explained is on account of Variable – VAR3 whose communality value is < 0.5. If this variable is removed, the total variance explained increases to 65.29% as shown in Table 5 below.

**Table 5 : Total Variance Explained – Learning Outcome
(with only four variables)**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.612	65.290	65.290	2.612	65.290	65.290
2	.698	17.439	82.729			
3	.466	11.660	94.389			
4	.224	5.611	100.000			

Extraction Method: Principal Component Analysis.

Table 6 : Component Matrix – Learning Outcome

	Component
	1
VAR00001	.712
VAR00002	.887
VAR00003	.682
VAR00004	.813
VAR00005	.747

Extraction Method: Principal Component Analysis.

As shown in Table 6, the variables have a loading of more than 0.4 and hence can be used for further analysis

Teaching Effectiveness

Teaching effectiveness is the second factor that influences outcome quality dimension. Teaching effectiveness is represented by six items in the questionnaire – (1) Enhancing teaching ability, (2) Updation of knowledge area, (3) Interactive and participative teaching, (4) Enhancement of Confidence, (5) Effective teaching and (6) Creation of positive impact.

Table 7: KMO and Bartlett’s Test – Teaching Effectiveness

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.854
Bartlett's Test of Sphericity	Approx. Chi-Square	309.916
	Df	15
	Sig.	.000

The KMO value is 0.756, which is more than 0.5, which is the minimum prescribed, hence further analysis is possible

Table 8 : Communalities – Teaching Effectiveness

	Initial	Extraction
VAR00006	1.000	.500
VAR00007	1.000	.700
VAR00008	1.000	.481
VAR00009	1.000	.733
VAR00010	1.000	.599
VAR00011	1.000	.604

Extraction Method: Principal Component Analysis.

The communality value of variable should be > 0.5 for it to be retained. As shown in the table above (Table 8), the communality value of four variables are > 5. One variable has a communality value of 0.481. However, this variable is retained since this is a key variable (Interactive and participative teaching) in the factor on 'teaching effectiveness'.

Table 9: Total Variance Explained – Teaching Effectiveness

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.618	60.302	60.302	3.618	60.302	60.302
2	.777	12.953	73.255			
3	.526	8.771	82.025			
4	.469	7.814	89.839			
5	.349	5.819	95.658			
6	.261	4.342	100.000			

Extraction Method: Principal Component Analysis.

As shown in Table 9, the total variance explained is 60.30% and hence the variables are accepted.

Table 10: Component Matrix – Teaching Effectiveness

	Component
	1
VAR00006	.707
VAR00007	.837
VAR00008	.694
VAR00009	.856
VAR00010	.774
VAR00011	.777

Extraction Method: Principal Component Analysis.

The variables have a loading of more than 0.4 (as shown in Table 10) and hence can be used for further analysis.

Summary of factor analysis

The summary of factor analysis vis a vis items in the questionnaire are as below:

Table flows to next page

Table 11: Summary of Factor Analysis Results

Items Code	Item Description	Factors	KMO Value	Communalities	Variance Explained (%)
VAR00001	Improvement of interest in the subject	Learning outcome	0.756	.507	59.53%
VAR00002	Enhancement of focus and concentration			.786	
VAR00003	Simplicity in understanding concepts			.465	
VAR00004	Retention and recall of knowledge			.660	
VAR00005	Betterment of academic performance			.558	
VAR00006	Enhancing teaching ability	Teaching Effectiveness	0.854	.500	60.30%
VAR00007	Updation of knowledge area			.700	
VAR00008	Interactive and participative teaching			.481	
VAR00009	Enhancement of Confidence			.733	
VAR00010	Effective teaching			.599	
VAR00011	Creation of positive impact			.604	

Outcome Quality = Learning Outcome + Teaching Effectiveness

The above Table 11 gives a summary of the factor analysis. From the factor analysis, it is observed that KMO measure of sampling adequacy for both factors are greater than 0.5 and hence is acceptable. The communalities are another significant criteria that has to be considered. All, but two of the communalities values of the variable lie in the acceptable range of greater than 0.5 and hence are acceptable. The two variables that are marginally less than 0.5 are also accepted since these are critical for the evaluation of learning outcome and teaching effectiveness factors.

Based on the exploratory factor analysis, the model for outcome quality dimension of service quality is confirmed as below in Table 12:

Table flows to next page

Table 12

SI No.	Constructs that constitute the factors	Factors that contribute to the 'outcome quality' dimension of Service Quality	Dimension of Service Quality
1.	Improvement of interest in the subject	Learning Outcome	Outcome Quality
2.	Enhancement of focus and concentration		
3.	Simplicity in understanding concepts		
4.	Retention and recall of knowledge		
5.	Betterment of academic performance		
6.	Enhancing teaching ability	Teaching Effectiveness	
7.	Updation of knowledge area		
8.	Interactive and participative teaching		
9.	Enhancement of Confidence		
10.	Effective teaching		
11.	Creation of positive impact		

Based on the factor scores, the values of learning outcome and teaching effectiveness were calculated and the same is used to calculate outcome quality.

Outcome quality = Learning Outcome + Teaching Effectiveness

Testing of Hypotheses

H1: The quality of services of DCS is positively associated with outcome quality experienced by the teachers of private CBSE schools.

Table 13 : Correlation Between Outcome Quality and Service Quality

		Outcome Quality	Service Quality
Outcome Quality	Pearson Correlation	1	.364**
	Sig. (2-tailed)		.000
	N	115	115
Service Quality	Pearson Correlation	.364**	1
	Sig. (2-tailed)	.000	
	N	115	117
**. Correlation is significant at the 0.01 level (2-tailed).			

As shown in Table 13, the correlation between outcome quality and service quality is significant and hence this hypothesis is accepted.

H2: The contribution from both factors – viz. learning outcome and teaching effectiveness to outcome quality is equal.

To test this hypothesis, chi square test for the proportions was used and the results are as per Table 14 below:

P1-Proportion of contribution from learning outcome to outcome quality	P2-Proportion of contribution from teaching effectiveness to outcome quality						Total
0.8034	0.1966						1
Table-I							
Category	Specified Proportion	Observed Frequencies	Expected Frequencies	(O-E)	(O-E) ²	(O-E) ² /E	
Learning Outcome	0.8034	57.8448	18	39.8448	1587.61	88.20045	
Teaching Effectiveness	0.1966	14.1552	18	-3.8448	14.7825	0.821249	
Total	1	72	36				
						89.0217	
Results							
Test Statistic		89.02169856					
Degrees of Freedom		1					
Level of Significance		0.05					
Upper p-value		0.0001					

Table 14

The value of P1 and P2 are 0.8034 and 0.1966 respectively. i.e., the contribution from both factors are not equal. Hence the hypothesis that the contribution from both factors – viz. learning outcome and teaching effectiveness to outcome quality is equal is not accepted. The chi square test shows that the proportion of contribution of learning outcome to outcome quality is more; i.e., Learning outcome is the key determinant of outcome quality as compared to teaching effectiveness.

The study has established the association between outcome quality and service quality of digital learning solutions. Also the study established the validity of factors viz., learning outcome and teaching effectiveness to the constituting of outcome quality dimension of service quality, though the importance of the factors vary.

Conclusion

Digital learning solutions as adopted in schools in India are unique and these services are provided by organisations who have spent hugely in developing content and provide state of the art hardware. The industry is growing fast and the industry must understand the needs of the customers, specifically teachers. They should also understand the perception of the teachers to the different dimensions of service quality and what factors the teachers view as important.

Among the three dimensions of service quality viz., functional quality, information quality and outcome quality, this study has taken up 'outcome quality' for

investigation. The study has proved that outcome quality is positively associated with service quality. Also the study has validated the factors that constitute outcome quality – viz. learning outcome and teaching effectiveness. Also the research has proved that learning outcome and teaching effectiveness contribute equally to outcome quality. Further the study has proven the validity of the variables that constitute these factors (Table 11).

The research output can provide a basic framework for the industry to focus upon to ensure service quality and thereby customer satisfaction. The industry should focus on the issues (Table 12) that result in higher learning outcome and teaching effectiveness to ensure their service is perceived as high on quality.

This research will be a useful addition to the body of research on digital classroom solutions and technology in schools, whose research is very scant in India.

Scope for Further Research

The sample size of current research is only 109. Increasing the sample size will further validate the finding and also the suitability of the variables that constitute the factors of outcome quality. While the current research covered the impact of outcome quality on service quality, it has to be noted that this is not the only dimension that impacts service quality. The impact of information quality as a dimension has been validated (Sugant & Anvekar 2015), while the impact of other dimensions on service quality need to be further investigated and studied upon. Also the

factors that contribute to the other dimensions need to be investigated and concluded upon. Further service quality is an antecedent to customer satisfaction and hence the impact of the service quality and the different dimensions of services quality on customer satisfaction could also be taken up for further research.

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