ICT enabled classroom effectiveness scale development and validation: A case of multi-campus university

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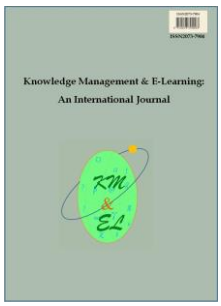

Knowledge Management & E-Learning: An International Journal (KM&EL)
ISSN 2073-7904

Recommended citation:
Tikoria, J., & Agariya, A. K. (2017). ICT enabled classroom effectiveness scale development and validation: A case of multi-campus university. *Knowledge Management & E-Learning, 9*(1), 111–127.

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ICT enabled classroom effectiveness scale development and validation: A case of multi-campus university

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Abstract: The research work aims at developing a valid and reliable scale for ICT (Information and communication technology) enabled classroom effectiveness from student's perspective in a multi-campus university setting. A standard methodology for scale development is used for developing and validating the scale which comprises of exploratory and confirmatory factor analysis. The sample population was the students from a premier multi-campus university. The results revealed ICT enabled classroom effectiveness as a multi-dimensional construct comprising of four factors namely class design and infrastructure; scheduling and coordination; technical support staff; and resource availability. Although a plethora of literature is available in the domain of e-learning, none of them have considered the aspects of ICT enabled classroom effectiveness specifically in an Indian multi-campus university. The limitation of the study lies in terms of sample size and generalizability. Emphasizing the identified factors will give a cutting edge advantage for the universities by enhancing the effectiveness and efficiency of ICT enabled classroom teaching.

Keywords: ICT enabled classroom effectiveness; Multi-campus university; Exploratory factor analysis; Confirmatory factor analysis; India

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1. Introduction

In the era of globalization, educational universities/institutes have also realized the importance of analyzing the external environment nationally & globally to identify the possible opportunities & threats as well as analyze the internal environment to identify their internal strengths & weaknesses. The higher educational universities/institutes are looking to identify appropriate strategies & means to exploit the available opportunities timely through building & enhancing its strengths and overcoming the weaknesses & threats. They have seen technology as one such strategic resource and mean to accomplish their objectives. There are various reasons for which Indian Higher Educational Institutes (HEIs) to implement technology specially Information and Communication Technology (ICT).

India has the largest higher education system in the world in terms of the number of institutions as 33,723 in year 2013, and the second largest in terms of the number of students, but still India's current higher education gross enrolment ratio (GER) is 18% which is quite below the global average of 27%. At the same time, only a handful of Indian Higher Educational Institutes (HEIs) feature in global rankings as QS World University Rankings and Times Higher Education World. For improving global ranking, Indian HEIs need to have an international outlook in terms of expanding operations abroad, attracting international faculty and students *(Federation of Indian Chambers of Commerce and Industry (FICCI, 2014) Report - "Higher education in India: Moving towards global relevance and competitiveness: FICCI Higher Education Summit 2014", prepared by EY and FICCI, India).*

Moreover, the Indian government has planned to increase GER in higher education to 30% by 2020, which would require establishing another 800 universities and over 40,000 colleges to provide the planned additional 14 million places by 2020. Realizing the vast opportunity for higher education in India, even foreign universities are looking at India to set up their campuses here (*British Council (2014) Report - Understanding India: The future of higher education and opportunities for international cooperation).* Some reputed Foreign Education Institutes have already partnered with local players in India to offer their programs *(FICCI (2014) Report - "Higher education in India: Moving towards global relevance and competitiveness: FICCI Higher Education Summit 2014", prepared by EY and FICCI, India).*

Globally several universities have multi-campuses located at different places in their home country or other countries. Such multi-campus universities have the concern to ensure the quality in teaching at all campuses and at the same time optimizing their resources. Information and communication technologies (ICTs) and digital learning technologies are vital component to achieve expansion nationally or internationally and increase access & quality leading to better visibility. (*British Council (2014) Report - Understanding India: The future of higher education and opportunities for international cooperation).* Educational institutes are using ICTs of various types & in various forms specifically in Higher education to exploit the opportunities available and addressing their concerns. But any technology embraces a lot more than just machines (Zeleny, 1986; Khalil, 2000). It is very much important for educational institutes to understand the important aspects/factors to be considered for making the effective implementation and usage of ICT.

One of the ICT based platforms that can be used by educational universities/institutes in the above described scenario stating opportunities & concerns related to higher education, is the specially designed ICT enabled classrooms equipped with video-conferencing facility with high definition cameras for entire class view with

zooming feature; audio-video facility, content & lecture sharing facility, microphone facility & camera zooming facility at each seat in the classroom, classroom networked with such other similarly equipped classrooms irrespective of their location. The faculty instructors can deliver lectures simultaneously to all students sitting in such technology equipped classroom at dispersed locations. Faculty and students sitting in these connected classrooms can see each other and can share the lecture/content in real time with each other. Any student from any such classroom can ask question orally to the faculty and faculty can address to all students. Such ICT enabled classrooms can help the universities/institutes having multiple campuses spread at various locations or having collaborations with other universities/institutes nationally or globally. If the same course is offered to students at different campuses, one faculty can teach to all students registered in different campuses through such classrooms. Even a guest faculty/experts can join from outside the university and can deliver the lecture. This also helps in efficient use of faculty resources and providing the best faculty resources to the students.

This study reports findings from a case of one of the premier universities in India having multiple-campuses located in home country and abroad. The university taken as a case has been pioneer in usage of Information and communication technology in carrying its various processes. One of such ICT based initiative is setting up and using such above mentioned ICT enabled classrooms for teaching students in its multiple campuses located nationally and internationally, providing the best faculty resources. Students join the lecture sessions from such ICT enabled classrooms from their respective campus and the faculty delivers the lecture to all students' indifferent campuses simultaneously. The students and faculty from all campuses can see each other and interact with each other. The courses taught through such classrooms are from various disciplines from engineering, management and social sciences to under-graduation and post-graduation programme. Faculty instructors individually or collaboratively teach these courses to students registered in same course from each campus. Same evaluation components are conducted for all students registered in the same course from all campuses. Grading of the students is done collectively for all campuses. Each such ICT enabled classroom can accommodate upto 100-120 students. The university has been focusing on technology enablement, internationalization and quality assurance in teaching & learning as some of its important identified imperatives to excel in and being ranked among the top global universities.

But there is a necessity to assess the effectiveness of such facility in terms of smooth conduct of the lectures and student's experience in terms of teaching & learning. At the same time, it is important to see how such facility can be improved further. With this aim an attempt has been made by the authors to develop and validate a scale for assessing the effectiveness of this specific facility from student's perspective. A survey was done among students who were experiencing teaching & learning in such environment to assess the effectiveness from their perspective. The outcome of the study has come with the development of a scale to assess the effectiveness of ICT Enabled Classroom that would help the universities/institutes to know the important factors can be focused upon while implementing such facility.

2. Literature review

A few research studies are found in the domain of adoption and usage of Information and Communication technology (ICT) for teaching and learning focusing on different aspects related to that as summarized in Table 1. Eze, Awa, Okoye, Emecheta, and Anazodo

(2013) in their study in context of ICT adoption in Nigerian universities found that irrespective of the perceived competitive pressures and perceived benefits of ICT solutions, government-owned universities are yet to exploit its full potentials in their operations. This behavior because of various factors as corrupt practices; irregular energy supply and internet connectivity/accessibility; lack of financial capacity, expert skills, managerial and technical flexibility/support; and poor regulatory policies and government supports.

Table 1
Select list of studies on use of ICT in education (2007-2014)

Author/Year	About the study
Stensaker, Maassen, Borgan, Oftebro, and Karseth (2007)	The study analyzes factors that are of importance for implementation of ICT in higher education in five Norwegian universities and colleges. The study stated that pedagogical issues and organizational and human development aspects must be better linked if ICT is to play a more effective role in teaching and learning.
Raiha, Tossavainen, Enkenberg, and Turunen (2012)	The study investigates teachers', school health nurses' and school catering managers' views on a nutrition health project implemented via an ICT-based learning environment in a secondary school. The study has stated that ICT-based learning environment required the school staff members to have motivation and a change in attitude. It requires more time for planning & co-operation between colleagues as well as well-functioning classrooms with a sufficient number of computers with telecommunications connections. Need discussion forum & web-based chat system for students to receive expert information and have interaction with experts/faculty & among themselves.
Papic and Bester (2012)	Addresses the problem of distancing between the prevailing traditional pedagogical methods within formal educational institutions and the ways in which students acquire information and knowledge outside of the schools as they are becoming less and less interested in traditional lectures. It is stated that specific information and communication system technologies (ICT) supported mechanisms, such as social learning and virtual communities may address these challenges.
Salehi and Salehi (2012)	This study aims to investigate the teachers' perceptions of the barriers and challenges preventing teachers to integrate ICT in the classroom. The study indicated that although teachers had a strong desire to use ICT in the classroom, they were encountered with some barriers. Insufficient technical supports at schools and little access to Internet and ICT were considered as the major barriers preventing teachers to integrate ICT into the curriculum. Moreover, the descriptive analysis of the results showed that shortage of class time was another significant barrier discouraging teachers to use ICT into the classroom.
Ion (2012)	The study presents the transition towards mobile learning, complementary to e-Learning. As mobile devices are becoming increasingly more popular, their role in education should not be neglected.
Eze et al. (2013)	The study investigates and prioritizes the effects of various factors in determining ICT adoption in Nigerian universities. Evidence from the

	study shows that, irrespective of the perceived competitive pressures and perceived benefits of ICT solutions, government-owned universities are still to exploit its full potentials in their operations. The incessant corrupt practices; irregular energy supply and internet connectivity/accessibility; lack of financial capacity, expert skills, managerial and technical flexibility/support; and poor regulatory policies and government supports are the reasons for their behavior.
Mkomange, Chukwuekezie, Zergani, and Ajagbe (2013)	The study investigates the beliefs on the usage of information and communication technology (ICT) of prospective mathematics teachers in mathematical problem solving. Findings from this study reveal the importance of the use of ICT in solving mathematics problems.
Agariya and Singh (2013)	Authors have developed a reliable and valid e-learning quality scale from the instructor as well as from student's perspective in Indian context. Different factor structures were emerged out of the analysis with some commonality and differences from both the perspectives.
Suhartanto and Junus (2014)	The study reports the result of the training on the portal developed by the Faculty of Computer Science, Universitas Indonesia (Fasilkom-UI) and the implementation using several non ICT subject modules as well as measuring the participants' readiness in implementing the e-Learning modules. The results show that the participants are ready to implement the modules at their schools; however, in order to gain more effective learning process they need supports from stakeholders particularly in improving the school internet infrastructures and the school policies on teacher working loads.

To gain more effective learning process, stakeholders must support in improving the school internet infrastructures and the school policies on teacher working loads (Suhartanto & Junus, 2014). Apart from infrastructure & well-functioning classrooms with a sufficient number of computers with telecommunications connections, ICT-based learning environment also requires the school staff members to have motivation and a change in attitude as compared with traditional classroom education, more time for planning and co-operation between colleagues is needed (Raiha et al., 2012; Salehi & Salehi, 2012). Salehi and Salehi (2012) also indicated that although teachers had a strong desire to use ICT in the classroom, insufficient technical supports at schools and little access to Internet act as major barriers preventing teachers to integrate ICT into the curriculum. The shortage of class time was another significant barrier discouraging teachers to use ICT into the classroom.

With respect to ICT based teaching environment, discussion forums, web-based chat, social learning and virtual communities are important to help the students to interact and receive expert information, present questions, and exchange opinions with their classmates, school staff and other experts (Raiha et al., 2012; Papic & Bester, 2012).

ICT driven pedagogies and platforms are also being found to be used for teaching technical subjects as mathematics (Mkomange et al., 2013; Chandra & Briskey, 2012). ICT platforms promote teamwork and collaboration among faculty in cross campuses. ICT plateforms make the faculty to invite and collaborate with external faculty/experts across the globe (Raiha et al., 2012). ICT usage shows a positive influence on the quality of the student-faculty interaction (Criado-Gomis, Iniesta-Bonillo, & Sanchez-Fernandez,

2012). Moreover, ICT can play a very efficient and effective role in internationalization as well. Thune and Welle-Strand (2005) addresses the issues of internationalization and how Information and Communication Technologies (ICT) are parts of internationalization processes in higher education. The case study indicates that although information and communication technologies are seen as central in internationalization processes, and for supporting and coordinating international activities, they are not seen as driving forces for internationalization of higher education.

In the transition towards mobile learning, complementary to e-Learning, as mobile devices are becoming increasingly more popular, their role in education should also not be neglected (Ion, 2012). The important factors highlighted by previous studies for effective implementation & usage of ICT in Schools/universities for education are listed in Table 2.

Table 2
Important factors for effective implementation & usage of ICT in Schools/universities for education

Author/Year	**Important factors for effective implementation & usage of ICT in Schools/universities for education**
Stensaker et al. (2007)	▪ Pedagogical issues
	▪ Organizational aspects
	▪ Human development aspects
Raiha et al. (2012)	▪ Motivation and a change in attitude of staff members
	▪ More time required for planning & co-operation between colleagues
	▪ Well-functioning classrooms with a sufficient number of computers with telecommunications connections.
	▪ Discussion forum & web-based chat system for students to receive expert information and have interaction with experts/faculty & among themselves.
Papic and Bester (2012)	▪ Social learning and virtual communities
Salehi and Salehi (2012)	▪ Insufficient technical supports at schools and shortage of class time was another significant barrier discouraging teachers to use ICT into the classroom.
Eze et al. (2013)	▪ Practices of universities
	▪ Energy supply and internet connectivity/accessibility
	▪ Financial capacity
	▪ Expert skills
	▪ Managerial and technical flexibility/support
Suhartanto and Junus (2014)	▪ Supports from stakeholders particularly in improving the school internet infrastructures and the school policies on teacher working loads.

From the literature review it was found that no study has been done to assess the effectiveness of described type of ICT Enabled Classrooms used in a multi-campus setting for teaching courses simultaneously to students registered for the same course in different campuses. There is a need for the development & validation of a scale to assess the effectiveness of such ICT Enabled Classrooms that would help the universities/institutes to know the important factors can be focused upon while implementing such facility.

3. Methodology

Churchill (1979) standard scale development methodology has been followed consisting of generation of items, pruning and fine tuning based on expert interaction, exploratory factor analysis and confirmatory factor analysis (comprising of measurement and structural model). Based on literature review and taking inputs from faculty having experience of teaching in the taken ICT enabled classroom in multi campus scenario 29 scale items (as given in Appendix I) were identified for assessing the effectiveness of ICT enabled classroom from student's perspective after the expert interaction a total of 21 scale items were retained based on context applicability, relevance, and expert consensus. Responses were received by using offline mode from the students of a premier university. In totality 220 responses were received. The data was divided in two equal parts, from first half exploratory analysis was carried out, whereas the second half was used to carry out the confirmatory factor analysis.

3.1. Questionnaire survey

A questionnaire was developed having 21 items followed by a pilot survey of the questionnaire to assess the *content validity*. *Content validity* was evaluated by a panel of experts, to judge whether a scale logically appears to accurately reflect what it purports to measure. The respondents were requested to select the response that best indicates their experiences or perceptions on each statement, using a five point Likert-type scale (From 1= strongly disagree to 5= strongly agree).

The respondents were students pursuing technical courses as part of their under-graduation and post-graduation programme. The students' respondents were briefed about the objective of the survey and were informed to answer specifically only for ICT enabled classroom as the purpose of the study is to assess the effectiveness of the specific ICT enabled classroom for teaching & learning. The courses which these respondent students have attended in ICT enabled classroom are both technical and theoretical ones. On an average the respondents had attended 35 lectures in the ICT enabled class room. Responses to the questionnaire were received offline from the respondents. A total of 220 responses were received. Furthermore, the reliability analysis, sampling adequacy analysis and exploratory factor analysis was carried out with the data to identify the major constructs followed by confirmatory factor analysis. SPSS-15 and AMOS-8 software was used for carrying out statistical analysis mentioned above. The demographic profile of the respondents is given in Table 3 and Table 4; the gender difference was due to the student enrollment ratio of male and female students in specific courses taught through ICT enabled classroom facility.

Table 3
Gender wise break-up of the respondents

Particulars	Number	%
Male	174	79.09
Female	46	20.91

Table 4
Education Level wise break-up of the respondents

Particulars	Number	%
Undergraduate students	128	58.18
Post graduate students	92	41.82

4. Analysis of results

The reliability of the data is found 0.812, which is in the quite acceptable range (> 0.7) (Nunnally, 1978). Further to this Kaiser Mayer Oklin (KMO) statistics was calculated that shows the value 0.711 (>0.5) which clearly falls in the acceptable range to carry out further analysis. In exploratory factor analysis, based on the results of rotated component matrix, 4 factors were emerged along with 17 indicators contributing towards 59.71% of the variance. On the basis of these factors ICT effectiveness models were proposed. The extracted factors along with their indicators are shown in rotated component matrix (Table 5).

Table 5
Exploratory factor analysis (Rotated component matrix)

Particulars	Factors			
	CDI	SC	TSS	RA
CDI1: Infrastructural facilities	.786			
The infrastructural facilities (i.e. audio-visual aspects and availability of the same for each participant) of this classroom are quite effective for lecture delivery.				
CDI2: Audio-visual facilities	.640			
Projector and OHP facility provided in this classroom is quite effective.				
CDI3: Size of the classroom	.505			
I am comfortable with the seating capacity and size of this classroom.				
CDI4: Classroom environment	.696			
I feel the classroom environment quite convenient in terms of interaction and clarifying queries.				
CDI5: Availability of classroom	.559			
I feel there should be multiple such class rooms available for other courses running in different campuses.				

CDI6: Internet connectivity The connectivity of internet is excellent during the lecture.	.765			
SC1: Room booking I am satisfied with the room booking procedure of this class room for consultation.		.592		
SC2: Instant/timely communication There is instant/timely communication from the instructor regarding class cancellations, rescheduling or any other important announcements across all the campuses.		.626		
SC3: Uniform evaluation I am satisfied with the fairness and uniformity maintained in evaluation for the courses delivered in this class room.		.666		
SC4: Conducting tutorial I am satisfied with the tutorials conducted in this class room.		.739		
SC5: Timeslot for lectures I feel convenient with the current time slots of lectures held in this class room.		.605		
TSS1: Technical support team availability Technical support team is always available in case of any technical interruptions during the lecture.			.705	
TSS2: Technical faults Generally, the classes held in this class room go well without much technical faults.			.539	
TSS3: Lecture delivery through guest The lecture delivery is quite smooth, when an external speaker/guest (from outside Campuses) delivers lecture in this Class room using online platform.			.774	
RA1: Content availability after class Teaching resources like PPTs and other supporting study material are made available easily after the end of the class.				.801
RA2: Solving technical problems I feel convenient in getting the numerical, mathematical problems, diagrams etc. solved by the instructor using available technological means.				.757
RA3: Slot for consultation Majority of the times I feel the need of consulting concerned faculty for queries in a dedicated time slot.				.613

Note. Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization; a. Rotation converged in 7 iterations; CDI: Class Design and Infrastructure; SC: Scheduling and Coordination; TSS: Technical Support Staff; RA: Resource Availability

The measurement model (Fig. 1) is represented as a multi-dimensional construct explained by four factors resulted from exploratory factor analysis. This measurement model is verified by using the second half of the data (Sample size: 110). Measurement model is accepted because of acceptable level of fit based on the calculated measures

(Anderson & Gerbing, 1988). Three indicators namely CDI 3, CDI 5 and SC 1 have been removed because of poor loadings and unacceptable degree of fit. The calculated statistics of measurement model is shown in Table 6. In addition to this all the indicators loaded significantly on the corresponding latent constructs. The values of the fit indices indicate a reasonable fit of the measurement model with the sample data (Byrne, 2001).

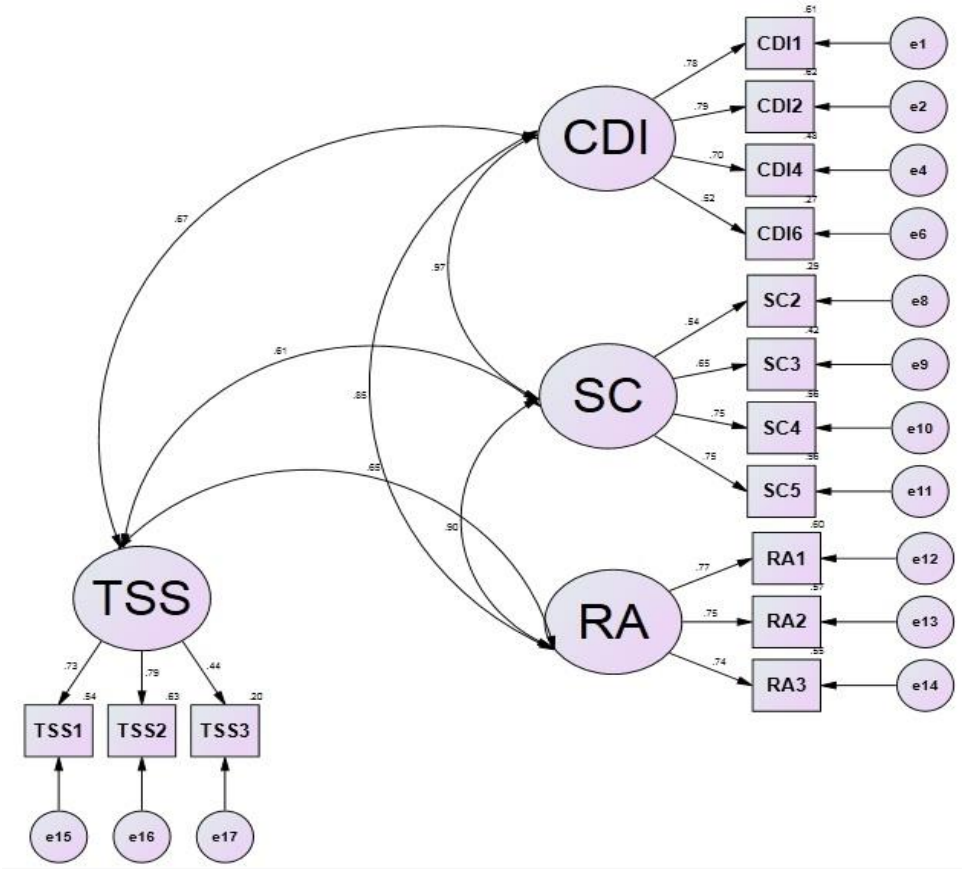

Fig.1. Model 1- Measurement model (4 Factor model)

The values of the fit indices measures were found in acceptable range (2 to 5) as $\chi 2$/ df vale is 2.46, which depicts the goodness of fit of the measurement model (Wheaton, Muthen, Alwin, & Summers, 1977; Tabachnick & Fidell, 2007). RMR value was also found in the acceptable range (Byrne, 1998; Hu & Bentler, 1999; Diamantopoulos & Siguaw, 2000). GFI and AGFI values also range between 0 and 1 and it is generally accepted that values of 0.80 or greater indicate best model fit. CFI $\geq$ 0.90 is established earlier however recent studies have shown that a value greater than 0.90 is deemed to be appropriate for ensuring the model acceptance (Hu & Bentler, 1999). PCFI should range in .50 to .80 regions, value of 0.706 depicts the acceptable fit (Mulaik et al., 1989; Byrne, 2001). The acceptable range of RMSEA is 0 to 0.08 (Byrne, 1998). This is also found in the acceptable range as shown in Table 6.

Table 6
Calculated statistics for the Model-1

	Model Fit	Absolute Measures			Incremental fit Measures		Parsimonious fit Measures	RMSEA
	$\chi 2$/ df	RMR	GFI	AGFI	CFI	TLI	PCFI	
Model 1	2.456	.04	.865	.800	.904	.877	.706	.07

Table 7 clearly indicates the calculated values of composite reliability for the four constructs and found more than 0.6, which is quite acceptable and also indicates the reliability of constructs (Carmines & Zeller, 1979). Construct validity is established in this study by establishing the content validity, convergent validity and discriminant validity. Content validity is verified through expert's interaction and literature support in the area of ICT effectiveness. Convergent validity is assessed by examining the AVE (average variance extracted) and factor loadings (Fornell & Larcker, 1981). All the indicators have shown significant loadings onto their respective latent constructs with values varying in between 0.44 to 0.79. In addition, AVE for each construct is greater than or equal to 0.50, which further supports the convergent validity of the constructs. Discriminant validity was established by comparing the AVE values with the corresponding inter-construct squared correlation estimates. The comparison revealed AVE values are higher than the square of the inter-construct correlations.

Table 7
Composite reliability of the constructs

Construct	**Composite Reliability**
CDI	0.63
SC	0.71
TSS	0.87
RA	0.82

Thus, the measurement model reflects good construct validity and desirable psychometric properties (Agariya & Singh, 2015).

Model-1 is the measurement model which includes covariance; weightage calculation and validity part whereas Model-2 is the structural model for checking out the interrelationship between dependent and independent factors consisting of residual errors. In the second model (Fig. 2), the structural ICT effectiveness model is validated. R1 to R4 are residual errors whereas e1 to e17 are error terms. The calculated statistics for the same is shown in Table 8. In short, the structural model confirms the four-factor structure of ICT effectiveness.

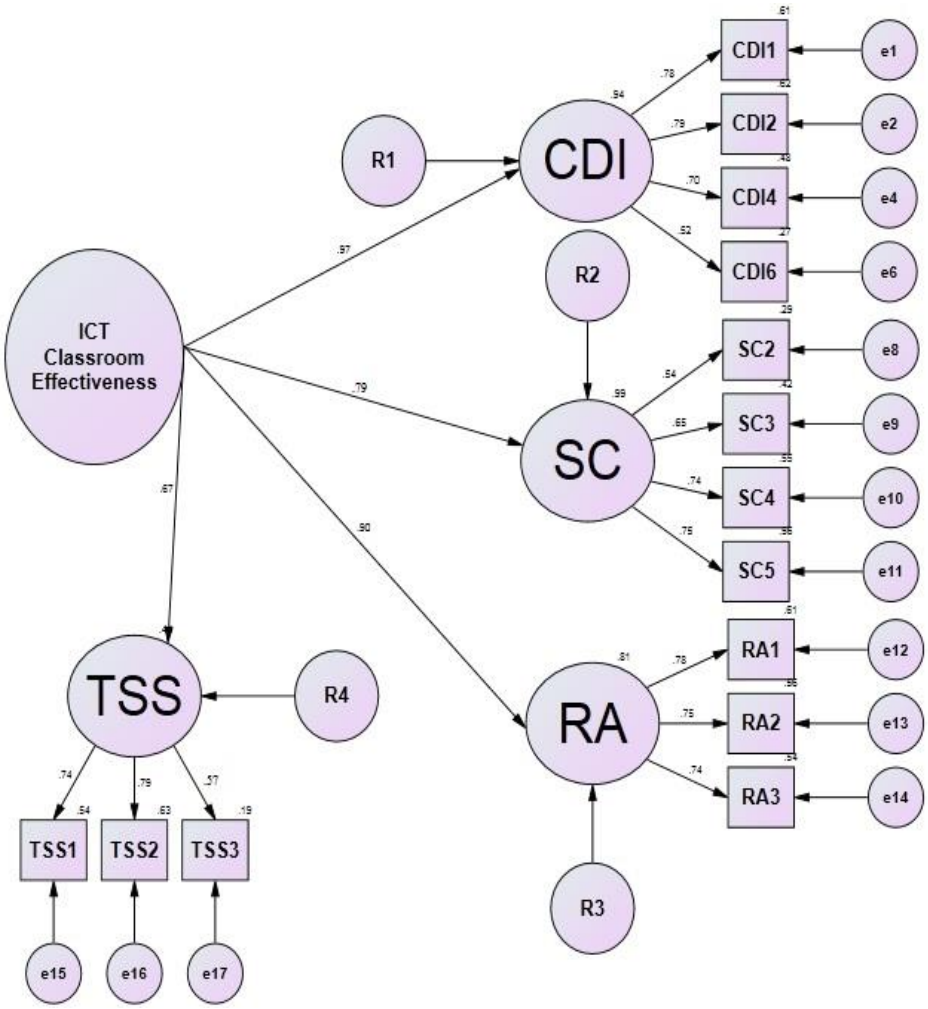

Fig.2. Model 2- Structural model (4 Factor Model)

Table 8
Calculated statistics for Model-2

	Model Fit	Absolute Measures			Incremental fit Measures		Parsimonious fit Measures	RMSEA
	$\chi 2$/ df	RMR	GFI	AGFI	CFI	TLI	PCFI	
Model 2	2.448	.04	.861	.800	.902	.878	.724	.07

5. Inferences & strategic implications

ICT enabled classroom effectiveness has been emerged as a multi-dimensional construct comprises of four factors namely class design & infrastructure; scheduling & coordination; technical support staff; and resource availability. These four factors have been comprised of sub-indicators which are discussed in this section as below.

5.1. Class design & infrastructure (CDI)

This factor emerged out as one of the critical factors contributing towards ICT enabled classroom effectiveness. This factor comprises of sub-indicators namely the physical and modern technical infrastructure i.e. audio-visual facilities; webcam and speakers etc.; projection facility i.e. projector and OHP at multiple campuses for better content display; environment of class room i.e. seating arrangement; ambience; automatic temperature and lighting control mechanisms; Internet connectivity i.e. proper bandwidth at all the campuses, external faculty inclusion convenience etc. This factor has to be given due importance for enhancing the ICT enabled class room effectiveness.

5.2. Scheduling & coordination (SC)

In a multi-campuses university setting this factor has its own impact on enhancing ICT enabled classroom effectiveness. This factor comprises of the sub-indicators namely instant and timely communication regarding case study discussion, content for the lecture and proper queries answering mechanism on a real time basis; uniform evaluation mechanism across all the campuses inclusive of faculty support from respective campuses; conducting tutorial; assigning proper time slot for lectures for the convenience of the faculty members, students and faculty coordinators at respective campuses for smoothing the process of course delivery. Proper emphases on these sub-indicators will in-turn enhance the teaching and learning experience through ICT enabled class room.

5.3. Technical support staff (TSS)

This factor has its critical role to play while delivering lectures using ICT enabled class room facility. This factor comprises of sub-indicators namely availability of technical support team across the campuses for smooth delivery of lectures in a proper manner; handling technical faults i.e. minimizing to the lowest level as this problem can't be eliminated completely; proper arrangement for including off-campus /guest faculty without much hassles through a proper mechanism. This factor has to be given utmost importance for better experience of the students by using ICT classroom facility.

5.4. Resource availability (RA)

This factor has a crucial role to play for enhancing the learning of the students in a multi-fold manner. This factor comprises of the sub-indicators namely lecture content availability (PPT form) after the class however the same will be more effective if shared before the class, lecture notes to supplement the content etc.; proper mechanism to solve technical problems by using white boards and assistance through faculty coordinators at respective campuses; availability of main instructor for consultation after the class if required on a case to case basis because of high number of students, the same can be more effective if the main instructor visits other campuses at least once during the course.

This will in turn contribute towards better satisfaction of students as well as the instructor by enhancing online and face to face interaction. These indicators will in turn enhance the effectiveness and efficiency of course delivery using ICT classroom setting.

6. Conclusion

The present scenario of teaching and learning has been completely changed due to inclusion of ICT enabled tools. The use of ICT enabled class rooms will be useful for premier institutes having multiple campuses across the country and also for making their international presence. This will enable a good learning platform for the students by using the faculty expertise for multiple campuses and answering the crucial shortage of faculty experts. The outcome of this research work in terms of a reliable and valid ICT enabled classroom effectiveness scale will serve as a critical aid in enhancing the effectiveness of teaching and learning both from the instructor and student per se. The identified factors have to give due consideration while implementing ICT tools as an aid for teaching as well as for identifying the areas for improvement for those who have already implemented the same. A handful of Indian premier institutes are using ICT enabled class room setting for delivering lectures for their multiple campuses however there is handful of research studies which have really touched the serious concern of identifying factors of importance for making the learning and teaching more efficient and effective. Here lies the contribution of this research work by proposing a scale for enhancing ICT classroom effectiveness which is the demand of the hour specifically in Indian scenario. These factors are unique to the context and no commonality was found from the previous studies. These factors have to be emphasized and a regular feedback on the sub-indicators from student perspective will in turn enhance the ICT platform effectiveness. Emphasizing the identified factors will give a cutting edge advantage for the universities through enhancing the effectiveness and efficiency of ICT enabled classroom teaching by making it more students centric. From the practitioner point of view these factors will help them in choosing right technology platform provider for designing the appropriate infrastructure for ICT enabled classroom.

The proposed scale items can be used for identifying the major factors of utmost importance for ICT enabled class room in different university level settings in different national context. The universities having multiple campuses or teaching through online mode (distance learning courses) will be more suitable for using the scale items and focusing on their own set of relevant factors from their student's perspective. This will also serve as an aid in dealing with the faculty shortage problems.

7. Limitations and future research lines

Relatively smaller sample size is one of the major limitations of this study. For overcoming this limitation, a large and more diversified sample can be taken to test the validity of the proposed scale in future. Future researchers may also look at comparing the factors commonality and difference specificity between ICT enables vis-à-vis traditional classroom settings. This research work can be replicated for different government and private educational institutes with ICT facilities in different national context to verify the generalizability of the proposed scale. The scope of the present research work is also limited in terms of taking online lectures delivery in multiple campuses using ICT facilities, future studies may broaden the scope by looking at the other aspects of ICT enabled class room to get a holistic perspective.

Acknowledgements

The authors would like to thank Late Professor Deepali Singh for her valuable guidance and support for the idea on this project.

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Appendix I

Items Inventory for Questionnaire

S. No.	**Items**
1.	The infrastructural facilities (i.e. audio-visual aspects and availability of the same for each participant) of this classroom are quite effective for lecture delivery.
2.	Projector and OHP facility provided in this classroom is quite effective.
3.	There is instant/timely communication from the instructor regarding class cancellations, rescheduling or any other important announcements across all the campuses.
4.	I am comfortable with the seating capacity and size of this classroom.
5.	I feel the classroom environment quite convenient in terms of interaction and clarifying queries.
6.	I feel convenient in getting the numerical, mathematical problems, diagrams etc. solved by the instructor using available technological means.
7.	I feel convenient with the current time slots of lectures held in this classroom.
8.	I feel there should be multiple such classrooms available for other courses running in different campuses.
9.	The connectivity of internet is excellent during the lecture.
10.	I am satisfied with the fairness and uniformity maintained in evaluation for the courses delivered in this class room.
11.	Technical support team is always available in case of any technical interruptions during the lecture.
12.	I feel the need of white board required for explaining the numerical, mathematical problems, diagrams etc.
13.	I am satisfied with the tutorials conducted in this class room.
14.	Majority of the times I feel the need of consulting concerned faculty for queries in a dedicated time slot.
15.	I am satisfied with the room booking procedure of this classroom for consultation.
16.	I get the same kind of attention and interest in the lecture in this classroom as in traditional classroom setting.
17.	I feel engaged during the lecture delivered in this classroom.
18.	I feel comfortable in asking questions when faculty from other campus delivers the lecture
19.	I am satisfied with the teaching pedagogy used by the faculties in the class
20.	I am satisfied with the preparedness of the faculties taking the class
21.	I find content taught in the class is organized well by the faculty
22.	I find lectures are well planned by the faculty according to the duration of the class
23.	I am satisfied with the way faculties make the classes interactive
24.	I feel faculties are comfortable in teaching through this classroom
25.	Classes in this classroom are conducted regularly.
26.	Generally the classes held in this classroom go well without much technical faults.
27.	I am satisfied with the faculties in providing feedback on given assignments etc.
28.	The lecture delivery is quite smooth, when an external speaker/guest (from outside Campuses) delivers lecture in this Classroom using online platform.
29.	Teaching resources like presentation and other supporting study material are made available easily after the end of the class.