

# Value and Price of Teaching-Learning Aids in Curricular Health Trainings in India

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**Abstract Background:** Teaching-learning (T-L) aids are being used for long time in medical education. With the technology and electronic revolution newer medical education aids are increasingly being applied that needs evaluation. **Objective:** To assess the overall impact of audio-visual aids in teaching-learning of medical students in India. **Methods:** Literature search for data sources were done through an extensive search in indexed literature and website based educational research reports. Altogether 92 studies were identified from 300 potentially pertinent articles. A broad criterion to define both physical instruments and educational instruments has been used for searching the comments. Moreover, we have utilized personal resources and from individual collections. **Results:** Outcomes of use of teaching-learning aids in undergraduate medical education varied largely with conventional and innovative methods, with few studies using different parameters and learning (unspecified) aids, innovative technology, and amalgamation of them. The researchers noted that in general the learning experience was not significantly dependent on the aids used during sharing knowledge and expertise, though some of the studies showed marginal and tangential benefits while the capacity of the facilitator matters most. **Conclusions:** In the last place it is the man behind the machine that imparts communication in health care scenario.

**Keywords:** *teaching-learning aids, medical, dental*

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## 1. Introduction

A teaching-learning method is a planned way of providing a teaching-learning experience. Extensive use of medical educational technologies is observed in India in this modern arena of information outburst with an urge for alternative medium to reduce dissatisfaction from conventional mode of education. Although basic educational principles include learning, engagement, feedback and assessments remain same with conventional and innovative methods, delivery can be more effective to learners by technological means. Teaching-learning aids are used at various levels of medical education worldwide since time immemorial for better communication. [1] With the technological revolution more and more innovative aids like E-learning, Online Learning, Web-based Learning, or Distance Learning are being introduced by various institutes. These are extensively used as many are freely available for wider knowledge dissemination. Even recorded lectures are uploaded in freely available public domain; webinar and live lecture demonstration are also available through v-sat virtual learning, virtual workshop, virtual classrooms; virtual conferences have become reality. [2] Some educationists have become proactive in the field of medical education to share their experiences with others to help learn optimal use of gadgets. [3]

Flexibility and cost-effectiveness are vital in selection of medical educational technology and continuing professional development programs. We are yet to find studies and meta-analyses regarding utility of aids in Indian medical undergraduates. The researchers of this systematic review have tried to find out the outcome of various TL aids. As integral component of medical education from reported studies in India various teaching-learning methodologies have been tried historically with the technological innovations having their distinct merits and demerits. So an attempt was made to explore feasibility and utility of use of technology to deliver academic contents to learners across undergraduate disciplines.

## 2. Methods

We attempted an extensive collection of different published studies in which effectiveness of teaching-learning aids were appraised in learning experience of medical and dental undergraduates, including meeting presentations and personal communications. Through an extensive website-scanned search in indexed literatures and study reports, we identified 92 studies on various teaching-learning aids on Indian medical undergraduates from 300 potentially relevant articles from 2001 to 2015. All indexed journal publications available from various

institutional libraries of India, and websites on related studies in medical education among medical undergraduate students published since 2001, were included in this study. The studies were identified by searching Pubmed-Entrez and other search engines and proceedings of scientific meetings, conferences, workshops, forums, homepages of different important institutes and universities and medical education programs (2001-2015) also. Reviews of citations and cross-reference lists were followed to identify additional eligible studies. Search terms included teaching-learning aids, audio-visual aids, medical education, teaching technologies, undergraduates etc. Wherever possible, sources and resource persons were contacted for further information on research data not readily available in the public domains. Manual searches were conducted for review article. The researcher also used their own publications and manuscripts communicated for publications in this review. We also contacted authors for additional information or for translations from languages other than English.

## 2.1. Selection Criteria

We developed few criteria to select studies from among peer-reviewed articles. First we used broad criteria to have teaching-learning aids in Indian medical undergraduate studies. Second, we sought to include all studies under various aids used in pre-clinical and clinical subjects separately. Thirdly, this study included the outcome of various studies with most preferred aid by the experimental group (single aid) and its comparison with other commonly used aids. Finally in the absence of universally accepted criteria of most accepted aid in teaching-learning, in the midst of several confounders and scope of subjective assessments of spectrum of learning experiences by the learner of most preferred aid, we discussed in depth the distinctive effects irrespective of the criteria of use of aids in undergraduate medical and dental teaching-learning.

## 2.2. Main Outcome Variable

Assessment of learning experience using various audiovisual aids.

## 2.3. Data Abstraction and Analysis

Main interest of this analysis was subjective learning experience of undergraduate students wherein we observed remarkable differences in teaching-learning aids, participants and primary outcome variables. To be more precise, heterogeneity varied in sample size, study instruments, disciplines among courses, topics or subject chosen, institution and its faculty and also criteria and/or protocol for use of teaching-learning aid and assessment module also. Thereby, outcome varied to a large extent with regard to the overall use and utility of various conventional and innovative teaching-learning aids in a majority of studies. Few studies also used different parameters, namely computer assisted learning (unspecified) aids, innovative technology, audio-visual aids and amalgamation of them in various permutations and combinations.

## 2.4. Literature Reporting Outcomes of Single Teaching-learning Aid

### 2.4.1. Chalk and Talk or Blackboard (BB) Teaching

Historical cost-effective way to display and deliver information to a large group uses writing on Boards (Black, Green etc.) with chalk (White and colored). With the turn of century, white board and pens with colored delible inks replaced age-old boards with reincarnation of chalk and talk.

### 2.4.2. Over-head Projector (OHP)

Over-head projectors get inroads to circumvent the problems of chalk-talk presentations i.e. time-consuming, lacking eye-contact, larger images etc [4]. This provides advantage of daytime use, note-taking along etc. to make it a popular medium in pre-computer era. In a recent study on 200 medical undergraduates at a tertiary care teaching medical institute at Maharashtra, majority opined for use of Over-head projectors in pre-clinical classes [5].

### 2.4.3. PowerPoint (PPT) Presentations

'PowerPoint' software, as an inbuilt component of Office software package combines signs, colors, fonts and typescripts, illustrations and animatronics in auto running or interactive displays required for innovative and dynamic presentation; demonstrate pathway and mechanism, diagrams; and in charts, animated text, sweeps, and other types of effects are easily implemented. Ppt put forward diverse and elaborate animations and sound effects; use of hyperlinks to plot a route to desired internet sites. Two recent studies, one on medical entomology from Puducherry [6] and the other on embryology from Bangalore favored computer assisted innovative tools [7]. In Gujarat study, majority (85.8%) in Pathology class preferred PPT for better comprehension [8].

### 2.4.4. Liquid Crystal Display (LCD) Panel

Computer generated images can be projected using a LCD panel and kept on the plate of an OHP. The effect is somewhat similar to video projector with slightly less quality in terms of sharpness of image and smoothness of animation. In Coimbatore learners supported Computer assisted learning with LCD as an effective method especially for practical of pharmacology [9].

### 2.4.5. Video Presentation

A video recorded session displayed live modus operandi and depicts with clarity. It is exceedingly valuable in elucidating surgical procedures and best for far-flung, unreachable and delicate demonstrations. Out of 162 of the first year students in a south-Indian study, majority (73%) reflected that the video assisted teaching-learning sessions made them understand three-fourths of the topics discussed in their Problem based learning (PBL) approach [10].

### 2.4.6. Slide Projector

Sequential presentation of written or printed matter, figures etc. on slides are shown through passing light on transparent slides in this device. This was considered as an inexpensive and effective tool in a study at Kolkata, for projecting magnified images of histopathology and hematology [11]. The popularity of this media faded away with the introduction of easily available and cheaper resources of digital imaging techniques and supportive

software to this aid eventually shelved in the museum of medical educational technology.

#### 2.4.7. E-resources

In the simplest form, a facilitator can upload a presentation, or writer or editor uploads a book or journal on the institutional library set up or some other webpages - for audience access it's termed as e-learning – narrations are taken care of by audio settings provisions too. Use of hypertext which are non-linear pages further linked to other links on different pages are also a mode of such e-learning. In a south Indian institute the students perceived that biochemistry e-learning resources made a positive impact on various aspects of their learning [12].

#### 2.4.8. Computer Assisted Learning (CAL)

This assist, augment or deliver part or whole of instruction even along with their evaluation with various modes as learning through multimedia and internet. With the help of multimedia text, sound, illustrations, still or videos are stored to use as offline material; hybrid model is also used where core material on disc is provided with external links for leisure reading and references even with apps available on handsets with each day adding more to it. A literature reported that even Pharmacy students of Maharashtra advocated the sensible use of CAL and found this attractive and satisfying [13]. Other researchers also supported that CAL served as a valuable alternative, innovative tool for better understanding [6,7,9].

#### 2.4.9. Animations

Animations overcomes the major drawbacks of static projections appreciated in disciplines as embryology, biochemistry etc. makes interesting, attention grabbing concept of communication of 3-D images. However technical expertise on software as Flash, Author ware, Macromedia is expected with necessary knowledge and operational skills of latest software in field are needed. Animations combined with chalk and talk was preferred by undergraduate medical students studying Physiology at Delhi instead of using animation standalone; also emphasized it should be used together to bring about maximum pedagogical benefits as compared to single aid [14].

#### 2.4.10. Handouts

These simple write out 'Take-away' given prior, during or post-lecture, depend upon need of topic under discussion ranging from a simple outline of discussion as related titles and sub-titles, to complete notes or copy of presentation. This is a way to reach more people as audience other than who attended the presentation. Advanced readily used internet facility help facilitators upload the presentation on webpage's so that the learners can go through it with their own ease of time and space. In a study, majority (89.67%) in Biochemistry classes preferred handouts during lecture as innovative, practical and helped them comprehending with abundant information [15].

#### 2.4.11. Models

These 3-D representations range from static dummy, high end mannequins to even phantom models used for

explaining structure and function in absence of specimen or object for demonstration varying in sizes. In the teaching-learning of laparoscopic surgery in New Delhi Phantom model for demonstration facilitated acquisition of laparoscopic skills in short-term focused program and improved their performance in real life [16]. Objective structured clinical examination using mannequins in Community Medicine was noted to be significantly better. [17].

#### 2.4.12. Simulators

In imparting diverse clinical skills simulators replicates the case scenario that is not viable to directly perform subsequent procedures on patients. Such recreated medical realities in virtual space provide an ethically sound platform for learning varying from psychomotor to cognitive, affective, endoscopic and emergency skills. In present scenario, higher costs and non-accepting mindset are responsible for its lesser use. Computer simulation models were preferred by most of students at Ludhiana in Pharmacology practical. Students expressed that animals should not be sacrificed for experiments and computer simulation models may be used instead [18].

#### 2.4.13. Other e-learning Tools

Using internet with search engines, video sharing, collaborative projects, Prezi for non-linear presentations, Moodle as course management system, Dropbox as a file syncing software, Kindle as e-book reader, Author stream for uploading and embedding presentations, Slide share for sharing presentations globally, Blogs which are diary type content sites, Edu blog as an educational blogging tools are examples of ample e-learning tools. In a multicenter study done to assess trends in computer and internet usage, students and faculty members across Kerala opined that computers and internet had remarkable range of application in the dental practice. Patient management software, video conferencing for case deliberations concerning specialists of various institutions and diverse specialties', and online ongoing dental education programs could be some of the diverse possibilities with internet which could be included into dental education in near future [19]. In another study in 2013 conducted among the students studying Pharmacology in a medical college in West Bengal, use of internet was found to be evolved as a modified medical teaching-learning approach incorporating lecture classes supplemented by interactive learning by project topics [20].

#### 2.4.14. Digital Visualizers

Digital visualizer or Document camera provides high resolution magnified real time sharper images. These are used to display close up details of smaller objects to a larger audience in normal lighted room. Using computer or laptop with this digital visualizer, lecture and demonstration is possible in outreach sites also. In a study carried out most recently at AIIMS Jodhpur for assessment of impact of digital visualizer in teaching anatomy, Feedback analysis by students depicted aid to be only average for teaching-learning. In this study both conventional and aid-assisted teaching showed significant

changes in knowledge of participants, though mean post-test score was higher with the use of digital visualizer [21].

#### 2.4.15. Literature without Specifying single TL aids

Studies are also reported to emphasize importance of audio-visual aids in Pharmacology etc. for better learning [22]. Others noted use of various teaching methodologies for the lectures to be more interactive for enhanced gain of knowledge and acceptance [23].

### 3. Comparative Outcome of Teaching-Learning Using Two Aids

Literature reported relative experience of teaching-learning among undergraduate students using two different aids on same group of participants in their studies under our systematic review.

#### 3.1. Power Point Presentation Versus Chalk and Talk

Many research groups have reported in the literature in medical education their observation regarding learning experience of the students using age old chalk and talk lecture/demonstration compared with Power Point presentations. In Andhra Pradesh, a study by Medical education unit was carried out aiming at faculty development program and educational research, focusing student centered teaching and learning methods. Eighty percent students in pharmacology preferred PowerPoint Presentation whereas, rest preferred didactic lectures with black board [24]. Another study in Mangalore to understand the preferred sensory modality (or modalities) of students for learning. Most of the participants were multimodal learners, which is fine from both teaching and also learning point of view. Aural and kinesthetic were the most chosen sensory modalities of education. Also, simple presentation of a PPT slide might not encourage and motivate the visual learners to understand if the slide content is structured in a manner that it can be conveniently read and implicit during the stipulated duration it is projected even if the student was not listening to the lecture. The study emphasized on active effort to determine that the combination of aids should adequately address the different types of learners [25]. In a study on Pharmacology at Goa, mostly (67.5%) of second year considered chalk and talk method as a preferred aid for better recall [26]. In a Pune study, more than two-third of the students in Anatomy lectures preferred chalk and talk over ppt. Almost similar preference was reported in post lecture test performance. They found that PPT lectures should not be substituted in any case by traditional chalk and talk, but it should be used as an add-on aid to augment the effectiveness of teaching. In the study mainstream of students favored incorporation of both the means, as per demand of the subject matter [27]. A collaborative study in Malaysia as well as India comprised of structured questionnaire and 2680 students from forty-three dental schools were approached via e-mail with a follow-up postal mailing. Out of 1980 responses, sixty-three percent preferred lectures with ppt and chalkboard, while twenty eight percent preferred lectures with clinical demonstration [28]. In another

similar questionnaire based extensive study, done in Department of Anatomy at Bangalore, to know outlook and belief about the various aids used for lectures preference were Pre-clinical (54.2%), Para-clinical (59.6%) and in Clinical (57.3 chalk and talk method. At the same time the percentage was 45.8 percent, 40.4 percent and 42.7 percent respectively for the use of PPT for the illustrations [29]. In a Karnataka study in Physiology noted learners' insight vis-à-vis pros and cons of note taking. PPT was found to provide adequate time span to inscribe and write up furnished information by facilitator in form of notes [30].

#### 3.2. Chalk-Talk Versus Computer Assisted Teaching Using LCD

In an Uttaranchal study intended to unearth the approval and utilization of CAL using LCD in embryology in lecture classes besides chalk and talk, majority opined for computer aided teaching. Ninety-three percent of the student's opined this valuable, whereas ninety-nine percent of them were in favor of; they required the facilitator's direction for the use of the technological aid for depiction of a complex illustration in an easy and simplified way. Also eighty-six percent were interested in optimum mix, making it interesting and better for understanding [31].

#### 3.3. Chalk-talk and Computers/Projectors

A Maharashtra study evaluated student's stance, insight and feedback in pharmacology, using a pre-validated questionnaire among undergraduates - 39.13 percent recommended the use of audio-visual aids in lectures such as computers and projectors in place of didactic lectures [32].

#### 3.4. Bedside Teaching and LCD with Bedside Teaching

In Pondicherry study students favored aids in clinical medicine like videos- downloaded and faculty made that were utilized with LCD projection whereby reproducibility was 85 percent in signs and symptoms of patients. Learners urged systematic incorporation of aids in clinics [33].

#### 3.5. Dummy Organs and Accompanying Short Video

In a study in Karnataka on 60 students of Gynecology and Obstetrics demonstrations, fetal skull and pelvis dummy were used for demonstrating mechanism of labor to one group whereas other was taught by incorporating short video with previous. In this video assisted learning, 86.6 percent students performed good in OSCE analysis as compared to 53.4 percent without it, which was due to aids imparted noteworthy improvement in psychomotor skills [34].

#### 3.6. Videos and Simulators

In another effort of making Psychiatry an interesting subject for undergraduates, a research was conducted in Bangalore. Using videos to portray clinical features improved the learning and withholding of the information



provided in theory lectures. Simulated patients also helped a lot in gaining practical knowledge in clinical sessions [35].

#### 4. Comparative OUTCOME of TEACHING-LEARNING USING MULTIPLE AIDS

Literature also reported comparable learning experience among undergraduate medical students when they were exposed to multiple teaching-learning aids in different permutations and combinations. Among studies using two or more aids, the commonest comparisons were among chalk-talk, Overhead projector (OHP), Power Points (PPT) in various combinations.

In Bihar in didactic lectures majority (90.1%) of three successive batches were inspired for additional reading in a blend of audiovisual aids during didactic lecture. While acuity of illustrations and note taking was considered finest with a ppt by first and second professional students, final professional students preferred OHP. Again majority of learners opined for collective use of aids rather than a single one [36]. Various technologies were assessed in Pharmacology in North India - forty five percent students preferred the traditional techniques while 51.7 percent liked PPT; only 3.4 percent liked OHP. It was concluded that learning was regardless of aid and rather depends on the facilitator [37]. In Tripura 81.6 percent preferred an optimum mix of aids during lectures; for understanding facts and clarity of concepts preferences were noted OHP (41.8%) for diagram, PPT (35.7%) for flow chart, Black board (46.9%) for stress on important points [38]. Other studies showed preference of optimum mix of aids - 87 percent in Anatomy in Karnataka [39], 54.9 percent in Karnataka [40], in second professional in Telangana [41], by majority in Gurgaon [42], 58 percent in pathology in Orissa [43]. Average outcome was high using combination of BB with either OHP or PPT in West Bengal [44]. In two Maharashtra medical colleges, 48.8 percent in Community Medicine [45] and as high as 90 percent favored mix of aids with chalk-talk in first and second professionals [46]. At Haryana, 95 percent students suggested judicious use of aids along with the conventional methods [47] whereas 60 percent preferentially liked a mix of PPT with BB in biochemistry in Uttar Pradesh [48]. In a Rajasthan study on physiology 67.1 percent preferred a mix of aid using both BB and OHP followed by BB (54%) as a reliable teaching aid [49]. Similar results were reported in Kolar, where students in biochemistry preferred combination [50]. Combination of aids as OHP in association with boards and chalk was preferred by 46.94 per cent in North Bengal [51]. Chalk and talk was preferred by 44.3 percent students in Uttar Pradesh [52], by 71 percent in Maharashtra [53], majority in Telangana [54], 82.83 percent at Chhattisgarh [55], in eastern India [56], in New Delhi [57], Bangalore [58] and in Maharashtra [59]. A study in Bangalore showed that BB teaching along with PPT, illustrations, and diagrams can increase awareness of pharmacovigilance [60]. Various technologies were assessed in medical students studying Pharmacology in their undergraduate course in North India. Forty five percent students preferred the

traditional technique of teaching while 51.7 percent students liked the PPT while only 3.4 percent students liked OHP. It was concluded that learning depends on the facilitator [61]. Among first professional subjects, most preferred method of delivering lectures was chalk- board (87%) while combination of aids (98.8%) was preferred for Demonstration of clinical conditions in Karnataka [62]. In another study majority of the medical (66.05%) and dental students (61.2%) studying first professional preferred PPT [63]. It was also found to be favored by 32.03 percent but when required, mix of aids was preferred by students at Maharashtra [64]. Another study noted that maximum score was given to PPT in pharmacology [65]. Students preferred LCD with PPT in anatomy at Bangalore [66]. Judicious use of audiovisual aids along with the conventional methods was suggested by 95 percent [67] while OHP was favored in Punjab [68].

Students liked combination of aids (58.8%), but chose flowcharts (47%) and diagrams (63.5%) for ppt for first as well as for second year in Bihar [69]. Others noted that 65.33 percent favored PPT in medical and dental [70] and in pharmacology in Rajasthan [71]. Even in allied health sciences, ppt with chalk and board was the most effective A-V aid [72]. In a study in Community Medicine in West Bengal, 62 percent liked LCD among various aids whereas OHP was least preferred in theory classes [73]. LCD or PPT was considered most preferable in Bangalore [74].

Next common comparisons were among A-V aids as ppt with Computer assisted learning (CAL) aids, animations, video tapes etc. A study in Bangalore emphasized marked positive effects created by digital aids in Anatomy classes with added diagnostic and analytical skills [75]. In embryology 3- D effect was invariably valuable by use of simple animations, though it was time-consuming too [76]. Computer assisted aids and simulations were favored in pharmacology by 32 percent in Karnataka [77] and 44.74 percent students in Uttar Pradesh [78].

Other aids as mini videos were also of choice (94.67%) in pre-clinical subjects [79]. In anatomy, prior to dissection, procedure was explained and understood well by most of the students with use of 3-D models and videos [80]. Workers also advocated other innovative ways as e-learning in understanding from student's prospective [81], use of audio-tapes, mobile tips, virtual teacher [82], video presentation [83] and CD-ROM's etc. [84]. A study also found students to be equivocal about their preference of black-board-based and multimedia-based lectures [85]. None approved potentials of CAL in biochemistry at Kolkata [86] and pharmacology at Goa [87]. Optimum mix of CAL with other aids were chosen by majority students of seventh semester at New Delhi [88]. Outcomes were better with aids in Anatomy lectures than traditional group [89].

##### 4.1. Unspecified Audio-visual Aids

In understanding novel teaching methods in undergraduate training in Pharmacology at Jammu, students preferred therapeutic teaching with audio-visual aids compared to theory classes without aids in self-assessment. Active learning with specific technology modalities were found to have better impact on students' learning [90]. Others

liked aids in pharmacology [83] whereas in all pre-clinical subjects by students at Belgaum [91] and Miraj [92].

## 5. Conclusion

To sum up in this debut study on the utility of teaching-learning aids we had a varied experience. A good number of studies could not find any major impact in switching over from one aid to other. Those studies reporting better learning experience by the stakeholders using any media also should be scanned well regarding quality of teacher, quality of the students, ambience of the venue including 'non-threatening learning environment' etc. All the preceding subjective components may not have been able to be evaluated properly in the classical Indian teacher-centric classroom scenario. In this debut study on the utility of teaching-learning aids we had a varied experience. A good number of studies could not find any major impact in switching over from one aid to other. Those studies reporting better learning experience by the stakeholders using any media also should be scanned well regarding quality of teacher, quality of the students, ambience of the venue including 'non-threatening learning environment' etc. All the preceding subjective components may not have been able to be evaluated properly in the classical Indian teacher-centric classroom scenario. In the health care courses and curriculum, learners necessitate remembering and memorizing innumerable facts; at the same time it is also extremely important to develop a concept about the topics. The progression of understanding a topic under discussion involves the skill and aptitude to incorporate and recollect the ideas, knowledge and data provided by the facilitator. While studying the broad umbrella term of Teaching-learning aids in literature, we came across aids ranging from various types of audio-visual devices, simple line figures using chalk and talk to highly sophisticated projectors as Digital visualizers.

The role of medical teacher is not only to impart communication of knowledge but also for holistic care in capacity building to improve the health care scenario in any country. Students build up concept and perceive facts through teaching-learning sessions and knowledge repositories like books and other virtual platforms.

## Strengths of The Study

To the best of our horizon of knowledge we are yet to find any systematic review on the outcome experience of undergraduate students regarding the use of teaching-learning aid in the medical education in India.

## Limitations of The Study

This novel attempt of the systematic review on the use of teaching-learning aids had several limitations. Firstly, we used published data of last 15 years. Secondly, in few years i.e. 2005, 2006 etc. we are yet to find any published articles. Thirdly, very few studies have been reported in literature in dental undergraduate education and none have been reported from AYUSH and other undergraduate

teaching in health care. Fourthly, some studies could not be properly analyzed where we could not find full text. Lastly we were unable to find the role of confounding variables like English language as medium of teaching-learning in Indian medical education, in their learning experience as majority of them learners have vernacular other than English.

## Future Directions of The Study

We wish to extend our study in postgraduate, teaching-learning of medical, dental and AYUSH also and on other self-learning aids.

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Table 1. Studies Using Single Teaching-Learning Aid To Improve Learning Experience

Year	S.No.	Teaching-learning Aid Used	Name of Authors	Sample Size	Discipline/Course	Remarks/Outcome
2015	1.	Mannequins	Partha Nandi, Dharmvir R Bharati, K A Narayan, T V Yamuna, A Lokeshmaran, Ranabir Pal	150	CMFM/MBBS	OSCE method was significantly better than conventional using mannequins etc., as in less time more students examined.
	2.	Power-point	Sudharsanam Manni Balasubramaniam	60	Medical entomology/ MBBS	The computer assisted group study served as a valuable alternative, innovative, and interesting tool to teach and learn.
	3.	Power-point	Shankar N, Roopa R	60	Embryology/ MBBS	A modified team based learning aided with power point is considered better for understanding
	4.	Books and articles in pdf in internet	Kanakath Harikumar, Sameera Gopinath, Arun Raghunath, Vivek Narayan, Santhosh Sukumar, Rosamma Joseph Vadakkekuttikal	233	Dentistry subjects/BDS	72.3% of subjects preferred hard copy textbooks to PDF format books. 81.3% thought internet is a useful adjunct to dental education. 73.8% opined that computers and internet could never be a replacement to conventional classroom teaching.
	5.	Digital visualizer	Potaliya P, Ghatak S, Pal R, Nayeemuddin SM	-	Anatomy	Conventional and aid-assisted teaching both showed significant changes in knowledge of participants, though mean post-test score was higher with the use of



						digital visualizer. Feedback analysis depicted aid to be average for teaching-learning.
2014	6.	Overhead Projector	Sushama K.Chavan, Kalidas D. Chavan, Purushottam A. Giri, Sandip S. Jogdand	200	All years/ MBBS	In pre-clinical primary phase liked PPT and aids.
	7.	Power-point	Shah AR, Shethwala ND, Parmar BH	127	Pathology/ MBBS	85.8% suggested use of power-point presentation in teaching any topic and felt that it made their comprehension better.
2013	8.	Internet	Deb T, Singh R, Mukhopadhyay K	70	Pharmacology/ MBBS	It evolved a modified medical teaching learning approach incorporating lecture classes supplemented by interactive learning by project topics.
	9.	e-resources	Joe Varghese, Minnie Faith and Molly Jacob	60	Biochemistry/ MBBS	98% students perceived that e-learning resources had made a positive impact on various aspects of their learning in biochemistry.
2012	10.	Computer-assisted learning	Jadhav S, Nikam K, Gandhi A, Shinde N, Salunkhe K	-	Pharmacy	Sensible use of computers in imparting education to pharmacy student has been found attractive and satisfying.
	11.	Phantom model	Bansal VK, Panwar R, Misra MC, Bhattacharjee HK, Jindal V, Loli A, Goswami A, Krishna A, Tamang T	256	Surgery/MBBS	Training with model helped in improving the performance of surgeons in the operation theater.
2011	12.	Conventional & Interactive	J. Thirunavukkarasu, K.Latha, C.Sathish Babu, C.B. Tharani	140	Pharmacology/MBBS	Interactive lectures has more role.
	13.	Video	R Abraham, I Adiga, B George	162	Ist year/MBBS	One hundred eighteen students (73%) reflected that through the videos they understood about 75% of the PBL process.
	14.	Unspecified Audio- visual aid	Nilesh Chavda, Preeti Yadav, Mayuri Chaudhari, N.D.Kantharia	107	Pharmacology/MBBS	9.43% mentioned audio-visual aided classes as better for learning
2010	15.	Computer-based simulators	Dinesh K Badyal, Suman Bala, Prashant Kathuria	50	Pharmacology/ MBBS	Computer simulation models were preferred by most of students in practicals.
2009	16.	Animation-based lectures	Satendra Singh, Savita Singh, Shikha Gautam	105	Physiology/ MBBS	ABL with board teaching can be used together to bring about maximum pedagogical benefits to the students as compared to any aid alone were least preferred.
2008	17.	Slide Projector	Agarwal AK, Bhattacharya N	-	Histopathology/MBBS	It is an inexpensive and effective tool for projecting magnified images of slides useful both for making observations and as a teaching aid.
2006	18.	Handouts	M.B. Soudarssanane	339	Biochemistry/MBBS	Handouts made teaching more practical.
2001	19.	Computer-assisted learning on LCD	A. Kuruvilla, S. Ramalingam, A.C. Bose, G.V.Shastri, K.Bhuvanewari, G.Amudha	76	Pharmacology/MBBS	CAL is an effective method of teaching practical aspects

**Table 2. Studies Comparing Usefulness of Two Different Teaching-Learning Aids in Improving Teaching-Learning Experience**

Year	S.No.	Teaching-learning Aid Used	Name of Authors	Sample Size	Discipline	Remarks/Outcome
2015	1.	Chalk-talk and Computer/projector	Uma A. Bhosale, Radha Yegnanarayan, Gauri E. Yadav	140	Pharmacology	48.53% students preferred AV-aided lectures as the best teaching method.
	2.	Videos and Simulators	S. M. Manohari, Johnson Pradeep R., Ravindra Baburao Galgali	-	Psychiatry	Appropriate use of A-V aids remarkably improves the impact of the class especially using videos to describe clinical features.
	3.	Bedside teaching, LCD with bedside teaching	Lokesh S	490	Medicine	The use of Audio-Visual Aids is not only effective in delivering seminars or theory lectures, but also make a big impact on the clinical bedside teaching
2014	4.	Black-board, PowerPoint	Subhash KR	115	Pharmacology	80 % preferred PowerPoint Presentation whereas, 20% preferred didactic lectures with black board
	5.	Chalk-talk, PowerPoint	Urval RP, Kamath A, Ullal S, Shenoy AK, Shenoy N, Udupa LA	500	Pharmacology	Most of the students were multimodal learners, which is good from both a teaching as well as learning perspective. Aural and kinesthetic were the preferred sensory modalities of learning.
	6.	PowerPoint, chalk-board	Desa SB, Keny MS	83	Pharmacology	The chalkboard lectures were preferred by 67.5% of the students.
2013	7.	Power-point, Chalk-board	Rokade SA, Bahetee B H	200	Anatomy	In all the three parameters studied—retention of lecture information in memory, conceptual understanding and reproducibility of

						diagrams – the students performed better in tests for C&B lectures.
	9.	Dummy organs and Short video incorporation	Shridevi A.S, Gayatri L. Patil, Arif N.K, Rashmi A.G, Satvik P, Shashikala	60	Gynecology & Obstetrics	Students exposed to audiovisual method performed better
	10.	Chalkboard, PowerPoint	Abhishek Parolia, Mandakini Mohan,M. Kundabala, Ramya Shenoy,	1980	Dentistry subjects (all) / BDS	63 percent of the students preferred lectures with PowerPoint and chalkboard, while 28 percent preferred lectures with clinical demonstration.
2011	11.	Computer assisted teaching using LCD, Blackboard	Sukhendu Dutta	100	Embryology	Ninety-three percentage of the students mentioned that computer aided teaching is beneficial, 86% expressed that hybrid approach of teaching, provoked further study of embryology.
	12.	Chalkboard, PowerPoint	Kulkarni R, Ashwini. C A, Reddy B	236	Preclinical/ MBBS	Traditional chalk and board method was preferred in teaching.
	13.	Chalkboard, PowerPoint	Kulkarni R, Ashwini. C A, Reddy B	89	Para clinical Subjects/ MBBS	Traditional chalk and board method was preferred in teaching.PPT considered better for illustrations
	14.	Chalkboard, PowerPoint	Kulkarni R, Ashwini CA, Reddy B	131	Clinical/ MBBS	Traditional chalk and board method was preferred in teaching.PPT considered better for illustrations
2010	15.	Blackboard, PowerPoint	Reem Rachel, Abraham, Surekha Kamath, K. Ramnarayan	110	Physiology	Power point provided enough time for students to write the information in form of notes.

**Table 3. Studies Comparing Usefulness of More Than Two Different Teaching-Learning Aids In Improving Teaching-Learning Experience**

Year	S.No.	Teaching-learning Aid Used	Name of Authors	Sample Size	Discipline	Remarks/Outcome
2015	1.	OHP, PPT, Mixed(Black Board, OHP & PPT)	Saha Nirmalya, Tripura Kaushik, Das Rituparna.	98	Ist year subjects/ MBBS	86.7% preferred Listening with visual aids and taking notes. 81.6% preferred mix of aid during lecture.
	2.	Chalk board, PPT,OHP, Combination of chalk board and PPT	Manoj Kumar, Indu Saxena, Jayballabh Kumar, Gaurav Kumar, Sangeeta Kapoor	506	Ist year Subjects/ MBBS	44.3% students preferred C&B with higher attentiveness, 40.1% preferred PPT and 15.6% preferred the use of OHP as TA. PPT and OHP were preferred by teachers.
	3.	PPT, Animations in 2D with use of FLASH, Interactive computer graphics coupled with animations	Vaidyanathan Balasubramanyam	-	Anatomy/ MBBS	Digital learning environments create immense learning platforms for students
	4.	Animation software as Flash, Author ware, Macromedia in power point slides	Manvikar Purushottam Rao	-	Embryology/MBBS	Animations are best modes of teaching supplements in embryology.
	5.	OHP, PPT, blackboard	Harish. G. Bagewadi, Rekha MS and Sabari Anandh JV	72	Pharmacology/ MBBS	Black board teaching along with PPT, illustrations, diagrams can increase awareness of pharmacovigilance. As a teaching aid, the correct response score increased to 87.5% as Post-KAP score.
	6.	OHP, PPT, blackboard	Florence L, L Samananda	100	Ist year/MBBS	Majority of the medical students (66.05%) preferred PPT, whereas 22.21% preferred the use of blackboard and 11.1% preferred OHPT.
	7.	OHP, Blackboard	Florence L, L Samananda	50	Ist year Subjects/ BDS	61.2% preferred PPT presentation, 26.5% preferred BB, and 12.2% preferred OHPT during lectures.
	8.	Unspecified A-V aids.	Bodhe CD, Jankar DS	100	Ist year/MBBS	Advent of newer audio-visual aids have greatly facilitated the teaching learning activity and made it much simple. However, these are supplementary and not substitute to a teacher.
2014	9.	Computer based aids	Mohammed Waseem Ahmed, Prashant Dass, Michell Gulabani, Rameez Ahmed, Pradeep Javedar, Rajat Mishra	120(94 MBBS &26 BDS)	Pharmacology/MBBS & BDS	15% expected more use of LCD. 32% favored Computer based aids
	10.	Blackboard, PPT, Mix of aid	Anne D Souza, Vrinda Hari Ankolekar, Sushma Rama Kotian,	189	Anatomy/ MBBS	Most common (60.2%) PPT, 19.89% BB,87% preferred mix of aids

			Antony Sylvan D Souza, Mamatha Hosapatna			
11.	Blackboard, PPT, OHP		Momi Baruah, Laxmi Patel	100	Physiology/ MBBS	PPT(32.03%) preferred but when required mix of aids preferred
12.	Laptop/computer related devices		Aditya Jain, Ramta Bansal, K D Singh, Avnish Kumar	150	Anatomy, Biochemistry, Physiology/ MBBS & BDS	94.67% (n=142) favored use of A-V aids. They preferred getting mini-videos.
13.	Blackboard, OHP, PPT		R.S.Khane, A.A.Joshi	100	Physiology	Blackboard (71%) was most preferred followed by OHP(19%) and PPT(10%)
14.	Chalk and Talk, TOHP, PPT and combination of Chalk and Talk with TOHP/PPT.		Mrinal Pal, Subinay Datta, Amit Kumar Pradhan, Kanika Mandi Chowdhuri, Joydeep Ghosh, Rajarshi Rahut	100	Biochemistry/MBBS	Dominant form of lecture delivery is still the chalk and talk. Average marks of students taught using combination of Chalk & Talk with either TOHP or PPT were 8.26 (max.) out of 10 than using TOHP, PPT, chalk and talk.
15.	Chalk and board, OHP, PPT		Prasad A, Datta PP, Pattanayak C, Panda P	74	Pharmacology/MBBS	Students preferred chalk and board
16.	Chalk-board, OHP, PPT		Hemalatha NR, Mamata P. Samaga	87	Anatomy, Physiology, Biochemistry/MBBS	Most preferred method was chalk-board (87%) while combination of aids (98.8%) are best for Demonstration of clinical conditions
17.	Dissection video, 2D images of sagittal and coronal sections, 3D model		Snigdha Mishra, Sathesha Nayak B. & Bincy M. George	126	Anatomy/ MBBS	A digital anatomical teaching tool with the combination of dissection, 2D diagrams and the demonstration of the 3D model enhances the understanding/ learning of the anatomy.
18.	Chalk-board, PPT, OHP		Kaur Simran, Chopra Deepti	100	Physiology/ MBBS	Students were ready to accept the newer methodologies in terms of technique and evaluation, they favoured traditional method in comparison to PPT and OHP.
19.	Chalk-board, LCD,PPT, mix of aids		Arora N, Kumar A	-	Anatomy/ MBBS	Students supported the existing durations of the lecture hours with the combined use of chalk -board and LCD projector.
20.	OHP, PPT, Mix of aids		Sushama K.Chavan, Kalidas D. Chavan, Purushottam A. Giri, Sandip S. Jogdand	200	All years / MBBS	Preferred chalkboard in total
2013	21.	Computer assisted learning softwares, Film and video, Multimedia computer simulation	Mukesh Ahirwar, Akanksha Sinha, Anshul Shakya, Vikas Kumar	38	Pharmacology/MBBS	44.74% of students preferred computer simulation
	22.	Chalk-board, LCD, Overhead Projector	Aditya Prasad Sarkar, Goutameswar Majumdar	150	CMFM	LCD projector was most preferred (62%) audio-visual aid over others while Overhead Projector was least one(13.3%).
	23.	Chalk and board, OHP, PPT	Hanmant S.Amane, Shilpa N.Kaore, Suresh V.Vasvani	54	Pharmacology/MBBS	Max. score given by students were to use of Power Point (27.96) out of 30. Recommended mix of blackboard and PowerPoint presentation whenever necessary.
	24.	Various unspecified	Shreemanta Kumar Dash, Shubhransu Patro, Basanta Kumar Behera	337	2 <sup>nd</sup> , 4 <sup>th</sup> , 5 <sup>th</sup> , 7 <sup>th</sup> Semester/ MBBS	82.83% (n=326) agreed on use of black board teaching, 55.87% (n=324) agreed that A-V aids as a useful mode of teaching and only 51.85% (n= 324) of them agreed that the faculties are well versed with the rational use of A-V aid.
	25.	Only chalk-board, Chalkboard-OHP, Chalkboard-LCD	Kar M, Roy H, Ghosh A et al.	98	Anatomy/ MBBS	Over head projectors and transparency sheets in association with boards and chalk was preferred by almost 46.94%
	26.	Black board, OHP, PPT, Combination of aids	Ashutosh Kumar, Ramanuj Singh, Lalit Mohan, Mani Kant kumar	85	Anatomy, Physiology, Biochemistry/MBBS	Preferred visual aid was combination of aids(58.8%), but for flowcharts (47%) and diagrams (63.5%) PPT.
	27.	Black board, OHP, PPT, Combination of aids	Ashutosh Kumar, Ramanuj Singh, Lalit Mohan, Mani Kant kumar	74	Pharmacology Microbiology, Pathology, CMFM/ MBBS	Preferred visual aid was combination of aids(54%), but for flowcharts (48.6%) and diagrams (67.5%) PPT.
	28.	Black board, OHP, PPT,	Bashir Mohammed	20	2 <sup>nd</sup> year / MBBS	Mixing of OHP or PPT along with

		Combination of aids	Shakeel Mohammed, Khade Ajay, Nazz Humera			BB during the lecture is better method and central processing ability is best after attending such classes.
	29.	Black board, OHP, PPT Combination of aids	Purushottam A. Giri, Deepak B. Phalke	125	CMFM/ MBBS	Majority (48.8%) respondents preferred a combination of audio-visual aids during a didactic lecture
	30.	Chalk-board, PPT, Mix of aids	Karve, A V Pujari, Pramod Jadhav, Amit	-	Pharmacology/ BPT & BOT	Power point presentation with chalk and board was the most effective A-V aid.
	31.	Chalk-talk, Power point, OHP	Hitesh Mishra, Vipin Kumar, Pankaj Kumar Modi	300	Pharmacology	Smart classrooms are a new concept of teaching but unfortunately one can't compare it due to lack of this facility.
	32.	e-learning, web based, computer assisted, Mix of aids	Atul Kotwal	-	CMFM/ MBBS	Innovation is also required as students have varied learning styles and need diverse opportunities for learning.
	33.	Chalk-board, audio-visual aids	Muneshwar JN, Mirza Shiraz Baig, Zingade US, Khan ST	200	1 <sup>st</sup> & 2 <sup>nd</sup> year / MBBS	90 percent Participants were in favor of using Audio visual aids with complimentary use of traditional chalk and blackboard methods.
	34.	Unspecified Audio-visual aids	Jayashree T,Prakash M, Shankar J	147	Pharmacology/ MBBS	23.08% students suggested that audiovisual aids should be used in class rooms.
	35.	Blackboard, OHP, LCD	Roopashree R, Tiwari S, Murthy KVN	100	Anatomy/ MBBS	Students preferred LCD or Power point media most. 95% of the students said yes to integrated modes of audio visual aids, out of which 61 % preferred BBT & LCD as the best of combinations of audio visual mode
	36.	Chalk-board, PPT, Computer based visuals	Kumar U, Madan S	150	Anatomy/ MBBS	Students performed better with aid used lectures than the traditional group. i.e. in 2009, four out of six examinations and in 2010, five out of six examinations, experimental group's average scores were significantly higher ( p < 0.05) than the traditional group.
2012	37.	Mobile tips/sms, use of virtual teacher through computer, use of audio-tape, mobile interaction with teacher, CAL, Web-based teaching	Suneel Ishwar Majagi, S.S.Torgal, S.V.Hiremath	108	Pharmacology/MBBS	Students preferred Mobile tips/sms (for retention), use of audio tape (to pass the exam), use of virtual teacher (useful in long run).
	38.	Over head projector, power point, multimedia and blackboard	Prasanna Chandra M, Biswajit Das, Sumeru Samanta, Ayaz K Mallick	200	Biochemistry/MBBS	Power point in combination with Black Board (60%) was most preferred mean.
	39.	Black board, OHP, PPT, OHP and Black board, PPT & Black board	Priyadarshini. K. S, H. V. Shetty, Reena. R.	117	Biochemistry/MBBS	High satisfaction index was noticed for blackboard + PPT teaching aid. Individually Blackboard (31%) was preferred.
	40.	Blackboard, audio visual aids, mix of aids	Asaranti Kar, Tushar Kar, Kanaklata Dash, Niranjan Rout, Pallavi Bhuyan, Sasmita Panda, Raghmani Mohanty	300	Pathology/ MBBS	Preferred black board teaching (36%) to the audio visual mode (6%) of teaching and majority (58%) opted for a combined mode of teaching
2011	41.	Blackboard, OHP, PPT	Meyur R, Mitra B, Adhikari A, Mitra D, Biswas S, Sadhu A.	140	Anatomy/ MBBS	The students preferred Black Board teaching over OHP ad PPT. A teacher should match the lectures with preferred AV aids and use the AV aids prudently.
	42.	Blackboard, OHP, LCD, Simulators	Deepinder Kaur, Jaswinder Singh, Seema, Anupama Mahajan and Gurdarshan Kaur	300	Unspecified	Overhead projectors allow the presenter to maintain eye contact with the students. Flip charts and white boards allow for creation of diagram. Multimedia and computer assisted learning also promotes interaction. Active models attempt to reproduce living anatomy or physiology
	43.	Unspecified	Vijaya S. Dandannavar	-	Anatomy, Physiology, Biochemistry/ MBBS	Audio visual aids for teaching are must in preclinical teaching, case stimulated interactive session and



						group seminar.
2010	44.	Blackboard, OHP, PPT, Mix of aids	Lalit Mohan, Ravi Shankar P, Ashwin kamath, Manish MS, Eesha BR	257	Pharmacology	Mix of aid (54.9%) was most preferred and OHP the least (11%). Perception of diagrams, flow charts and note taking was best accepted with a OHP.
	45.	Chalk-board, PPT, OHP	Vikas Seth, Prerna Upadhyaya, Mushtaq Ahmad, Vijay Moghe	62MBBS 44 BDS	2 <sup>nd</sup> Year/ MBBS & BDS	Rated PPT (65.33%) based teaching higher in terms of all the parameters
	46.	Chalk-board, TOHP, PPT	Vikas Seth, Prerna Upadhyaya, Mushtaq Ahmad, Virendra Kumar	102	Pharmacology/ MBBS	Students preferred PowerPoint (23.2 out of 25). As the objective assessment students performance is concerned, the impact of Chalkboard and PowerPoint was much more.
	47.	Patient oriented problem solving (POPS) with A-V aids	Arjun Singh	150	Pathology/ MBBS	Modification of PBL, namely POPS, with AV Aids are great to break the monotony of dialectic lectures.
	48.	Videos & Audio, PPT, Blackboard use, flow chart	Jayshree S. Dawane, Pandit VA, Dhande P P, Sahasrabudhe RA, Karandikar YS	153	Cardiac Pharmacology/ MBBS	Preferred use of video presentation as a better aid for understanding of mechanism of action of drugs. Students were equivocal about the PPT presentations by teachers but requested to make the presentation available before the class.
	49.	Chalkboard, PPT alone, mix of aid	Manoj Goyal, Monika Bansal, Anshu Gupta, Shailesh Yadav	150	2 <sup>nd</sup> Year/ MBBS	95% students suggested the judicious use of audiovisual aids along with the conventional methods, so that the PPT should complement the teaching methodology
	50.	Blackboard, PPT, LCD	Chandra Prakash, Bhavana Srivastava, Sanjay Gaur, Ajay Kumar Sinha	475	2 <sup>nd</sup> year/ MBBS	40.86% preferred use of LCD over blackboard and ppt.
2009	51.	Blackboard, slide projectors, videotapes and multimedia	<i>SN Baxi, CJ Shah, RD Parmar, D Parmar, CB Tripathi</i>	93	2 <sup>nd</sup> Year/ MBBS	Equal number of students preferred black-board-based or multimedia-based lectures. Teachers should take note of the reasons why a significant number of students still prefer 'outdated' teaching modalities compared with computer-based presentations.
	52.	Blackboard, OHP, Mix of aids	Chaudhary R, Dullo P, Gupta U	100	Physiology/ MBBS	Max. Students (67.1%) prefer a mix of aid using both BB and OHP followed by BB (54%) as a reliable teaching aid.
	53.	Blackboard, OHP, PPT, Mix of aids	Ashakiran S.	100	Biochemistry/MBBS	Use of AV aids was found to be appropriate by 97% of students. Proper use of newer media like power point presentation along with blackboard can make the lecture more interesting
	54.	Chalk-board, projection media, CAL(Computer Assisted Learning), combination of aids	Kaushik Bhowmick, Mousumi Mukhopadhyay, Sandip Chakraborty, Pradyut K. Sen, Indranil Chakraborty	107	Biochemistry/MBBS	62% students preferred blackboard teaching. Not a single student mentioned Computer Assisted Learning (CAL) as a potential vehicle of teaching learning.
2007	55.	OHP, LCD, Computer Assisted Learning	Dhaliwal U	-	7 <sup>th</sup> semester/ MBBS	Combination of two or more teaching-learning media is best. Blackboard (interaction and helping recall), OHP (providing information point wise, 89.3%) & Slides (imparting clinical details) were preferred.
2004	56.	OHP,LCD, Computer Assisted Learning	A Garg, PV Rataboli, K Muchandi	63	Pharmacology/ MBBS	It was concluded that A-V aided lectures were useful. Not a single student wrote about Computer-Assisted Learning (CAL) as a potential teaching method.
	57.	Unspecified audio-visual aids	Rashmi Sharma, Ujala Verma, Bhuvneshwar Kapoor, V.S. Chopra	100	Pharmacology	Learning with audio-visual aids ( both 7 out of 10) were seemed to have great impact on students.
	58.	Video-based teaching resources Internet, Multimedia software	K. Sri Nageswari, Anita S. Malhotra, Nandini Kapoor, and Gurjit	50	Physiology/ MBBS	Learning through videos, CD-ROMs, PowerPoint presentations, demonstration of experiments,

		available on CD-ROM	Kaur			undergraduate projects, didactic lectures, etc., employs the visual and auditory forms of learning.
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