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COMPARATIVE STUDY OF INTERACTIVE TEACHING-LEARNING METHOD WITH VIDEO LECTURE IN RADIODIAGNOSIS RESIDENCY PROGRAMME

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ABSTRACT

Context: Interactive teaching-learning (T-L) method is popular effective T-L method in small group teaching. There is paradigm change in teaching radiology due to available archival storage of electronic images & cine loops; which are used for learning.

Objectives: Aims were to bridge the gap between learning by video/multimedia resources and by interactive Teaching-Learning session blended with resources by evaluating & comparing them.

Subjects and Methods: This comparative interventional study was done with eight radiology resident doctors as participants and a faculty observer. Six lectures were taken in 3 modalities – Ultrasound, CT scan & MRI with one core topic and one non-core topic. All topics were taught first by video lecture and then, interactive session with video. Pre-tests of ten questions were taken before first intervention. After each lecture session, post-tests and written feedback were taken. Qualitative Data Analysis of all tests and scaled feedback form was done by Paired T-test with p values < 0.005 considered significant.

Results: Significant knowledge improvement (p value < 0.0001) was found in core topic, non-core topic and overall performance after these lectures among all residents. Significantly more joyful learning was experienced by residents for blended interactive lecture with video.

Conclusion: This study showed promising results for blended interactive T-L method with video in knowledge gain and joyful learning with teacher having role of facilitator. This method should be experimented at multiple teaching institutions for validation.

KEYWORDS : blended interactive teaching-learning, multi-media education resources, radiology residency teaching, video lecture, teacher as facilitator.

Context:

Didactic lecture is oldest time-tested method used for teaching in education. Various modifications have been done over a period of time from verbal and blackboard teaching as described by Farrow R (2003, p. 921) with usage of transparency of text/diagram with projection by overhead projector and now, power point presentation. [1] Newble D & Cannon R (2002, p. 39) have described various innovative teaching methods to improve learning and understanding by students with interactive Teaching-Learning (T-L) method being highly recommended for teaching in small group. [2]

In 1993, first edition of *McGraw-Hill's Multimedia: Making It Work*, Tay Vaughan declared "Multimedia is any combination of text, graphic art, sound, animation and video that is delivered by computer." Multimedia resources enhance educational experience in teaching as reported by Damodharan VS & Rengarajan V (On-Line Resource, p. 7). [3] With availability of dynamic multi-media files like MPEG-3, MPEG-4 video, avi, wml etc. and audio-visual players in computer like Window Media Player, QuickTime, Active X, Adobe Flash Player, Real Video, VLC Player, Gom Player etc.; various multimedia resources are available for medical teaching as mentioned in University of Virginia School of Medicine website (Multi-media section); [4] including radiology teaching as reported by Lim CCT & Yang GL (2006, p. 1). [5]

Radiology practice depends on visual input, image perception & understanding of change in image. Hence, Lim CCT & Yang GL (2006, p. 1) mentioned that big paradigm shift has developed in radiology teaching due to availability of electronic case files, cine loops, video clips and their storage in the Picture Archiving & Communication Systems (PACS). [5] This research project was done to compare learning by dynamic multi-media resources with interactive Teaching-Learning Method and to explore bridging of gap between them.

Aims and Objectives:

1. To evaluate effectiveness of video lectures used alone and importance of teacher in interactive session blending same video resource, as two different T-L methods.
2. To compare above two different T-L methods to find out effectiveness of teacher as facilitator and guide in learning process.

Subjects and Method:

In this comparative interventional educational study; all eight resident doctor doing Post-Graduation in Department of Radiodiagnosis in Pramukhswami Medical College, Karamsad had participated voluntarily; which was done between December 2014 to February 2016. Six residents were doing M.D. (Radio-diagnosis) and 2 were doing D.M.R.D. with 2 third year (R3), 3 second year (R2) and 3 first year residents (R1). They were oriented to this education research project and written informed consents were taken. Approval of Human Research Ethical Committee was taken. Junior faculty in Radiology Department was appointed as independent observer for these teaching sessions.

Before implementation, three sets of questionnaire having similar difficulty level for each topic were prepared for short test of 10 minutes duration. Each questionnaire had 10 questions with 5 multiple choice questions having 4 choices and 5 open ended questions to be answered in 1 or 2 lines. Each question had carried 1 mark. Open ended question may be given half mark, if answer is incomplete or partially right.

Feedback form was devised using Likert 9 points rating scale (with 1 to 4 unsatisfactory to average, and 5 to 9 on good to excellent) for quantitative analysis. Spaces were provided for best moment, area of improvement and sharing experience in their own words. Written feedback from resident were taken anonymously; as it is essential to provide safe environment for honest and credible feedback needed for reliability, as mentioned by Fluit CV, Bolhuis S, Klaassen T, Visser MDE, Grol R, Laan R, et al. (2013, p. e1485). [6] Feedback was also taken from observer faculty about learning of resident as discussed by Dijksterhuis MGK, Lambert WT, Schuwirth, Braat DDM, Teunissen PW & Scheele F (2012, p. e1396) to create open environment for credible opinion and act as control in perception. [7]

Implementation steps of this education research project were as follows:

1. Pre-test of all 8 residents in radiology department were

taken on same topic just before first session of video lecture to know their baseline knowledge.

2. After first session of video lecture (intervention A) of 40-60 minutes duration, first post-test was taken to assess improvement in knowledge by residents. Anonymous feedbacks were taken from all residents. Independent feedback was also taken from the faculty observer.
3. After 3 to 5 weeks, students were taught by a faculty taking interactive lecture with same video in teaching session of 40-60 minutes duration (intervention B). In this blended session, first background of topic was given by power point presentation by teaching faculty. Then, while showing the video, it was paused at important steps/points and questions were invited, discussed and answered by faculty. Residents were encouraged to ask questions at any time and start discussion. At the end, teacher had summarized topic and answered questions raised, if needed, by drawing diagram.
4. After blended interactive lecture with video, second post-test was taken. Anonymous feedbacks were taken from residents with feedback from the faculty observer.

Radiology Curriculum and Multi-media Resources:

In radiodiagnosis post-graduate curriculum; core areas include basics of radiodiagnosis; which residents must know during residency programme. Non-core areas include advanced or in-depth areas of Radio-diagnosis, which is considered good or nice to know by residents at the end of residency programme.

Six sessions of two topics in a lecture taken by both methods were tabulated below:

MODALITY	CORE TOPIC	NON-CORE TOPIC
Ultrasound and Doppler	Abdominal Vascular Ultrasound and Colour Doppler: essential views and scanning technique. Normal arterial & venous doppler flows of abdominal vessels.	Antenatal sonographic markers of chromosomal anomalies. Antenatal sonography of Central Nervous System: Head and Neural tube anomalies.
Multi-detector CT scan	Interpretation of MDCT dataset: emerging issues & potential solutions. Contrast enhanced nephropathy (CIN): risk factors and prevention.	Coronary MDCT Angiography: what should we look for? Experience of Cardiac 64 raw detector CT scans.
MRI scan	MRI: Basic Principles. MRA: Basic Principles.	Physics of various MRA techniques. MRI: Future directions.

Table 1: Lecture topics of all 3 modalities with categorisation in core and non-core area.

Original Compact Discs (CD) and Digital Versatile Discs (DVD) of lectures from personal collections were used as Multimedia resources; which were published overseas [4 from USA and 2 from Germany]. On internet search, these video lectures were not available on internet or You tube; hence, this rules out previous viewing.

Results:

***Qualitative Analysis:**

Knowledge Evaluation Method was taking short test before intervention A (Pre-test), after intervention A (Post-test 1) and after intervention B (Post-test 2). These have generated 3 pairs of data for quantitative analysis; which were (1) Pre-test & Post-test 1, (2) Pre-test & Post-test 2 as well as (3) Post-test 1 & Post-test 2.

Learning Experience Evaluation Method was taking feedback after both interventions by Quantitative Likert Rating Scale rating of Feedback 1 (after intervention A) and Feedback 2 (after intervention B). These were analysed qualitatively by comparing pair of Post-test 1 feedback & Post-test 2 feedback.

Number of data points (N) was arrived by multiplying No. of Lectures with No. of Residents in all topics (overall assessment), core area topics & non-core area topics.

These four pairs were analysed by Paired T-test using Statistical Package for Social Sciences (SPSS) version 14 software. For Paired T-test, results of all questionnaires and ratings of statements in feedback forms, *P* value of < 0.005 was considered significant before analysis.

Quantitative statistical analysis of knowledge gain assessment (3 pairs) and learning experience (1 pair) of radiology resident doctors were tabulated with paired T-test (Two tailed) and significance (*p* value) as overall assessment (Table 2), core area assessment (Table 3) and non-core area assessment (Table 4); where N is Number of Data Points.

Qualitative statistical analysis of knowledge gain assessment of radiology resident doctors in first year, second year and third year of residency were similarly tabulated with paired T-test (Two tailed) and significance (*p* value) as overall assessment (Table 5).

Table 2: Statistical analysis of residents in overall knowledge gain & learning experience

STATISTICAL ANALYSIS		**OVERALL ASSESSMENT** [N = 48]				SIGNIFICANCE [2 TAILED]
Paired T-Test	Between	Mean Marks [Out of 10]	Range	Standard Deviation (S.D.)	Absolute Difference Between mean	P Value [Upto 4 number after decimal]
Pair 1 (Knowledge)	Pre-test	3.58	1.00-6.50	1.438	1.646	< 0.0001
	Post-test 1	5.23	3.00-7.75	1.246		
Pair 2 (Knowledge)	Pre-test	3.58	1.00-6.50	1.438	3.089	< 0.0001
	Post-test 2	6.67	4.75-9.50	1.066		
Pair 3 (Knowledge)	Post-test 1	5.23	3.00-7.75	1.246	1.443	< 0.0001
	Post-test 2	6.67	4.75-9.50	1.066		
Pair 4 (Learning Experience)	Feedback 1	6.3917	1-9	0.81524	0.85208	< 0.0001
	Feedback 2	7.2437	2-9	0.58923		

Table 3: Statistical analysis of residents in core area knowledge gain & learning experience.

STATISTICAL ANALYSIS		**CORE AREA ASSESSMENT** [N = 24]				SIGNIFICANCE [2 TAILED]
Paired T-Test	Between	Mean Marks [Out of 10]	Range	Standard Deviation (S.D.)	Absolute Difference Between mean	P Value [Upto 4 number after decimal]
Pair 1 (Knowledge)	Pre-test	2.88	1.00-5.50	1.236	1.990	< 0.0001
	Post-test 1	4.86	3.00-7.00	1.227		
Pair 2 (Knowledge)	Pre-test	2.88	1.00-5.50	1.236	3.667	< 0.0001
	Post-test 2	6.54	4.75-9.25	1.246		
Pair 3 (Knowledge)	Post-test 1	4.86	1.00-5.50	1.227	1.677	< 0.0001
	Post-test 2	6.54	4.75-9.25	1.247		
Pair 4 (Learning Experience)	Feedback 1	6.5458	1-9	0.75871	0.71667	< 0.0001
	Feedback 2	7.2625	2-9	0.67875		

Table 4: Statistical analysis of residents in non-core area knowledge gain & learning

STATISTICAL ANALYSIS		NON-CORE AREA ASSESSMENT [N = 24]				SIGNIFICANCE [2 TAILED]
Paired T-Test	Between	Mean Marks [Out of 10]	Range	Standard Deviation (S.D.)	Absolute Difference Between mean	P Value [Upto 4 number after decimal]
Pair 1 (Knowledge)	Pre-test	4.29	2.00-6.50	1.285	1.302	< 0.0001
	Post-test 1	5.59	3.50-7.75	1.180		
Pair 2 (Knowledge)	Pre-test	4.29	3.50-7.75	1.285	2.510	< 0.0001
	Post-test 2	6.80	5.50-8.00	0.856		
Pair 3 (Knowledge)	Post-test 1	5.59	3.50-7.75	1.080	1.208	< 0.0001
	Post-test 2	6.80	5.50-8.00	0.856		
Pair 4 (Learning Experience)	Feedback 1	6.2375	1-9	0.85608	0.98750	< 0.0001
	Feedback 2	7.2250	2-9	0.49804		

Table 5: Statistical analysis of radiology resident doctors in different years in overall knowledge gain assessment.

STATISTICAL ANALYSIS		OVERALL KNOWLEDGE ASSESSMENT				SIGNIFICANCE [2 TAILED]
Paired T-Test	Between	Mean Marks [Out of 10]	Range	Standard Deviation (S.D.)	Absolute Difference Between mean	P Value [Upto 4 number after decimal]
First Year Resident Doctor [R1] [N= 18] (Knowledge)	Pre-test	2.89	1.00-5.00	1.278	1.661	< 0.0001
	Post-test 1	4.55	3.00-7.50	1.173		
	Pre-test	2.89	1.00-5.00	1.278	3.069	< 0.0001
	Post-test 2	5.96	4.75-8.00	0.796		
	Post-test 1	4.55	3.00-7.50	1.173	1.408	< 0.0001
	Post-test 2	5.96	4.75-8.00	0.796		
Second Year Resident Doctor [R2] [N= 18] (Knowledge)	Pre-test	3.56	1.50-6.00	1.454	1.756	0.0001 (< 0.005)
	Post-test 1	5.31	3.50-7.00	1.141		
	Pre-test	3.56	1.50-6.00	1.454	3.056	< 0.0001
	Post-test 2	6.61	5.50-7.50	0.637		
	Post-test 1	5.31	3.50-7.00	1.141	1.300	< 0.0001
	Post-test 2	6.61	5.50-7.50	0.637		
Third Year Resident Doctor [R3] [N= 12] (Knowledge)	Pre-test	4.67	2.00-6.50	0.985	1.458	0.0002 (< 0.005)
	Post-test 1	6.13	5.00-7.75	0.926		
	Pre-test	4.67	2.00-6.50	0.985	3.167	< 0.0001
	Post-test 2	7.83	6.00-9.50	0.967		
	Post-test 1	6.13	5.00-7.75	0.962	1.708	0.0002 (< 0.005)
	Post-test 2	7.83	6.00-9.50	0.967		

The *p* values in this study were significant for knowledge improvement in overall, core area & non-core area performances and in R3, R2 & R1 at all 3 levels. Significant improvement in rating for joyful learning experience by residents was found with *p* value being < 0.0001. Nearly similar rating for joyful learning was given by observer faculty.

These results were homogeneous on evaluation by Oneway Annova tool of S.P.S.S. software; which revealed no significant difference between core & non-core topic groups as well as in R3, R2 & R1 groups.

***Qualitative Analysis:**

Open spaces provided in the feedback forms to comment for best moments / points and areas of improvement, were analysed qualitatively and coded in few theme. Feedback of observer faculty is nearly matching with students' feedback assessment.

Out of two sets of 48 feedback forms [Total 96 forms], 91.67 % feedback forms had commented at least one good comment, among which interactive teaching sessions have more numerous comments with better word description. Some of the good comments received for interactive lecture session with video were "Very informative lecture on topic with super-duper examples", "Discussion with faculty was the best part of this session", "excellent explanation", "enjoyed learning with better understanding" and "Very good conversation, Thank you, Sir*ji*."

Regarding suggestions on area of improvement; 37.5 % feedback forms had some suggestions, out of which 65.9 % feedback forms had few suggestion for video lecture, mainly related to video clarity, audio and accent. While 14.8% feedback forms had suggestions for interactive lecture session with video, mainly of more time allotment for questions and answers.

Teaching-Learning by good e-resource (video lecture) had led to significant improvement in knowledge; but blended method of combining video/multimedia resource in interactive teaching by teacher had more significant improvement in knowledge with better understanding and enjoyable learning experience.

Discussion:

Medical students like other learners, have different learning styles or learning preferences; which may be one of four styles: Visual, Auditory, Read/write or Kinesthetic (VARK).

Each learner may have a preferential learning mode; but 64 percent of students had preference for multiple learning styles or modes; out of which using all 4 styles is most common (43.4 percent), in first year medical students in Lujan HL & DiCarlo SE (2006, p. 13) research study.[8] Medical students prefer that information came in various modes and they have better learning in active or interactive methods.

Medical teacher should use various teaching methods and teaching styles to create optimum teaching-learning environment. Teaching styles may be assertive, suggestive, collaborative and facilitative as one progress from teacher centred to learner centred approach. Vaghan L & Baker R (2001, p. 610) has reported 5 similar positive preceptor styles outlined by Montaunk & Grasha (1993); which are expert, formal authority, personal model, facilitator & delegator , as well as further suggestion of Grasha (1996) to use various teaching styles to fulfil diverse need of learners.[9]

In this study; students' learning was better, when teacher provided information using multiple learing style in blended interactive method; which has correlated with observations by Lujan HL & DiCarlo SE (2006) in medical students.[8]

Use of computers as computer assisted learning (CAL) in medical education was reported by Clayden GS & Wilson B (1988, p. 456) long ago; who concluded that CAL in medical education can increase imagination and reasoning in medical students, while relieving them from burden of mere learning facts.[10]

According to Liaskos J & Diomidus M (2002, p-359); active multi-media technologies are favourably applied in medical informatics education and nursing education with user having

active role.[11] Learning with multi-media instruction is also favourably valued, when compared with traditional instructions in dental health care education by Stegeman CA & Zydney J (2010, p. 130).[12]

Many medical teachers and educators face the challenging task to make decision about when, which and how to make best use of video resources, as well as how to integrate videos into their teaching session. Dong C & Goh PS (2014, p. 1) has published list of 12 tips for effective use of videos in medical education based on their review of best practices in curriculum design, research in multimedia learning and their experience in producing educational videos. They found use of videos has advantages and discussed how videos can be integrated in teaching program.[13]

Regarding the radiology education, in Nyhsen CM, Steinberg LJ & O'Connell JE (2013, p. 103) study, undergraduate medical students preferred that radiology teaching should be part of teaching in all undergraduate years and with most students liking case based interactive session.[14] In another study by Zou L, King A, Soman S *et. al.* (2011, p. 253), undergraduate medical students had preference for Socratic method ; in which teacher asked questions without giving information, allowed time to see images and had open discussion, making learning process active and combining Socratic teaching with gentle questioning by instructor through use of PowerPoint was preferred.[15] Study on interactive teaching in oral and facio-maxillary radiology by Ramesh A & Ganguly R (2016, p. 211) had found positive outcome in assessment with conclusion that technological tools had impacts on learning and their usage enabled interactive learning environment.[16]

In United Kingdom, junior doctors (non-radiologists) during their first two years of training before entering specialty training; receive basic radiology teaching. Research study of Nyhsen CM, Lawson C Higginson J (2011, p. 261), had found interactive case-based discussion most favourite teaching technique for radiology in these junior doctors; followed by interactive system-based discussions. Sessions with interactive elements lead to better results.[17] Lieberman G, Abramson R, Volkan K & McArdle PJ (2002, p. 40). concluded that "more students said that they liked interactive tutorial learning" as compared to computer-assisted instruction, and test results were marginally, but significantly better after interactive teaching by tutor. [18] Blended method of teaching consisting of an integration of computers with small group and didactic instructive lecture was used by Shaffer K & Small JE (2004, p. 1059) for teaching of radiological anatomy; which was well accepted by students and had allowed optimal use of faculty.[19]

For future developments; Kellman PJ (2013, p. 98) has described two major innovation areas in learning sciences having medical learning context, which are 1. Perceptual learning (PL) and 2. Adaptive learning technologies (ALT) and have synergy between them. The PL technology gives systematic computer-based method for teaching; which can be used in pattern recognition, structural intuition, transfer and fluency. New adaptive learning technologies optimize learning for every individual, contain objective assessment and carry out mastery criteria. [20] These technologies include adaptive learning modules for initial medical diagnosis and perceptual / adaptive learning modules (PALMs) in specialties of radiology, dermatology and histology.[20]

This study is a pilot study done in single institution in India with single small group of participants; which are limitations of study. In future, this new teaching-learning method of incorporating multi-media resources should be experimented for radiology teaching to more students and at multiple teaching institutions for further evaluation and validation as it has potential to become good innovative and effective T-L method in general.

Conclusion:

In this study; students learn more effectively, when the teacher provides information in blended method having visual & auditory inputs with reading/writing options and if needed, kinaesthetic activities (e.g. showing ultrasound transducer placement). Role of teacher is of a facilitator, while giving background by short presentation, detailed explanation in video session and answers of questions, as and when asked. In conclusion, synergetic role of teacher as facilitator in blended interactive T-L sessions leads to effective learning and better understanding in residents with more enjoyable learning experience.

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