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"Teaching ENT to MBBS Students - A comparative study of Small Group Demonstration of 3D models and Hands on making of 3D models"

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ABSTRACT :

AIM : To prove that Hands on Model making by the ENT student himself under faculty guidance is a better method of Teaching and Learning ENT than regular small group Demonstration of 3D models.

OBJECTIVES :

Primary: To Determine if Innovative teaching method like"Hands on Model Making" by students themselves is better than "Small Group Demonstration of 3D model" in learning ENT easily .

Secondary : To Ascertain challenge of Hands on model making in ENT , To address all the 3 domains of learning [Cognitive , Affective and Psycho-motor domains] at once in one teaching method.

Results : In a cross sectional study done on 112 students , by using lottery method of randomization , 56 were under 3D model making group, 56 were under Regular teaching with 3D Model. Pre test , Teaching session, Post test ,Viva and Feed back were done. After analysis the final data was favorable to the Hands on Model making

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group with a statistical significance.

Conclusion: Teaching ENT by Hands on model making by the student under the guidance of Faculty can enhance the understanding of the subjectbetter and can give a better outcome in theory ,viva exams and generatingmore interest towards the classes in the students.

Key words: ENT student , MBBS III year students , ENT Teaching , 3D Models ,3D Model making ,Hands-on ,Domains of Learning **,**Teaching and Learning method

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Introduction : Teaching and Learning are a part of Medical Education. There is always a chance to improve the teaching methods so that students can understand and retain the subject better. A change in thinking by Innovative teaching methods are the need of the hour. There are many methods already in use like learning with 3D models and hands on cadaver learning for students. As cadavers are not that easily available , a Novel thought of making hands on models by themselves[1] might help the students in understanding ENT concepts much better than just observing the 3D models as it incorporates psychomotor domain of learning

Review of Literature:

There are a lot of methods for teaching ENT like Traditional Black board teaching ,overhead projector ,power points, cadaver dissection .All these have been in use since long time. Recently with the advent of Information technology ,addition of new mwthods like video teaching especially on the social media platforms[2] , 3D Modules on computers[3],there is a lot of innovation being used

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- They all train the cognitive, affective domains of learning . The psycho-motor domain is a not fully addressed and each method has their own shortcomings. For this reason,if hands on model making can be included in the curriculum there may be a phenomenal improvement in understanding the subject better ,memorize better and recollect better. However, there are no published articles on the use of 3D hands on model making by the student himself under the guidance of the faculty . The cognitive load theory says that the use of certain teaching methods can increase cognitive load, while other methods can decrease cognitive load [4].
- While using this idea , hands on 3D model making may become a cornerstone for the students to improve their recollection of the subject . student engagement greatly impacts academic performance[5,6].
- It is something similar to the school children being taught about model making with dough or paper cutting models and making them understand easily about basic concepts like fruits, vegetable models.
- Medical students can find it easier if hands on model making can help them in recalling the subjects in theory examinations and also in the practical viva or OSCE. It may be quoted as learning by doing [7]

Research Question

"Is 3D hands on model-making better to Teach ENT to MBBS students compared with the traditional small group demonstration?

Hypothesis

Hands on 3D model making is more effective in teaching ENT to MBBS students when compared with the small group demonstration.

Objectives :

Primary: To Determine if Innovative teaching method like "Hands on Model Making" by student himself is better than "Small Group Demonstration of 3D model" in learning ENT easily.

Secondary :To Ascertain challenge of Hands on model making in ENT

Methodology :

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Materials and Methods

Setting – Bhaskar Medical college, Demonstration Room

Design – Prospective Cohort Study

Subjects- phase III MBBS students appearing under KNRUHS ,Warangal ,Telangana.

After obtaining clearance from the Institutional Ethics Committee, [Annexure ii] students were informed about the study in whats app group.

They were invited to take an anonymous online survey about their opinion on the two teaching methods with a questionnaire.

Consent statement was obtained from participants. The class representatives were requested to indicate the number of interested participants to the Principal Investigator (PI).

- Based on convenience, we conducted the Hands on model making session regular teaching method simultaneously .

- All this was done after discussion and permission from Senior professor and Head of the Department and valid inputs and feedback are taken .
- All sessions were recorded (participants were informed about this beforehand).
- sample size -109 students rounded off to 110 ,calculated in website ,taking 150 students per batch as study population ,with confidence level 95% , margin of error 5 % ,population proportion 50 %[8]
- Initially 134 students were willing to participate ,but for various reasons there were dropouts which we called it as attrition in the study and we could get 112 students ,which was 3 more than the calculated required sample size
- At the end of the study and after drop out calculation we could take the sample as 112 students
- After taking Typed ,Informed ,valid consent from the students ,we proceeded with the study ,consent form can be seen in the annexure iii.
- Intervention – 2 Batches[cohorts] are made and called as “Surgeon Cohort” [who make their 3D Model] and “Physician Cohort” [Who are taught with already existing model in the market]
- Tools – 1. Conduct Pre Test or both batches with a same Multiple choice questions for both batches
- 2.Conduct the Teaching session with one teaching method to the cohorts
- 3.Post Test assessment with Multiple choice questions ,
- 4 .Followed by Viva voce and
- 5. Feedback forms about teaching method after the sessions completion

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- All the activities were video recorded with permission from students , faculty and in-charge of administration.
- Data collection – Students were briefed about the study and after taking consent ,112 students were selected , from phase iii MBBS students and were designated to 2 batches of 56 each , and one batch was subjected to regular small group demonstration with only 3D models , and the remaining students were subjected to hands on model making
- After this statistical analysis was done taking the help of statistician
- We have conducted the study for the students in monthly batch wise and 2 sessions were done for each batch , which was done as Day 1 and Day 2
- Every time a practical posting batch comes , we announced them about the programme to be conducted and used the chits to Randomly allocate the student to a particular Group
- We named the 2 cohorts as “Surgeon Group” and “Physician Group”
- After Randomization of students into 2 groups ,Every time students were called from each group ,as the minimum number for a small group was taken as “three” according to studies[9], students were briefed about the protocols of the study.
- A pre-test using multiple choice questions was conducted with questions related to the topics to be explained for every topic prior to its teaching.
- Sessions of small group demonstration was done with regular 3D models demonstration of the topics selected for physician cohort
- Other group called “Surgeon cohort” students group was indulged in Hands on model making in the morning period .
- Every day “post test” with Multiple choice Questions was conducted in the afternoon session ,Viva Voce was done and after which feedback forms were given with a proforma [Annexure IV]
- Feed back is divided into 2 parts with 35 marks for 7 questions on the method of teaching as shown in the figure ,giving 7 x 5 = 35 marks ,and 15 marks were given based on their options in the second part of the feedback like 1.very good =15 ,Good =10 ,Bad = 5 marks .
- Thus Feedback is taken for 50 marks for every day and for 2 days it was 100 marks
- The same is repeated to the rest of the students without any deprival .
- Materials to be used in the study are 3D Models of ENT Anatomy available in the market and new models to be made by the students themselves under investigator’s guidance using materials like paper , stick on , clay ,Gloves , dough .

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- Analysis: Pre-test Multiple choice questions are conducted by giving 10 multiple choice questions in each topic chosen ,3 topics were tested .So 10x5 = 50 ,50 x 3 = 150 , marks allotted , post-test Multiple choice questions ,conducted with same questions and made for 150 marks
- Later viva is conducted to test the practical point of view for 30 marks asking 3 questions and maximum marks were 10 for each ,10 x 3 = 30 marks
- We added 20 marks for the participation so that calculation can be made for 50 each day i,e 30 marks for viva added with 20 marks to all so that it can be 30 +20 = 50 marks for each day
- Total marks tally : 1. Pretest =150 , 2.post test =150 , 3.Viva= 30 , 4.Participation= 20

5.Feedback [lickert scale] =35 , 6. Feedback as personal judgement = 15

- It was followed by adding the 2 days results.
- Followed by statistical analysis of the results

At the end of the study we will cross over the students and provide hands-on method to the students who were taught in the traditional method and vice-versa and also the rest of the students in the batch shall be taught the same so that no student is denied of the new method of learning

Results

In Total there are 134 students who participated in the study , equally distributed as 67 to each group .

At the end of study we could get 56 students in each group and total was 112

Those who participated in 3D Model making group were named as ‘Surgeons Group ’

Those who participated in Non model making group were named as ‘Physician Group’

Name of the Group	Number of Participants [students] Willing to participate
Surgeon cohort	67
Physician cohort	67
Total	134

Table 1 : Number of Participants willing to participate in the study

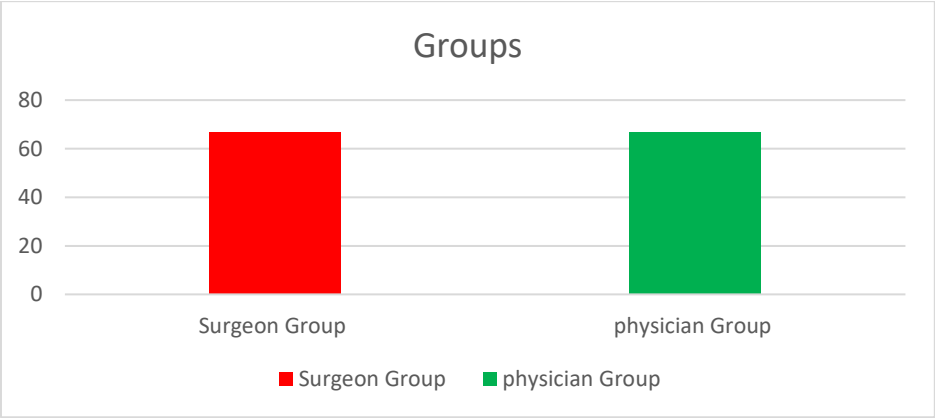

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Chart 1 : Surgeon group and Physician Group preliminary entry

- out of 134 students in total ,22 were absent for various reasons on 1 st or second day of the programme. So we calculated the sample for 120 students only ,surgeon group included 56 and physician group included 56

Finally we could do the study on 112 students but 2 more than the sample size we chose was 110.

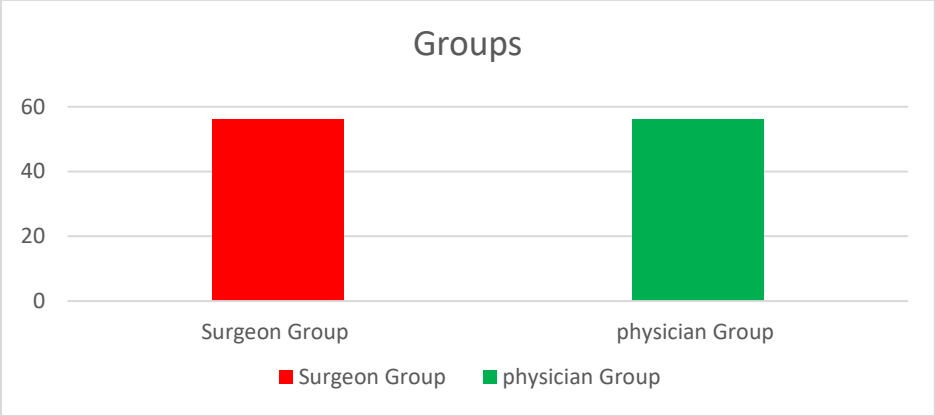

Chart 2 : Surgeon group and Physician Group final count

Comparison of pre test Marks between surgeon and physician group:

For Both groups , Pre-test Multiple choice questions were done as an examination.

ANALYSIS

The Entire results were tabulated in Microsoft Excel sheet and were analysed.

Group No	Pre-Test	Post -Test	Viva	Feedback
1	1007	2971	1106	1190
2	980	2460	1212	1296
3	584	3031	1171	1160
4	1020	2968	1292	1269
Total	3591	11430	4781	4915

Table 1: Surgeon Group Results

Group No	Pre-Test	Post -Test	Viva	Feedback
1	752	3872	1162	1093

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2	1053	3722	1279	1104
3	715	3770	1135	1083
4	753	3809	1118	1084
Total	3273	15173	4694	4364

Table 2: Physician Group Results

Group No.	Surgeon Group	Physician Group
1	1007	752
2	980	1053
3	584	715
4	1020	753
Total	3591	3273

Table 3 : Pre -Test Table for comparing Surgeon vs Physician group

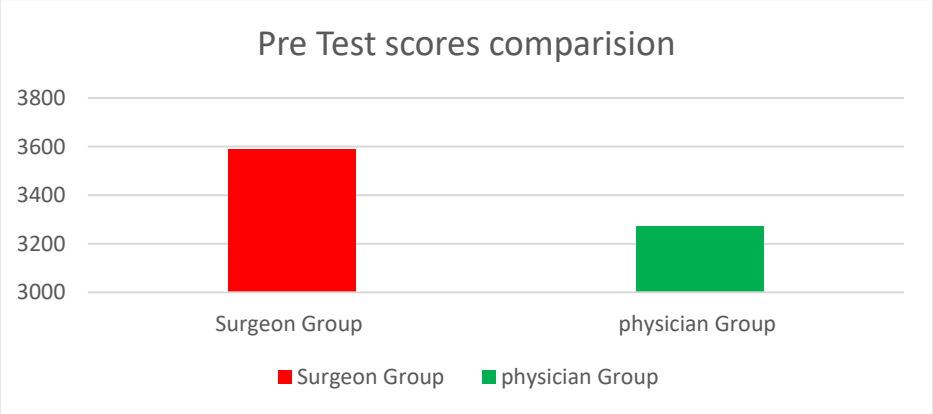

Chart 3 : Surgeon group and Physician Group

Pre Test score comparison

Group No.	Surgeon Group	Physician Group
1	2971	3872
2	2460	3722
3	3031	3770
4	2968	3809
Total	11430	15173

Table 4 : Post -Test Table for comparing Surgeon vs Physician group

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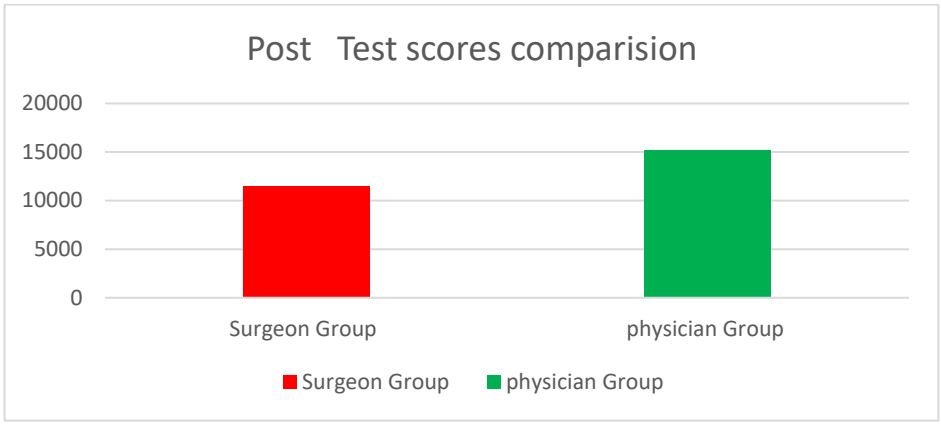

Chart 4 : Surgeon group and Physician Group

Post Test score comparison

Group No.	Surgeon Group	Physician Group
1	1106	1162
2	1212	1279
3	1171	1135
4	1292	1118
Total	4781	4694

Table 5 : Viva comparing surgeon group vs physician group

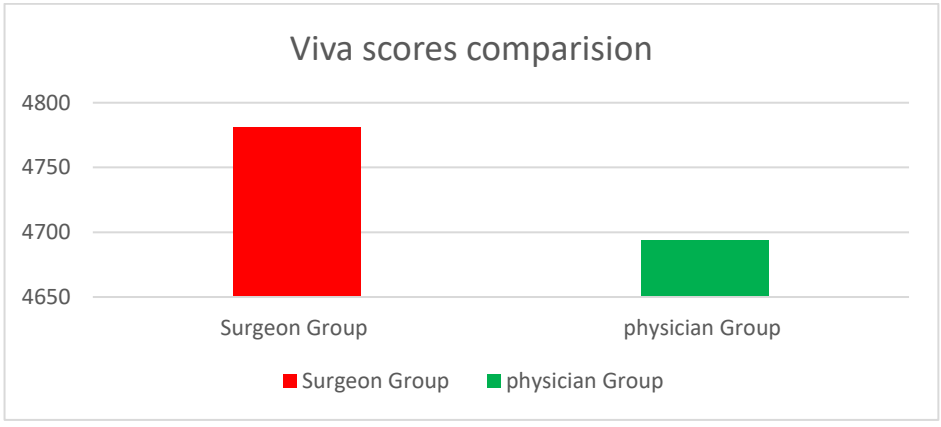

Chart 5: Surgeon group and Physician Group

Viva score comparison

Group No.	Surgeon Group	Physician Group
1	1190	1093

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2	1296	1104
3	1160	1083
4	1269	1084
Total	4915	4364

Table 6 : Feed Back Table comparing surgeon group vs physician group

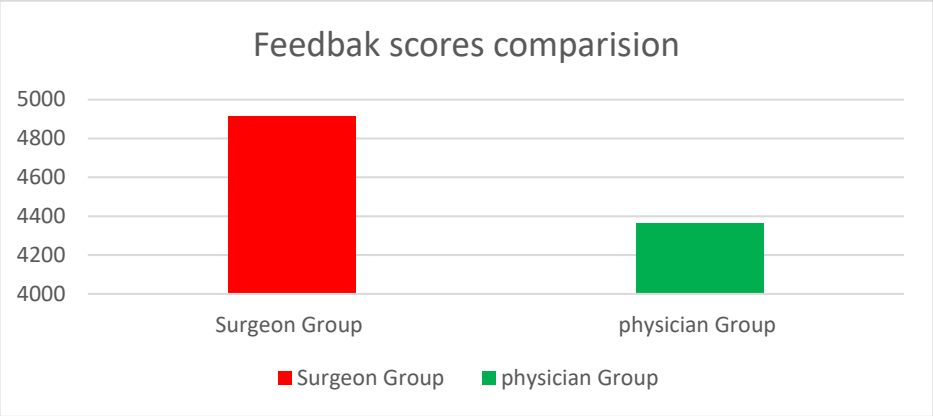

Chart 6: Surgeon group and Physician Group

Feedback score comparison

STATISTICAL ANALYSIS :

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
PRETEST (300)	112	143.00	15.00	158.00	61.2857	29.76649	886.044	.478	.228	.015	.453
POSTTEST (300)	112	166.00	130.00	296.00	237.5268	43.68952	1908.774	-.645	.228	-.403	.453
VIVA (100)	112	83.00	17.00	100.00	84.1250	11.61090	134.813	-2.129	.228	9.137	.453
FEEDBACK (100)	112	40.00	60.00	100.00	82.8482	9.29032	86.310	-.265	.228	-.137	.453
Valid N (listwise	112										

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)

Table :7 Descriptive statistics

Group Name

GROUP		Frequency	Percent	Valid Percent	CumulativePercent
Valid	PHYSICIAN GROUP	56	50.0	50.0	50.0
	SURGEON GROUP	56	50.0	50.0	100.0
	Total	112	100.0	100.0	

Table : 8 : Groups

Group No

GROUP		Frequency	Percent	Valid Percent	CumulativePercent
	1	28	25.0	25.0	25.0
Valid	2	28	25.0	25.0	50.0
	3	28	25.0	25.0	75.0
	4	28	25.0	25.0	100.0
	Total	112	100.0	100.0	

Table : 9 : Group wise Results

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Statistics

		Group Name	Group No	PRE TEST (300)	POST TEST (300)	VIVA (100)	FEEDBACK (100)
N	Valid	112	112	112	112	112	112
	Missing	0	0	0	0	0	
Mean			2.50	61.2857	237.5268	84.1250	82.8482
Median			2.50	60.0000	239.5000	87.5000	83.0000
Mode			1[a]	60.00	220.00[a]	90.00	80.00
Variance			1.261	886.044	1908.774	134.813	86.310
Skewness			.000	.478	-.645	-2.129	-.265
Std. Error of Skewness			.228	.228	.228	.228	.228
Kurtosis			-1.367	.015	-.403	9.137	-.137
Std. Error of Kurtosis			.453	.453	.453	.453	.453
Range			3	143.00	166.00	83.00	40.00
Percentiles	25		1.25	40.0000	215.0000	79.0000	78.2500
	50		2.50	60.0000	239.5000	87.5000	83.0000
	75		3.75	82.2500	276.7500	92.0000	90.0000

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a. Multiple modes exist. The smallest value is shown

Table :10 : Statistics

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	PRETEST (300)	61.2857	112	29.76649	2.81267
	POSTTEST (300)	237.5268	112	43.68952	4.12827

Table :11 : paired sample statistics

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	PRETEST (300) & POSTTEST (300)	112	-.007	.945

Table :12 : paired sample correlations

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PRETEST (300) - POSTTEST (300)	-176.24107	53.02664	5.01055	-186.16980	-166.31234	-35.174	111	.000

Table :13 : Paired Differences

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Correlations

		PRETEST (300)	POSTTEST (300)	VIVA (100)	FEEDBACK (100)
PRETEST (300)	Pearson Correlation	1	-.007	.216*	.118
	Sig. (2-tailed)		.945	.022	.214
	N	112	112	112	112
POSTTEST (300)	Pearson Correlation	-.007	1	-.002	-.477**
	Sig. (2-tailed)	.945		.982	.000
	N	112	112	112	112
VIVA (100)	Pearson Correlation	.216*	-.002	1	.148
	Sig. (2-tailed)	.022	.982		.120
	N	112	112	112	112
FEEDBACK (100)	Pearson Correlation	.118	-.477**	.148	1
	Sig. (2-tailed)	.214	.000	.120	
	N	112	112	112	112

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Table :14 :correlations

Interpretation of pearson correlation coefficient :

In all the 4 parameters like pre test ,post test ,viva and feed back ,pearson correlation coefficient was coming as +1 , that there is a positive association between the teaching methods and the result

p-value [2 tailed analysis] : says that correlation is significant ,null hypothesisis refuted and alternate hypothesis proves .According to this ,Novel teaching method has got an extra edge than traditional method.

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ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PRETEST[300]	Between groups	9981.286	3	3327.095	4.066	.009
	With in Groups	88369.571	108	818.237		
	Total	98350.857	111			
POSTTEST (300)	Between Groups	10542.884	3	3514.295	1.885	.136
	Within Groups	201331.036	108	1864.176		
	Total	211873.920	111			
VIVA (100)	Between Groups	1681.821	3	560.607	4.558	.005
	Within Groups	13282.429	108	122.985		
	Total	14964.250	111			
FEEDBACK [100]	Between	528.098	3	176.033	2.100	.104
	With in Groups	9052.321	108	83.818		
	Total	9580.420	111			

Table : 15 :ANOVA

In ANOVA ,the higher F Ratio is showing that the teaching method is creating a difference , p- value is rejecting null hypothesis.

Discussion :

According to the above tables we have the following analysis :

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- Pre- test : for surgeon group ,the score was 3591 and physician score was 3273,which says that Scoring by the students in surgeon group was higher than the physician group

- Post test : for surgeon group was 11430 , and physician group was 15173 The result speaks that after the teaching was done and student tested immediately ,physician group students fared better than surgeon group

- Viva score : for surgeon group was 4781 , and physician group was 4694. The result speaks that after the teaching was done and student tested immediately for viva , surgeon group students fared better than physician group.

- Feedback : for surgeon group was 4915 , and physician group was 4364 . The result speaks that after the teaching was done and student tested immediately for viva , surgeon group students fared better than physician group.

- Based on the above statistics , surgeon group was better than physician group in 3 out of 4 aspects .

- Our Understanding of the above results :

- Surgeon group was ahead of physician group in pre-test. It can be always possible that one group of students may do better than other

- Post test was ranked high by the physician group and this may probably by the better concentration of the students in theoretical aspects dealt in the physician group

- Viva is done better by the students in surgeon group ,and this may be due to the better understanding of the practical issues that we deal during making of model by oneself

- Feed back points were higher for surgeon group than physician and this may be due to the impact on interest generated by the novel teaching method

Conclusion:

- Teaching and Learning methods are useful to deliver a proper method of understanding to the students and by the teachers .
- Better teaching method is always shown to be loved by the students
- Based on the need for today practical exposure is more important than theory
- Models help us in understanding the subject but just by training the cognitive domain and affective domain only
- But Making models by oneself will help in addressing Cognitive ,Affective and psychomotor domains ,which can make learning more effective and interesting
- Our results between the two groups suggest the same
- Physician group which is intended to train only the cognitive and affective domain could help in getting more marks in the post test ,where as lagged in viva answering and feedback
- Surgeon group could probably help in understanding the psychomotor component also , which could help in getting more marks in viva .

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- Feedback was good for surgeon group as it could have proved more interesting to the students because of its novelty
- It is the time for us to think in making model by ourself so that we can understand the anatomy better and thus the subject better as a whole
- Because it is very difficult to procure cadavers ,it is better we use more and more mannequins ,but because of the cost it may not be always feasible .So it could be a better option to make our own model.

After doing statistical analysis ,we were able to conclude that :

- Pearson correlation coefficient was coming as +1 , that there is a positive association between the teaching methods and the result
- p-value [2 tailed analysis] : says that correlation is significant ,null hypothesis is refuted and alternate hypothesis proves .According to this ,Novel teaching method has got an extra edge than traditional method.
- In ANOVA , the higher F Ratio is showing that the teaching method is creating a difference , p- value is rejecting null hypothesis.

Our study is matching many similar other studies done before with 3D printing technology . But articles on self model making which is a very cost effective method of learning were not found in literature.

P.Canzi etal study is telling about how 3D printers can help in understanding and designing the Anatomy with a huge cost and maintenance.[12] Our study, when compared to it, is a simple and cost effective and without any need for the technology.

Oshri Wasserzug etal study was done for understanding the pediatric airway ,by making preoperative 3D models[13]. It was helping in good planning and understanding. Our study is not a surgical study ,but a teaching project and rathercost effective .If students can be tuned right from their MBBS days we can createa lot of interest in studies.

Chen, G etal in their article [14] were discussing about the utility of 3D printing technology in teaching the surgical skills. The author was discussing the benefitsof 3D printers in hand on training. This study nearly matches our work ,but not very cost effective. Involvement of MBBS students in simple model making mayprove beneficial from the basic level of learning.

Meglioli etal in their work [15] quoted about the utility of their 3D printing technology and the cost associated with that. Our model making is again a simplified and cost effective one for the beginners and can help in learning subjecteasily.

- **Acknowledgements:**
We extend our gratitude to all the students who participated in our study. We also thank our Institute and Institutional Review Board for providing us permission to conduct the study. I personally thank my Professor and HOD Dr. S. Indira Madam for making this study possible and guiding me in every aspect of the study and encouraging the Novel teaching method ,Dr.P.Ramakrishniah sir , Professor for being a co-Investigator ,without whose help this study would not have happened. I thank for his valuable suggestions and participations. Our Post graduates for their cooperation and Dr P.V .Chalam sir our Dean and principal for guiding towards the mighty ocean of Knowledge of Medical Education . My

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sincere thanks to my daughter Sthithir Mownee for making me think towards model making in ENT while she was playing with dough in her project in school. A sincere thanks to all the mentors and colleagues who helped me in taking up the project.

- **Conflicts of Interest: Nil**
- **Financial disclosures: Nil**
- **Ethical clearance : BMC/IEC/July 2021**

PROFORMA OF TEACHING PLAN FOR THE STUDY

- Students are divided into 2 groups ,surgeon group and physician group
- They will have to face 2 sessions in 2 days
- Both were conducted pre test ,post test ,viva and have to give feedback
- Pre-test has 3 concepts related questions each carrying 5 marks and they are MCQ pattern
- 5 x 10 = 50 marks for one concept
- 50x 3 = 150 marks per one day
- In the same way the same questions are done for post test after the completion of session
- Viva is done for 50 marks in the afternoon
- Feedback is done for 50 points while leaving the exam hall
- After 2 days we have to calculate the marks for both sessions
- 150+ 150 =300 for pre-test
- 150 + 150 = 300 for post test
- 50 + 50= 100 for viva
- 50 + 50 = 100 for feedback
- At the end everything was tabulated and calculated

The following topics were covered for the 4 batches of the students :

1. Temporal Bone Gross Anatomy,Inner Ear Surgical Anatomy ,Tympanic Membrane and its perforations
2. Surgical Anatomy of the Nose, Tonsil ,Larynx
3. Surgical Anatomy of the Middle ear, Mastoid, Facial Nerve
4. Surgical Anatomy of the Neck ,Larynx ,Thyroid and Trachea
5. Surgical Anatomy of the Deep Neck spaces and Parotid
6. Surgical Anatomy of the Neck

ACTIVITIES IN THE STUDY & MODELS DONE

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Briefing done to Students about the project

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Randomization done by Lottery of chits

Principal Investigator along with the Senior Co-Authors

Picture compilation : 1: Teaching ENT to MBBS students,by Hands on Model making [Surgeon group]

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Picture compilation : 2: Teaching Activity with already existing 3 D Models

Picture compilation : 3 : conducting viva after post test

PARAPHARYNGEAL SPACE MODEL

NECK ANATOMY MODEL

TONSILLECTOMY MODEL

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TEMPORAL BONE ANATOMY DOUGH MODELS

FACIAL NERVE ANATOMY MODEL

LARYNX DOUGH MODEL

LARYNX PAPER ,BRATHUKAMMA CROWN MODEL

NECK ANATOMY PAPER AND COVER MODEL FOR TRACHEOSTOMY

DIRECT LARYNGOSCOPY -PAPER MODEL

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