



## MODEL CONSTRUCTION : VALUABLE FOR TEACHING , LEARNING AND REMEMBERING EMBRYOLOGY IN MEDICAL CURRICULUM

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**ABSTRACT** The knowledge of embryology is beneficial for medical , dental and nursing students for understanding the causes of congenital birth defect and disorders applicable in all clinical settings . In embryology teaching it is common to use artificial models to represent the different phases of developing embryonic structures . It facilitates learning since the students can see and touch the models , obtaining knowledge by analogies . The aim of the present study was to analyse if the construction of models by the students during embryology practical classes would facilitate their knowledge , learning and remembering . This academic year in our institute , the students of separate courses were divided into groups and are provided with materials and instructions. The purpose of the study was explained and written informed consent was obtained from all the participants . After 3 weeks of time, the students construct 15 models under the supervision of teachers , representing the development of different embryonic structures and organ system . At the end of the semester, the evaluation was made through tests containing objective and discursive questions related to constructed models . The result has been remarkably positive and the student's responses suggested that teaching embryology through model construction in the practical classes enhance their learning , knowledge transfer and long-lasting memories .

**KEYWORDS :** Embryology , Birth defects , Model construction

### INTRODUCTION

As an integral part of the pre-clinical basic science , teaching embryology facilitates the study of anatomy . It can explain the emergence of anatomical variations and anomalies . The knowledge of embryology is beneficial for medical , dental and nursing students for understanding the cause congenital birth defect and disorders applicable in all clinical settings .As a subject , it is neither straight forward nor easy to teach and learn in a busy modern medical curriculum and can be easily overlooked . The vary size and dynamic nature of embryonic development has always made it a difficult topic to learn and memorize . At most medical curriculum , embryology is presented as a lecture based course typically with no practical laboratory (1) . The question is : how can be embryonic information presented effectively to students ? The condensed course provided by Kuzzazi and Bartlett` (2) includes using artificial models , animations , computer based learning programs and greater focus on clinical application increases the confidence and motivate students in the understanding of embryology.

For human embryology , it is common to use artificial models to represent the different phases of developing embryonic structures (3) . The use of this tool has the purpose to facilitating learning since the students can see and touch the models , easily observing the three dimensional aspects of the structures (4) . There are some commercial models for embryology classes but they are too expensive and vulnerable to repeated manipulation therefore , some instructors have introduced an alternative low cost method that includes the construction of models by the students during classes (5) . Thus the aim of the present study was to analyse if the construction of models by the students during embryology practical classes would improve or facilitate their knowledge , learning and remembering .

### MATERIAL AND METHOD

The construction of embryonic models were implemented during practical classes . Every academic year there are 150 medical , 80 dental and 60 nursing students are studied in our institute . Basic embryology are tout to them by the traditional method with one hour theoretical classes combined with two hours practical classes every week .This academic year during embryology practical classes , the students of separate courses were divided in group of 15 to 20 . All groups are provided with materials and instructions and allotted two hours of time every week .The easily available and of low cost

materials used to build the models are – Ply board ( 30x25x1 inches ) , Old news papers , Saw dust from timber , Plaster of Paris , Fevicol and Varied colours febric paints .

**In the 1<sup>st</sup> week** – Looking at the outlines of the book , the students made the designs of the models to be studied on the plywood board using textbooks and models prepared in advance by the teachers as guide . The teachers were present to supervise the construction .

**In the 2<sup>nd</sup> week** – The News papers were shredded and soaked with water over night than blend with blender . Remove the excess of water from papers and produce a spongy wet material. Add equal part of Fevicol , Saw dust and Plaster of Paris into this material . Mixed with hands or other devices and make a homogenous mass . The models were constructed on the board using a ready material which is soft and pliable at room temperature . It was left to dry for about one week

**In the 3<sup>rd</sup> week** – Finally the structures duly represented on models are painted using Febric paint of varied colours (**photo 1**) . The students made 15 models representing the development of different embryonic structures and organ system . The schemes for making models were taken from the chapters of book Langman`s medical embryology (6) One year after the classes , with effective participation of 150 medical students in 8 groups , 80 dental students in 4 groups and 60 nursing students in 3 groups presented theoretical concepts associated with the models in a test and seminar . The purpose of the study was explained to all students and all of them signed an informed consent document .



**Photo 1 :** Students engaged in embryology model construction during their practical classes

## RESULTS

The evaluation of the students on embryology course is made through test containing objective and discursive questions related to constructed models. The models which gives the result are of a high standard and our experience has been remarkably positive. The students have exhibited great respect and strong interest in the model construction.

**Table 1** indicates a statistically significant majority of the students evaluated that the construction of the model was that most caught attention and improved their learning. Most of the students rates their learning as excellent (13%) or very good (55%). This results indicated that the students used several sources of information to build the models. The percentage of the students average performance (24%) was significantly higher in embryology teaching using self constructed models. This analysis also indicates that the students consulted text books or hand outs not only for building the models in embryology but also in other subjects. Clearly these students agreed that some content should be learned, when they acted directly in the construction of didactic models. This sensation tends to become a commitment to your training, which is reinforced by a efficient exposure of content by the teacher.

Finally almost all of the members of each group contributed to the construction of the models rates their participation as excellent, very good or above average and indicates that the model construction method improved and contributed to their learning and long lasting memories (photo 2)

**Table 1 : Average grades obtained by students after test containing objective and discursive questions related to constructed models ( Total 290 students )**

S. No.	Total no. of Medical students ( 150 )	Total no. of students of Dentistry ( 80 )	Total no. of Nursing students ( 60 )	Total % of students	Grades obtained by students
1	22	09	06	13 %	Excellent
2	80	46	33	55 %	Very good
3	37	19	14	24 %	Above average
4	11	06	07	08 %	Below average

## DISCUSSION

Modern embryology deals not only with morphogenesis – the development of organs but also with various developmental disorders that results in congenital birth defects. Embryology normally considered part of the anatomy, explains the emergence of possible variations in their number, changes of final position or topographic particularities of human anatomy (7). Hence effective learning of embryology need to be solid and clear in the minds of the students. The reduction in the duration of the first year of MBBS course requiring changes in medical education that affect the basic science (8). The changes must focus on new and alternative methodologies of teaching and learning (9). This research aimed to analyse whether the construction of models by the students during embryology classes would enhance or facilitate their learning.

“ A model can be defined as a abstraction of a real system built only with the attributes relevant to experience ” (CELLIER, 1991) (10)

Model building is a great help in understanding the structure of human embryo. As this study shows that the process of construction focuses your attention on positional relationship and once your hands have learned their way around the model your brain won't easily forget it. Despite the fact that the use of various educational techniques to work like traditional didactic lectures, animations, digital and non-digital methods on embryology teaching, acquisition of knowledge through artificial models minimize the stressful effects of just reading and observing classes expository. We observed that the students enjoy the model building exercise and comment that this is a fun activity that you can do just as well in your own home as in a classroom (photo 1). Learning occurs more effectively if the student experiences the information to be learned through sensory ( auditory, visual and tactile ) channels. In the absence of active teaching-learning methods, the student becomes a passive receiver of information. the information processed by the sensory channels must be accumulated as long-lasting memory for subsequent retrieval. (11) According to the student's responses they effectively improved and contributed to their

learning. The data indicates that the construction of models as an adjunct method of teaching link the traditional explanatory theoretical classes with practical activities and enhances the knowledge transfer. Majority of the students ( table 1) rated their participation in the construction of their own knowledge as very good or excellent. The paper relies solely on student confidence as a marker of attainment. The students actively participate on the teaching-learning process become a fundamental agent of their own learning since it is suggested that self-knowledge and self reflection help the learning (12). It is important to point out here that the students worked well in groups. Collective work facilitates not only the acquisition of knowledge but also several other desirable attributes, such as communication, team work, problem solving and information sharing skills, as well as respect for others opinions (13). The student should get involved in learning with the activities proposed by the teacher and not only with the repetition by heart in order to obtain credit for a course. At this point, the way the teacher acts becomes relevant, since the teacher's mission is to provide the situations and experiences that allow the acquisition of knowledge for the academic development and the professional practice.



**Photo 2 : Students involved in learning embryology by self constructed model during their practical classes**

The result discussed here do not rule out the necessity of traditional classes that provide fundamental basic knowledge and motivation to the student, since the formal exposition of contents when conducted correctly by teacher is necessary to guide the students thus facilitating learning (14). During the model construction, the teacher acted as a mediator, promoting exchange conditions between the students and guide them to choose the best way to construct models and obtain knowledge (15). Therefore we consider that an association between theoretical exposition and new methodologies, such as models construction is important to help the students to develop social relationship, self learning and autonomic problem solving, which is not a trivial task.

The study demonstrate that the construction of the model during embryology classes (photo 2) generates a long-term memory from the many associations required to perform the task. Indeed learning is more effective when the student uses various reception channels, became the stimulus is reinforced as short-term memory, generating the stock in long-term memory and increasing the activation of the prefrontal cortex (16). The majority of the students in this study valued embryology teaching with use of self -constructed models enable learning and form long-lasting memories about the embryonic structures and their development overtime. We consider that this and other strategies that promote the active participation of the students are motivating and reinforce learning

## CONCLUSION :

As embryology provides a foundational knowledge of the human body and has clinical relevance, it has been suggested that teaching embryology through cost-effective educational resources like model construction in the practical classes as an adjunct method of teaching may enhance the learning, teaching, knowledge transfer and interest to students and assist in its clinical application in medical and para-medical settings.

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