

## Better Knowledge Retention In Physiology: A Favourable outcome of Vertical Integration

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**Abstract:** Background & Objectives : In traditional medical curriculum, the main focus is on understanding of physiological concepts; however application, relevance and clinical co-relation of basic knowledge remains uncovered. Therefore retention of basic knowledge by students till later years of clinical exposure is not adequate and hence is seldom applied for patient care. Vertical integration if introduced in physiology can bridge the gap between physiology and clinical subjects, improving knowledge retention and student's capacity for clinical correlation. A pilot study was undertaken in first year medical students, to study the impact of vertical integration on learning and retention of physiology concepts. Methods: Two topics of endocrinology were taught through traditional and integrated approach to two groups of students with cross over for second topic. In integrated approach, integrated modules were developed and taught by faculties from Physiology, Pathology and Medicine together; whereas traditional approach included usual didactic lectures in Physiology. Knowledge based tests were carried out immediately post intervention (post- test) and after three months interval (repeat post- test). Results Students obtained significantly higher marks in repeat post- test when taught by integrated method than by traditional method (paired t test,  $p < 0.001$ ), implying better knowledge retention in integrated group. Conclusion: There is better retention of knowledge after three months in group that underwent vertical integration. Therefore we recommend introduction of vertical integration along with traditional physiology teaching in first year of medical curriculum. [ Kumar S et al NJIRM 2013; 4(5) : 60-64]

**Key Words:** vertical integration, integrated teaching, traditional teaching, retention.

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**Introduction:** In traditional medical curriculum, physiology is taught by passive didactic lectures supplemented with practical lab sessions. Physiology is a basic science that requires students to grasp new terminologies and have good understanding of underlying concepts for learning the subject<sup>1, 2, 3</sup>. Most of the colleges following traditional curriculum mainly emphasize on explaining and building concepts however the relevance and application of physiological concepts gets overlooked. Therefore by the time students gain clinical exposure, basic physiology knowledge is forgotten<sup>4, 5, 6</sup> and hence is not applied for patient care. There is a need to introduce new teaching-learning methods in physiology with holistic approach that develop an in-depth understanding and clinical relevance<sup>7</sup>. Probably, this could also help with better retention of basic concepts.

Integrated teaching has an approach that tends to co-relate knowledge from various subjects to provide more meaningful learning. Horizontal integration tends to interlink subjects taught at one stage of traditional curriculum (example anatomy, physiology and biochemistry are linked at preclinical stage) where as vertical integration interlinks the subjects across the different levels that are taught at different

stages of traditional curriculum (example anatomy, pathology and surgery can be linked by vertical integration) bridging the gap between pre-clinical and clinical subjects Therefore, vertical integration can help building student's capacity for clinical correlation of basic knowledge<sup>8</sup>.

In India where largely traditional curriculum is followed, integrated teaching is still at nascent stage. At K. J. Somaiya Medical College where largely traditional curriculum is followed, we conducted a pilot study on introduction of vertical integration in first year of medical curriculum. The over-all goal of this study was to evaluate the impact of vertical integration on student's learning as well as retention of physiology concepts in comparison with present traditional teaching. The present study had following objectives:

- Develop integrated learning modules for selected physiology topics for first year M.B.B.S students
- Observe the effect of vertical integration on performance of students
- Compare the results of vertical integration with traditional teaching

- Compare the retention of knowledge as stimulated by vertical integration to that by traditional teaching.

**Material and Methods:** The present study is open labelled, nonrandomized controlled; cross-over intervention study conducted in first year M.B.B.S students. The inclusion criterion was all first year M.B.B.S. The exclusion criterion was non-consenting students. Therefore consents were obtained prior to beginning of the study through consent forms. The entire batch of 50 students was divided into two groups based on their class roll numbers. Roll numbers 1-25 were group A and 26-50 were group B. The institutional ethics committee approval was taken at the beginning of this study.

Study materials included were integrated modules and pre-test, post-test and repeat post – test.

**Integrated Modules:** After a meeting with senior faculty from physiology, pathology and medicine, two topics from endocrinology were selected for vertical integration. After few more meetings two integrated modules on selected topics ‘thyroid’ and ‘pancreas’ were developed. These modules integrated contents from Physiology, Pathology and Medicine and were to be taught by respective faculties together. One faculty from each discipline was appointed to participate in integrated teaching via prepared modules. Teaching schedule was designed in such a way that students were not pre-exposed to selected topics.

Each module had two parts. Part 1 included the ‘basic physiology’ of the topic and Part 2 had ‘pathology’ section that included related pathology with investigations and a ‘medicine’ section that had related clinical and applied. At the end of each module there were few short clinical cases meant to be discussed in the class.

**Pre-test, Post-test and Repeat post –test:** Two Tests on selected topics were designed. Each test comprised of objective closed ended questions in form of multiple choice questions, true-false and also few open ended short answer questions. The questions were graded till higher levels of cognition. The maximum marks for each test was 20. The test questions were pre-validated by two physiology experts. Before conducting the actual test, pilot testing in few students from second year was done. The questions were modified as per results of pilot

testing. The same set of questions was used for pre-test, post-test and repeat post-test. Repeat post-test was conducted three months after the post-test.

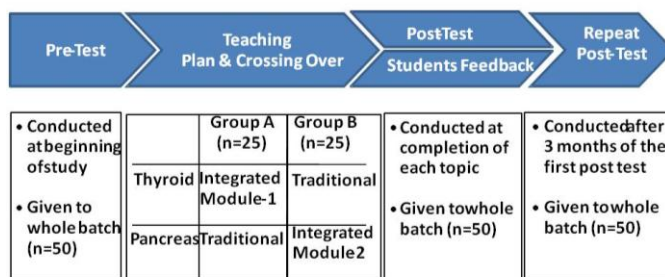
As part of the study design, two selected topics from endocrinology, namely thyroid and pancreas, were taught to two groups of 25 students each, using vertical integration and traditional methods. In integrated approach, faculties from Physiology, Pathology and Medicine taught together using integrated modules; whereas traditional approach included usual didactic lectures in Physiology. Both traditional and integrated teachings on each topic were of same duration of 3 hours each and both were divided into two sessions of 1.5 hours each. Each session was taken on two consecutive days. First, ‘Thyroid’ was taught to group A by vertical integration method and to group B by traditional method. Thereafter, for ‘Pancreas’, the groups were crossed-over, that is the group A that earlier received integrated teaching for Thyroid, now received traditional teaching for ‘Pancreas’ and vice-versa.

To evaluate the impact of two approaches on students’ learning, a series of cognitive tests were conducted; pre-test at commencement of the study, post- test at the completion of teaching on every topic<sup>9</sup>. Retention of knowledge by each method was assessed by a repeat post- test after 3 months of the post- tests<sup>10, 11</sup>.

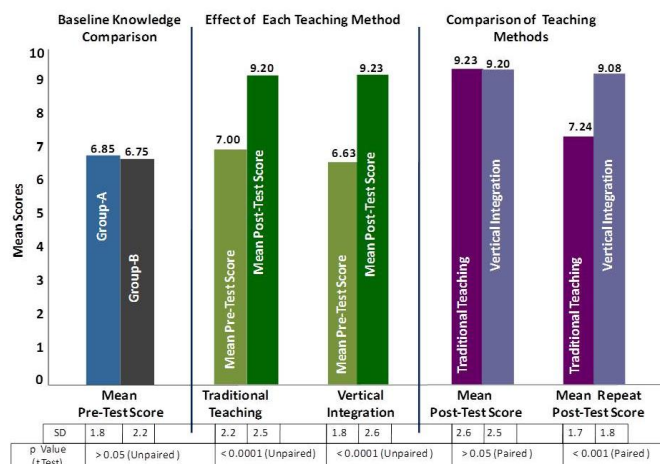
Data analysis was done by comparing means test scores in integrated and traditional group. Since this was a non-randomized study, the comparability of the two groups was established at the beginning of the study by comparing the mean pre-test scores of group A and group B by using unpaired student’s t test. Learning in each group was assessed by comparing pre-test and post-test scores of both integrated group and traditional group using unpaired student’s t test. Comparison of traditional and integrated approaches was evaluated by comparing the mean post-test scores of the two groups by applying unpaired student’s t test. Retention of knowledge in each group was accessed by comparison of mean repeat post-test scores of the two groups by paired student’s t test.

**Results:** All students took a pre-test for both the topics before beginning of the study, post-test at the completion of each topic and repeat post-test after 3 months of each post-test. The mean pre-test scores in Group A were  $6.85 \pm 1.8$  and group B was  $6.75 \pm 2.2$  respectively as shown in figure 2A. This difference in scores of the two groups is statistically insignificant by unpaired t test. The results from two topics were combined (Fig 1). The vertical integration group included group A (topic 1) + Group B (topic 2) while traditional group had group B (topic 1) + group A (topic 2). The mean post-test score in integrated group improved significantly from  $6.63 \pm 1.8$  (pre-test score) to  $9.23 \pm 2.6$  (post-test score;  $p < 0.005$ ) while in traditional group also it improved from  $7 \pm 2$  (pre-test score) to  $9.2 \pm 2.5$  (post-test score;  $p < 0.005$ ) as shown in figure 2B. The mean post test scores in vertical integration group was  $9.2 \pm 2.6$  and in traditional group was  $9.23 \pm 2.5$  as given in figure 2C. The difference in two groups was statistically insignificant by paired t test ( $p > 0.05$ ). However the mean repeat post-test scores were  $9.08 \pm 1.8$  in integrated group and  $7.24 \pm 1.7$  in traditional group, shown in figure 2C. This difference was highly significant by paired t test ( $p < 0.001$ ).

**Figure 1: Study design and Implementation**



**Figure 2: Analysis of test results**



**Discussion:** Learning physiology in traditional medical curriculum is mostly passive and lecture based. Educational content devoid of clinical relevance is delivered to students without their active involvement<sup>12</sup>. This leads to learning that is superficial<sup>13</sup>. Moreover, no training to learn application is imparted in traditional curriculum<sup>14</sup>. Therefore, knowledge acquired by students is quickly forgotten and is not retrieved easily when required. Theoretical knowledge even if retained, is seldom applied for patient care due to lack of clinical-correlation skills<sup>15</sup>.

Retention of basic science information has always been a major concern in undergraduate medical education. Basic science education has been criticized enough in past for unreasonable large factual material lacking clinical relevance, a laxity towards practical application of basic science knowledge to clinical setting and use of passive lecture based teaching- learning methods<sup>16, 17, 18, 19</sup>. Since then considerable changes in basic science instruction have taken place worldwide. Many schools have transitioned from traditional, discipline-based curricula to a more integrated approach to ensure holistic and meaningful learning.<sup>20</sup>

In India, traditional curriculum is followed in majority of medical colleges. There are only few medical colleges that have introduced integrated learning programmes to enhance clinical learning<sup>9, 21</sup>.

Our study is a pilot study that introduced vertical integration in first year of medical curriculum to evaluate and compare the effect of vertical integration with that of traditional learning. We also compared the knowledge retention in both the groups. To find efficacy of each of the methods we compared average pre-test scores with average post-test scores in each group. It was found that both methods are effective as both increase the post-test scores significantly. To compare the efficacy of vertical integration with traditional method, the average post-test scores of both the groups (taken immediately post-intervention) were compared and it showed no statistically significant difference (by unpaired t test,  $P > 0.05$ ), suggesting that vertical integration may be at par with traditional method in short term. However, when we compared retention of knowledge after 3 months in both groups by

comparing repeat post- test marks of the two groups it was found that students obtained statistically significant higher marks when taught by integrated method compared with the traditional method ( $P < 0.001$ ), implying that vertical integration is more effective as compared to traditional teaching in long term as it leads to better retention of knowledge.

Unlike our study which is a comparative study comparing integrated with traditional teaching, a literature search shows that most of the studies on integrated teaching like Brynhildsen J et al or Dhale LO et al<sup>22, 23</sup> are non-comparative studies. The effectiveness of the intervention in these studies is determined by students and teachers feedbacks and perceptions. In all previous studies most of the students and teachers have rated integrated teaching good to excellent. Vyas R et al<sup>9</sup> have also done student assessment in addition to perceptions where 96% students have obtained more than 60% marks in formative (for problem-based learning sessions) and average score was 62% in summative assessment (knowledge tests). The findings of our study on perceptions of students are consistent with previous studies where students have rated integrated teaching better than traditional teaching.

The most influential work on retention test was started by Hermann Ebbinghaus in 1966. He described knowledge retention in terms knowledge attrition or decay after varying retention interval (RI)<sup>24</sup>. Hence 'Ebbinghaus' curve of forgetting,' came into being. We have not found any comparative study on integrated teaching where retention of knowledge is tested and compared with traditional teaching. However there are a number of studies where retention of knowledge is tested after a course or an educational intervention. These studies have tested retention by using knowledge retained after RI instead knowledge attrition. Jay Silverberg et al<sup>10</sup> have compared knowledge retention by lecture format with small group interactive teaching in a CME. Knowledge retention was assessed by comparing multiple choice test scores on a pre-test, a post-test and a follow-up test taken 3 months after the educational intervention. Francis J Real et al<sup>11</sup> tested retention of a new paediatric nutrition curriculum in second year medicine students using test scores of pre-test, post-test and repeat test at 4 months. Our study design is similar to Jay Silverberg et al<sup>10</sup> and we found that retention of knowledge

with RI of 3 months is much better with vertical integration as compared to traditional teaching. This result is not consistent with Silverberg study as they found scores in lecture format were slightly better, though the difference was not statistically significant.

Vertical integration may require lots of efforts in terms of planning, organizing and execution. But the results of our pilot study have been rewarding. Retention of basic science knowledge and its application that has always been considered a challenge in medical curriculum can be resolved to some extent by introducing vertical integration right from the first year of medical curriculum. Changing whole traditional curriculum into integrated may have feasibility issues. Instead, vertical integration can be interspersed with traditional curriculum by vertically integrating few clinically relevant topics to begin with. And knowledge retention over longer retention period can be tested in future studies.

**Conclusion:** Vertical Integration is a useful teaching-learning methodology for first year medical students. It leads to better retention of knowledge as compared to traditional teaching. This may improve skills to correlate basic knowledge clinically in long-term. Hence vertical integration can be used along with traditional curriculum in first year of medical curriculum.

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