

RESEARCH ARTICLE

Application of horizontal integration module within traditional teaching to enhance active learning of first year allied health science students

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ABSTRACT

Background: Allied health science (AHS) courses in India include degree, diploma, and certificate courses in various disciplines that support the practice of medicine to make the health-care team function efficiently as they provide assistance in the laboratory, technical, and other support services. Many of the AHS courses have basic medical sciences that are taught in a compartmentalized manner as traditional method. However, horizontal integration module is not included for AHS. **Aims and Objectives:** The objective of this study was to analyze the performance of the 1st year AHS students to the application of horizontal integration as a small module within traditional teaching in physiology. **Materials and Methods:** Thirty-three students underwent 12 lectures in physiology in the topic of “*The Gastrointestinal Tract (GIT)*” in a traditional teaching method of didactic lectures. The students then had an interactive 2-h horizontally integrated modular session on “*Biochemical principles of diet-nutrition.*” The interrelated topic from biochemistry and physiology was incorporated as horizontal integration. The students’ performance was assessed with a pre-test and post-test, structured viva voce in diet-nutrition and a traditional viva voce in the traditionally taught GIT topic. **Results:** The results showed that the post-test mark was higher than the pre-test mark; the performance of students who scored <60% termed as average and below-average students with 50%: Being cutoff for passing in health professions education in India improved in the structured viva voce in diet-nutrition when compared to traditional viva voce in GIT. **Conclusion:** We conclude this integrated module demonstrated enhanced learning performance of students with high scores in post-test, the better performance in the structured viva voce showing improved understanding and learning ability.


KEY WORDS: Allied Health Science Courses; Preclinical Subjects; Horizontal Integration; Traditional Teaching; Enhanced Learning

INTRODUCTION

Allied health science (AHS) courses in India include degree, diploma, and certificate courses in various disciplines that support the practice of medicine to make the health-care team

function efficiently.^[1,2] These AHS professionals contribute to the diagnosis and management of patients at all levels of specialties as they provide assistance at the level of laboratory, technical, and other support services.

In the class, lectures are usually highly didactic in a traditional mode with bare variations in teaching methodologies. AHS professional education is provided to train students of various health-care branches that include laboratory sciences, physical therapy, occupational therapy, neuroelectrophysiology, dietetic services, audiology and speech-language pathology, physician assistant, and several technology courses.^[3,4]

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Many of the AHS courses have basic medical sciences or pre-clinical subjects before embarking on the core allied health specialization topics. This comprises subjects such as anatomy, biochemistry, and physiology that are taught in a compartmentalized manner as is done in the traditional method, often without integration.

In our college, while scheduling and drawing time table for AHS class teachers have noted the difficulty in standardization of teaching for AHS courses as many courses are clubbed together for pre-clinical subjects for a standard number of classes in spite of varying requirements. In the Indian context, most of the AHS courses are technical in nature. Hence, it is also expected that students should learn more from an “apprenticeship model” environment rather than a structured, planned teaching session with suitable methodologies. Teaching AHS students have been a challenge due to the overabundance of AHS courses offered today for many specialties.

In this model, the authors designed a module on the topic “*Biochemical Principles of Diet-nutrition*” which was seamlessly horizontally integrated into the traditional teaching of “*The Gastrointestinal Tract (GIT) of physiology*.” It is termed as horizontal integration because biochemistry, diet-nutrition, and clinical scenarios were integrated with physiological principles. The diet-nutrition principles and GIT functions are closely interrelated for the management of diseased conditions such as chronic gastrointestinal disease, cardiovascular diseases, and diabetes mellitus. The cause for 30% of death is due to inappropriate diet emphasizing the disease-modifying role of nutrition in many disease states.^[5-8] Therefore, knowledge of a healthy diet, calorific requirement in various physiological state, energy expenditure, energy balance, and growth and maintenance of the body is essential and needs to be taught in the classroom so as to ensure that the learning is relevant and contextual.

The AHS students were selected from four bachelor degree courses, namely, Physical Therapy (BPT), Occupational Therapy (BOT), Medical Laboratory Technology (BSc MLT), and Neuroelectrophysiology (BSc NEP) based on their syllabus to integrate physiology and biochemistry in an interesting environment and to create an awareness of interrelated systems for health care for these students.

The horizontal integration method is not incorporated in the teaching schedule of AHS courses.^[9]

Horizontal integration principles have largely been incorporated already for medical students,^[10] nursing,^[9] and few AHS neurosciences course.^[11] Based on this that, the primary aim of the present study was to introduce horizontal integration of biochemistry principles of diet-nutrition with traditional teaching of GIT physiology with a structured, planned interactive session to make biochemical principles

active, useful, and appropriate in the teaching of the GIT for AHS students to enhance their learning performance.

The following objectives were considered.

1. To study the application of an interactive, horizontal integration-based method along with traditional teaching
2. To assess the AHS student performance after the application of horizontal integration in a milieu of interactivity with pre-test and post-test, structured and traditional viva voce method
3. (a) To analyze students’ performance because the student population is diverse in terms of academic background and area of study and (b) analyze student performance in terms of student quartiles to see if the intervention helps those students who have struggled to improve academic performance.

MATERIALS AND METHODS

The study was carried out with the permission from the Institutional Review Board and Ethics Committee (IRB Min No. 10829, dated 23-08-2017), Christian Medical College (CMC), Vellore, South India.

Participants and Sample Size

Thirty-three students ($n = 33$) from our institution (CMC) who were undergoing the following AHS bachelor degree courses, namely, BPT, BOT, BSc MLT, and BSc NEP were inducted into the study. Informed written consent was taken from the students. The sample size of this study revealed that the total intake of students for each course was limited for this college.

Design of Integrated Module

We planned to introduce horizontal integration between physiology and biochemistry for the 1st year AHS students. Consequently, the teaching program was separated into two sections. The initial section was conducted according to the prepared schedule in physiology which traditionally included physiology lectures in the topic GIT. These students attended 12 lectures in physiology in the topic “GIT,” each lecture being of 1 h duration. The subtopics that were covered in the lectures were as follows: Introduction to GIT (1 h), glandular secretion (3 h), motility of GIT (1 h), digestion and absorption (4 h), gastrointestinal hormones (1 h), and the pathophysiology of GIT (2 h). Lectures were conducted as traditional didactic sessions using a blackboard and PowerPoint presentations.

The second section was designed as an integrated interactive module of 2 h duration which included biochemistry sessions based on “*Biochemical Principles of Diet-nutrition*” facilitated and moderated by a faculty of biochemistry after the didactic lectures in GIT in physiology were completed. The biochemistry sessions were seamlessly integrated into

physiology with prior planning and preparation by faculty involved in taking these sessions. This was conceptualized as a feasible module which could be aligned within the constraints of a rigid traditional curricular structure.

Study Setting

The 2-h integrated module was designed and implemented after the traditional GIT lectures in physiology to integrate biochemical principles into physiology to pique inquiry, motivation, and learning in students using interactive components within the session such as interpretations of case vignettes, interactive two-way questions, problem-solving tasks and calculations to elicit relevant nutritional indices, narration of experiences, and buzz groups where the students are subdivided into small groups, consist of three in a group which would responded to specific question or developing (involving) a task.

These were designed to build on existing knowledge and provide a platform for learning with appropriate explanations from the teacher.

The following were the various interactive activities used within the class so as to elicit interaction between the teacher and students to understand concepts in an integrated manner relevant to the physiology of the GIT:

- a. Case vignettes or clinical cases used to measure students' knowledge and clinical reasoning at the beginning of the session and during the session to elicit critical thinking and analysis of commonly encountered health problems associated with nutritional deficiencies and pathophysiology to create an interest and an inquiry-based environment
- b. Problem-solving exercises or problem-based learning that involved describing case scenarios, with interactive questions to tap into critical thinking and comprehension of knowledge where two-way interactions, discussions and questions were actively encouraged between students and teachers
- c. Calculation of values relevant to nutrition used as common indices for nutritional interpretations in health and disease such as basal metabolic rate, body mass index, and waist-hip ratio to enhance understanding of the application of nutritional principles in real-life settings
- d. In addition to sharing of experiences by the facilitator, students were encouraged to share personal experiences of health issues experienced among family and friends to build a rich narrative into the class and were enthusiastically participated in, (facilitator was the faculty of biochemistry who handled biochemistry diet-nutrition integrated section)
- e. Buzz group sessions are a small, intense discussion group usually involving to three persons who were used to evolve concepts using the above exercises to encourage peer-to-peer sharing and communications.

Student Assessment and Data Collection

- a. Students were assessed using a formative pre-test and post-test to analyze their understanding of concepts. The pre-test and post-test consisted of written examinations in the form of short answer questions and multiple-choice questions
- b. A structured oral viva voce in diet-nutrition was administered for the integrated biochemistry sessions to assess the understanding of concepts which ensured that all students were assessed objectively with the same set of questions. The structured viva voce consisted of a prior prepared list of questions on the topic diet-nutrition with the key for these questions agreed upon by two faculties from the specialty biochemistry. The prepared questions and keys for the questions were used to mark each student for a total mark of 10. The time allocated for each student was a specific time period of 5 min for the structured viva voce to ensure uniformity of time allocation. This was done to build in objectivity and reliability into the assessment tool.

A traditional viva voce was conducted for all students in the topic GIT for 5 min for a total mark of 10 (which was usually done as a regular assessment procedure) where there was no specified prior prepared questions or pre-prepared answers. This is the disadvantage usually noted in traditional method of viva voce where a subjective bias distorts the marks obtained due to it being unstructured as the questions asked and marks given by the assessor are highly subjective and not comparable between students.^[12] To avoid this, structured viva voce uses pre-prepared questions and assessor allotted mark distribution method would be more objective to avoid the bias between the students.^[13]

The rationale for using a viva voce as an assessment tool: It was known that the general strength of using a viva voce as an assessment tool is its ability to explore the depth of knowledge in a subject.^[14] However several times, it has been shown to be an unreliable assessment tool due to the subjectivity and variations involved in this method. Hence, we devised the structured viva voce format in the integrated module diet-nutrition so that the in-depth exploring of knowledge through assessment in a viva voce could be reliable and objective and relatively standardized for all students.

Analysis Methods

Statistical analysis was done using the paired Student's *t*-test. The values of the results were expressed as mean and standard deviation with $P < 0.05$ considered as statistically significant, $n = 33$.

RESULTS

The student details of the four courses involved in the study were shown as AHS bachelor degree courses, namely, BPT,

BOT, BSc MLT, and BSc NEP with gender distribution who were inducted into the study, as shown in Table 1 ($n = 33$).

The pre-test (plain bars) and post-test marks (grid bars) of all individual students from BOT, BPT, BSc MLT, and BSc NEP were compared. The post-test marks were significantly higher than pre-test marks, $n = 33$ [Figure 1].

The stacked column plot shows marks of students in percentage ranging from 0 to <25 (black stack); 25 to <50 (striped stack); 50 to <75 (gray stack); and 75 to 100 (white stack) in the structured viva voce of diet-nutrition and the traditional viva voce for GIT. In the structured viva voce, a greater number of students scored between 50 and 75 and none of them got <50. Whereas in the traditional viva voce of GIT, three students scored <50%, especially in BSc MLT (2) and BSc NEP (1) courses, $n = 33$ [Figure 2].

Table 1: Demographic details of AHS students of four courses involved in this study

Courses	Student's details		Gender	
	Total number of students	Students participated in the study	Male	Female
BOT	10	9	2	7
BPT	10	8	1	7
BSc MLT	12	12	7	5
BSc NEP	5	4	1	3

AHS: Allied health science

DISCUSSION

The student details of the four courses involved in the study were shown as AHS courses, namely, BPT, BOT, BSc MLT, and BSc NEP with gender distribution who were inducted into the study, as shown in Table 1 ($n = 33$). The assessment tools used for this study included marks obtained from the pre-test and post-test in the integrated component; structured viva voce from diet-nutrition and a traditional viva voce in GIT made a balanced way of assessment of the cognitive domain enabling exploratory assessment of knowledge in the higher cognitive domains too. The pre-test and post-test marks of all individual students from all four courses were compared. The post-test marks were higher than pre-test marks [Figure 1]. The authors opted for a viva voce as an assessment tool in this study, with the structured viva voce for the integrated module for “biochemical principles in diet-nutrition” and the traditional viva voce for “GIT of Physiology.” This assessment tool proved to be a good choice to explore and clarify concepts of learning enabling the faculty to understand gain of knowledge by the students. The comparison of marks between the structured viva voce of diet-nutrition and the viva voce of the traditional GIT of all individual students is shown in Figure 2. The performance of most students in the viva voce examination in diet-nutrition and traditional viva voce showed excellent performance. The performance scores of structured and traditional viva voce of all courses revealed that average and below-average students especially seemed to have benefited from the integrated module class, as the scores in the diet-nutrition viva were more than 60% marks while viva voce in the topic GIT showed a larger variation

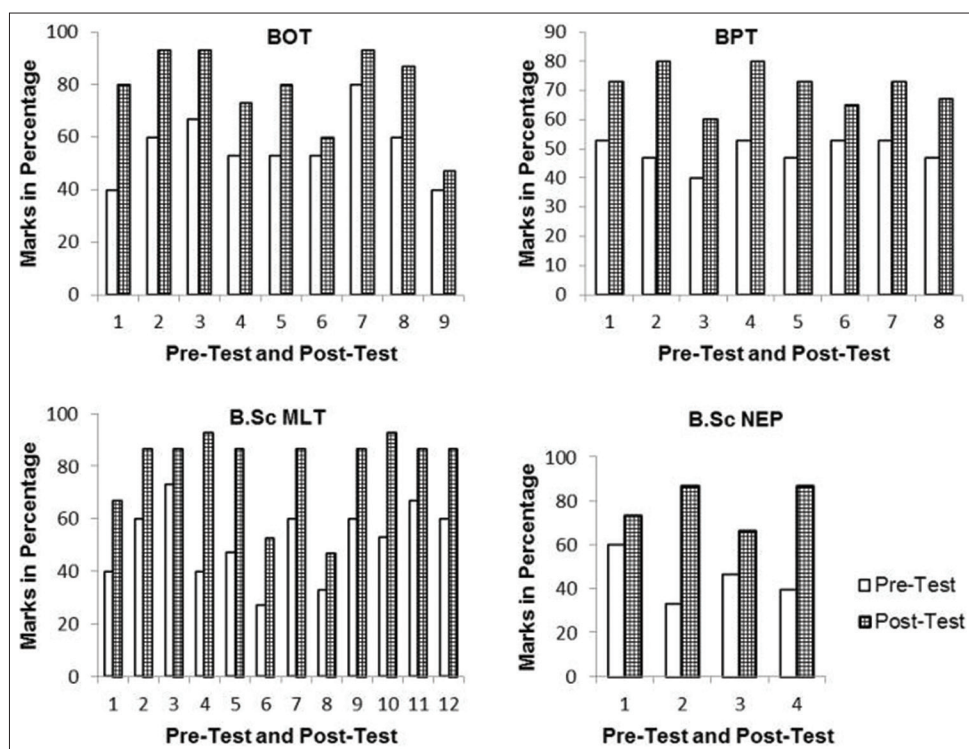


Figure 1: Comparison of pre-test marks with post-test marks

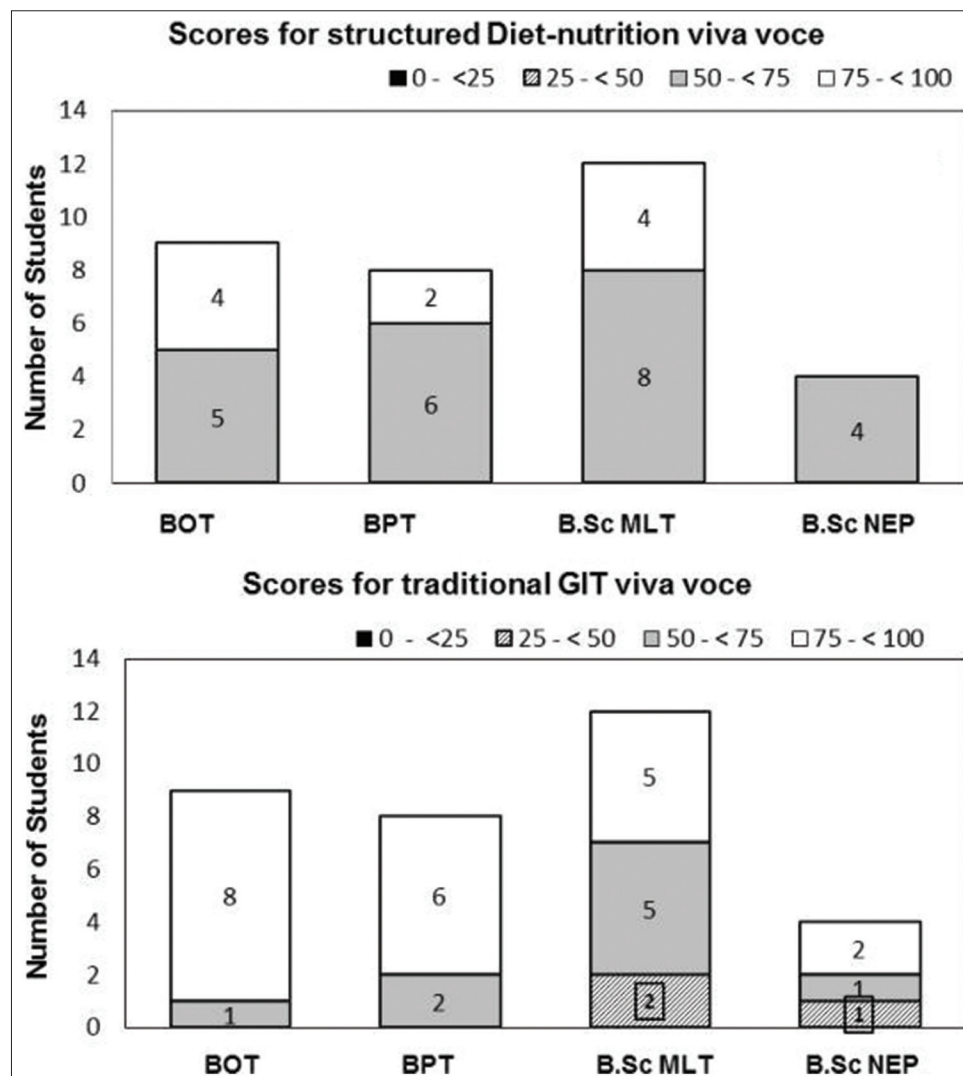


Figure 2: Stacked column plot scores for structured viva voce of diet-nutrition and traditional viva voce of gastrointestinal tract

across other percentage ranges. The performance of students' who scored <60% with 50% being cutoff pass mark and students who scored <50%, especially from the BSc MLT and NEP courses showed significant improvement in the structured viva voce in diet-nutrition when compared with the traditional viva voce in GIT [Figure 2]. This fact was very encouraging as the module seemed to benefit weaker students who were in the average (<60% but more than 50%) and a few who scored in the below-average category (<50%) in the traditional viva voce for the traditionally taught GIT topic. These students moved into a better performance category of above average (more than 60%) and average (<60% but more than 50%) in the integrated module.

This study focused on a combination of traditional teaching and an introduction of a new horizontal integrated module aimed to integrate physiology^[12-14] and biochemistry^[15-17] for a useful outcome. Studies have shown that small group teaching with discussions, clinical videos have enhanced the students' attention, involvement, and interaction during a discussion session.^[18,19] Hence, it is important to choose different

methods that would enhance self-regulated learning.^[20,21] It is difficult to do away with the traditional scheduled teaching methodologies and in a curriculum, where traditional modes of teaching and delivery of instructions are popular and practiced, especially for AHS courses. Hence, introduction of a feasible, integrated module enabled to deliver the beneficiality of integration in a tight, strict time-bound traditional curriculum. This made both types of methods, traditional and integrated essential to make learning more meaningful, relevant, and contextual for AHS students learning. Since these 1st year AHS students joining for AHS courses have only recently completed their schooling from final year of secondary school otherwise termed as the 12th grade, these professional courses require intense time allocation for studying where students sometimes found it difficult to find a balance between curricular and extracurricular activities within a strict traditional curriculum.^[22-24] Students' skills in understanding and learning the concept of basic medical sciences would improve if they are introduced to several learning methods designed as strong components within the restricted traditional modes of teaching. Therefore, teachers have been

using various methods of teaching to introduce interactivity in large classrooms such as buzz group discussions to enhance attention span, promote discussion, bringing out individual group leaders, and enhancing peer interaction which has shown to help the students to understand the subject better.^[18] Studies have shown that tailoring teaching methods to the visual-auditory-kinesthetic learning styles of students when compared with traditional styles have helped students receive information better and in a systematic manner.^[19,25] This study demonstrates an improvement of cross-sectional learning of students from multiple disciplines of AHS stream. Hence, it is suggested that horizontal integrated planning by faculty in basic science streams in a rigid traditional curriculum would not only allow interdepartment interaction but would also achieve the desired learning outcomes. We also propose that these small integrated modules could be started from the 1st year teaching for all other AHS courses, most of which are carried out within rigid traditional curriculum.

The strength of this is traditional teaching, made interactive with horizontal integration, could largely benefit average and below-average students, and helped in moving them into performing better. Some of the limitations of this study are the planning and meeting of basic medical sciences teachers to design a better workable module which could have taken the integration to a higher plane. The successful implementation of horizontal integration with active learning components depends on many factors such as number of teaching faculty required, mandatory time for planning the schedule to align the components of different subjects' better, conception of more modules, and designing activities. The authors realize that more number of such modules could have been extended into other topics as well, but due to feasibility issues, we could successfully implement this module.

CONCLUSION

This study concluded that the application of horizontal integration in an environment of high interactivity between the subjects of biochemistry and physiology enhanced the performance of learning for the 1st year AHS students. It particularly helped average and below-average students who were not performing well but seemed to have responded in their learning outcomes with the help of a small integrated module designed carefully to improve learning with interactivity enhancing activities. We propose that integration could be done at any year of study and level of subjects either as a large or a small module. This was successfully done with proper planning and dedicated time allocation, coordination, and aligning of subject matter from teachers of both subjects.

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