

RESEARCH ARTICLE

Innovation in teaching-learning methods with an effective application of adult learning principles for the first year of allied health science courses

Silviya Rajakumari Jared¹, Minnie Faith², Dhayakani Selvakumar³, Rashmi Vyas⁴

¹Department of Physiology, Christian Medical College, Vellore, Tamil Nadu, India, ²Department of Family and Community Medicine, School of Medicine and Health Sciences, University of North Dakota, North Dakota, USA, ³Department of Medical Education, Christian Medical College, Vellore, Tamil Nadu, India, ⁴Foundation for Advancement of International Medical Education and Research, A Member of Intealth, Philadelphia, Pennsylvania, USA

Correspondence to: Silviya Rajakumari Jared, E-mail: silviyajared@cmcvellore.ac.in

Received: December 20, 2022; Accepted: January 13, 2023

ABSTRACT

Background: In Indian context, most of the allied health science (AHS) courses are taught using an “apprenticeship model” rather than, structured, planned teaching methodologies. **Aims and Objectives:** This study was focused to reform the teaching methodology guidelines for faculty, to afford enthusiastic learning of AHS students in the classroom environment and evaluating their performance through formative and summative assessments. **Materials and Methods:** AHS students from Christian Medical College, Vellore, India ($n = 33$) were inducted into the study. The traditional lectures for gastro-intestinal tract were completed by physiology faculty. The diet-nutrition topic was chosen for horizontal integration between physiology and biochemistry subjects. This integrated module was handled by one of the biochemistry faculty and sessions were observed by two other faculties as observers from departments of physiology and biochemistry. The observers followed the guidelines to evaluate the teaching methodology through prevalidated checklist using a modified Likert scale. The degree of agreement between two observers was determined using Cohen’s kappa statistics. The students’ performance was evaluated with students paired “t” test for written test and viva voce marks based. **Results:** The results demonstrated that the inter-rater reliability calculated by the observers for teaching methodology on integrated session of the biochemistry faculty was significant with a score of 93%, with total criterion score of 28 and a matched criteria score of 26. As well this proves an improvement in the students’ learning process, evidenced by better performance in the post-test and structured viva voce. **Conclusion:** The new innovative teaching methods exercised by the faculty, demonstrated enhanced performance of the students with horizontal integration, proving the robustness of this module.


Key words: AHS Students; Teaching; Learning; Methodologies; Pre-clinical Subjects

INTRODUCTION

The training of allied health science (AHS) students has an inclusive role in health care system, as they provide assistance by forming an effective team with the physicians

in the diagnosis of diseases and management of patients at all levels of specialties.^[1-3]

Teaching AHS students have been a challenge due to the plethora of AHS courses offered today. Teachers have noted the difficulty in standardization of teaching for AHS courses as many courses are clubbed together for pre-clinical subjects in spite of varying degree of requirements. As many of the AHS courses are technical in nature, it is also expected that students should learn more from an environment of “internship model” than of structured, planned teaching with suitable methodologies.

Access this article online	
Website: www.njppp.com	Quick Response code 
DOI: 10.5455/njppp.2023.13.01005202313012023	

National Journal of Physiology, Pharmacy and Pharmacology Online 2023. © 2023 Silviya Rajakumari Jared *et al.* This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), allowing third parties to copy and redistribute the material in any medium or format and to remix, transform, and build upon the material for any purpose, even commercially, provided the original work is properly cited and states its license.

In the current scenario, a medical college or university in addition to training medical students also trains nursing and a large number of AHS students. As a medical college expertise, it is also significant to note that in India, the basic-science/pre-clinical subjects' framework for AHS students is similar to preclinical syllabus of the 1st year medical students and the nursing students. In such a system, it is important to pay close attention to develop classes for AHS students, similar to current curriculum for medical students.

At recent commencement, the medical education department which serves under the direction of National *medical* commission has put forth guidelines for faculty to explore enhanced teaching methods for medical and nursing courses by conducting compartmentalized workshops and conferences. However, lectures for AHS students are still highly didactic without any variations in teaching methodologies. Hence, to fill this gap and ameliorate, we planned to introduce structured, interactive and integrated trigger-based modules to teach AHS students similar to those employed for teaching medical,^[4,5] nursing,^[6] and few other AHS students.^[7,8]

The AHS students were selected from four bachelor's degree courses namely bachelor of physical therapy (BPT), bachelor of occupational therapy (BOT), bachelor of science-medical laboratory technology (B.Sc., MLT), and bachelor of science-neuro electrophysiology (B.Sc., NEP) based on their syllabus, and a module was designed to integrate biochemistry and physiology in an attempt to take cognizance of the interrelationships in the health care system.

Aims and Objectives

The aim of this study was to reform the teaching methodology guidelines for faculty, to afford enthusiastic learning of AHS students for improving better permanence in their assessments.

The following objectives were considered

1. To introduce an innovate teaching methodology guidelines for faculty
2. To creative a horizontal integration model of basic science subjects (physiology and biochemistry) to explore knowledge for enhanced understanding of concepts studied or discussed
3. To foster enthusiastic learning environment of students to perform better in the formative and summative assessments.

MATERIALS AND METHODS

The study was carried out at Christian medical college (CMC), Vellore in India after being approved by the institutional review board and ethics committee (IRB Min No. 10829, dated August 23, 2017), CMC, Vellore, India. (Statement of

ethics committee permission mentioned as, we approve the project to be conducted as presented).

Students of AHS bachelor's degree courses namely BPT, BOT, B.Sc., MLT and B.Sc., NEP were inducted into the study after obtaining a written consent from the students. Thirty-three students ($n = 33$) participated in the study.

Tutoring Design

The authors designed a module on the topic, "The Physiology of gastro-intestinal tract (GIT) and the biochemical principles of diet and nutrition" to innovate teaching-learning process in the class room environment. In this model, three faculties were involved, of which, two were from the department biochemistry and one from the department physiology, CMC, Vellore. The traditional lectures for GIT had completed by physiology faculty. One of the biochemistry faculties handled the integrated session, teaching physiological and biochemical aspects of diet and nutrition to the AHS students by applying horizontal integration and employing various preplanned triggers in the class [Table 1]. Two faculty, one each from the departments of physiology (who handled the physiology of GIT for 12 h) and biochemistry were nominated to observe the session.

Checklist for observers feedback [to evaluate based on Table 1]. The purpose of this checklist was, for the observers to observe the innovative teaching learning program and report their observation, about the application of the adult learning principles in the teaching-learning process.

The two observers were asked to evaluate the teaching sessions of the faculty with a pre-validated checklist using modified Likert scale.^[9]

The Following Objectives were given to the Observers

1. Kindly rate items given below
2. The checklist provided to the observers for rating various aspects of the interactive class is given in Table 1. The seven themes included were - (1) activate prior knowledge-learning built on previous knowledge and experiences; (2) create a safe and non-threatening environment; (3) elicit active participation; (4) relevant learning; (5) problem solving; (6) constructive feedback; and (7) presentation skills of the teacher.

Use the following rating scale:

1 = Never, 2 = Seldom, 3 = Sometimes, 4 = Usually, and 5 = Always.

3. Calculate the inter-rater reliability using Cohen's kappa statistics analysis.
4. Evaluate the students' performance: Statistically compare students' performance in written tests marks with pre-test and post-test as well a traditional viva voce in GIT

Table 1: The checklist provided to the observers with rating scale

Themes	Item No.	Checklist for observers	Rating scale				
			1	2	3	4	5
Theme 1: Activate prior knowledge-learning built on previous knowledge and experiences	1	The teacher provided an opportunity to the students to share what they already knew about the topic					
	2	The teacher allowed the students to draw on their previous experiences with the topic					
	3	The teacher asked probing questions to the students to elicit prior knowledge on the topic					
	4	The teacher used a variety of teaching learning methods to activate prior knowledge of the students in the topic					
Theme 2: Create a safe and non-threatening environment	5	The class was conducive to active participation from the students					
	6	The teacher encouraged the students to ask questions					
	7	The teacher encouraged the students to respect each other’s views during discussions and question answer sessions					
	8	The teacher addressed different student learning styles by using a variety of teaching learning methods					
Theme 3: Elicit active participation	9	The teacher provoked interest about the topic in the students at the start of the class					
	10	The teacher asked questions to the students					
	11	The teacher actively engaged the students in the class discussion					
	12	The teacher used different teaching learning methods to elicit active participation					
Theme 4: Relevant learning	13	The teacher shared the written specific learning objectives for the topic with the class					
	14	The content presented by the teacher was relevant to the class of students (*BPT, BOT, BSc MLT and BSc Electro neurophysiology)					
	15	The content presented by the teacher was adequate to pass the formative and summative assessment					
	16	The teacher encouraged relevant student discussion around the topic					
Theme 5: Problem solving	17	The teacher presented opportunities and challenges to motivate interest in the topic					
	18	The teacher supported the students to learn by providing a choice of problem solving tasks					
	19	The teacher enabled the students to move to a higher level of cognitive domain					
	20	The teacher used problems as triggers to explain the concepts					
Theme 6: Constructive feedback	21	The teacher gave appropriate and relevant feedback to the students about their participation in problem solving group activities					
	22	The teacher gave appropriate and relevant feedback to the questions asked by the students					
	23	The teacher gave appropriate and relevant feedback to the answers given by the students for teacher asked questions					
	24	The teacher gave appropriate and relevant feedback to student centred discussions					
Theme 7: Presentation skills of the teacher	25	The teacher used nonverbal cues such as eye contact, voice modulation and gestures effectively					
	26	The teacher explained the concepts clearly and effectively					
	27	The teacher used proper audio-visual aids effectively					
	28	The teacher summarized the main points at the end of the session					

The observers rated the innovative teaching learning program based on the themes and items using the checklist provided in the table

topic handled by physiology faculty and structured viva voce in diet-nutrition in integrated session handled by

biochemistry faculty. The students’ performance was evaluated by students paired “t” test.

Statistical Analysis

Statistical analysis was calculated by applying Cohen’s kappa statistics^[10] to calculate inter-rater reliability. A score of more than 80% was considered significant. The students’ paired “t” test was used for students’ performance in pre-test, post-test, and viva voce with traditional verses structured methods.

RESULTS

The degree of agreement between the two faculties revealed the inter-rater reliability (inter-rater agreement or concordance) as 93% [Tables 3 and 4]. The assessment methods used for the study included marks obtained in pre-test, post-test and the viva voce on the topic ‘diet-nutrition (Structured method) and GIT (Traditional method); The maximum and minimum marks are shown in the Table 2, Pre-test maximum mark (73%) was higher than mean pre-test minimum (27%). The post-test maximum mark (93%) was higher than the mean post-test minimum (40%). Minimum viva voce marks for both “diet-nutrition” and “GIT” were (50%) and (20%), respectively; (Maximum viva voce marks for both “diet-nutrition” and “GIT” were (90%) and (100%), respectively; [Table 2], (*n* = 33).

Table 2: The descriptive statistics provide the information about the assessment methods used for the students’ performance

Assessments (<i>n</i> =33)	Minimum (%)	Maximum (%)
Pre-test in diet-nutrition	27	73
Post-test in diet-nutrition	40*	93*
Viva-voce in GIT (Traditional method)	20	100
Viva-voce in diet-nutrition (Structured method)	50*	90

The minimum and maximum marks obtained in the pre-test and post-test; Viva voce from GIT (Traditional method), and Diet–nutrition (Structured method); the minimum and maximum of post-test were significantly higher than pre-test minimum and maximum marks. The structure viva voce minimum was higher than traditional method (*n*=33, the statistical analysis obtained by comparing second row with first row and fourth row compared with third row)

Table 3: Observers check-list under seven themes with four items, each was matched except in themes three and five

Theme	Rating scale of observers		Matched/Unmatched	No. of item matched
	I	II		
Theme 1: Activate prior knowledge-learning built on previous knowledge and experiences	4	4	Matched	4
Theme 2: Create a safe and non-threatening environment	4	4	Matched	4
Theme 3: Elicit active participation	5	4	Unmatched	3
Theme 4: Relevant learning	4	4	Matched	4
Theme 5: Problem solving	4	5	Unmatched	3
Theme 6: Constructive feedback	4	4	Matched	4
Theme 7: Presentation skills of the teacher	5	5	Matched	4

Checklist for observers showed various themes that were developed. Items were rated using the following rating scale: 1=Never, 2=Seldom, 3=Sometimes, 4=Usually, and 5=Always, [Refer Table 1 to check items]

DISCUSSION

In the present module, two faculty observers had observed the session for its effectiveness on employment of horizontal integration. They evaluated the methodology of faculty role in integration of biochemistry and physiology topics and level of interaction in the class using the checklist provided. They observed the innovative teaching-learning program and rated (using modified Likert scale, i.e., 1 = Never, 2 = Seldom, 3 = Sometimes, 4 = Usually, and 5 = Always) their observations, about the application of the learning principles in the teaching-learning process using the checklist provided. [Refer Table 1 for checklist]. The results of feedback of observer rated session on a modified Likert scale, are shown in Table 3. The inter-rater reliability calculated by Cohen’s kappa statistics and derived as was significant at 93%, with a total criterion score of 28 and a matched criterion score of 26 by the observers. Only themes three and five were unmatched because one item was rated differently by the observers [Table 4]. A significant inter-rater reliability value proved that the faculty incorporated numerous aspects of active learning principles with horizontal integration, which was the major strength of the program. The recommendations for improvement were also discussed with the faculty involved. The assessment methods used for the study, included marks obtained in the pre-test and post-test; marks obtained in viva voce of GIT and diet-nutrition [Table 2]. The post-test marks were significantly higher than the pre-test marks, indicating effective learning by the students, following introduction of this innovative module. The results of the study showed that the combination of physiology of the GIT (using traditional structured class) and biochemical principles of diet-nutrition using horizontal integration model was an effective and innovative teaching method that improved students’ performance. In addition, the marks of structured viva voce proved the elimination of bias in the students’ performance.

Our previous study revealed the advantage of adapting horizontal integration of basic medical science subjects of

Table 4: Calculation of inter-rater reliability with total and matched criteria by the observers

Inter-rater reliability	Observers score
Matched criteria score	26
Total criteria score	28
Inter-rater reliability score	93%

The Inter-rater reliability was calculated by Cohen's kappa statistics as 93%, with total criteria score (28) and matched criteria score (26) by the observers, considered as significant reliability, a score of more than 80% was considered significant

physiology and biochemistry for AHS courses. Definitely, such models would enable students to understand the comparative knowledge of subjects that will help them to explore in the clinical areas to manage the health-care system more efficiently.^[8] The present module was designed to bring about active participation of students using two-way question-answer sessions in which the faculty asked questions and created an interactive environment, while the students were also encouraged to ask questions at any point during the process of teaching in the class. The students were provided continuous constructive feedback throughout the session to clarify doubts, interpret and solve problems in an active and interesting manner. Furthermore, the previous studies have shown that small group teaching with discussions and clinical videos has improved the students' attention, involvement, and interaction during the discussion session.^[11] Hence, it is important to choose different methodologies to enhance self-regulated learning progression.^[12,13] This study revealed that both methods, traditional as well horizontal integrations were relevant and contextual learning methods for the students. Enriching teaching of AHS students with a well-structured interactive teaching module would help students to learn in a systematic and meaningful manner.^[14,15]

The strength of this study suggests that, employment of such innovative teaching modules would improve cross sectional learning of students from multiple disciplines of AHS course. The introduction of horizontal integration in the 1st year of AHS courses creates a sound foundation, which would help the students to handle information and curricular load in an integrated manner in the subsequent years. Hence, the integrated planning by faculty of basic science streams in a rigid traditional curriculum should be worked out to include inter-department interaction, to enhance desired learning outcomes. This would serve as a successful model that can be emulated in any traditional curriculum. We also propose that this small integrated module be employed from 1st year of teaching for all AHS courses.

The limitation of study design is as follows. It is essential to create integration of subjects for relevant understanding and successful execution of professional courses. The inclusion of horizontal integration with active learning components by faculty of basic-medical sciences requires dedicated time and man-power, in order to align the components of different

systems, conception of more modules and designing activities. The authors also realize the importance of creating a greater number of modules and could have included other topics as well. However, due to feasibility issues, we had restricted the implementation of this module to only a few of the topics. This was successfully done with proper planning, dedicated time allocation, coordination and aligning of subject matters from faculty of both subjects.

CONCLUSION

We have shown that the integrated module enabled the integration of knowledge, in physiology of GIT and biochemical principles of diet and nutrition, to form a cohesive knowledge core. This enabled the students to perform better in all the assessments. The innovation in teaching-learning processes improved performance scores among students. The marks obtained by the students showed that they were able to receive and process knowledge of the subjects in the milieu of horizontal integration where, problem solving using various triggers became a strong core, leading to a strong learning process. We accomplished that there is a need to upgrade teaching of 1st year AHS students with innovative teaching methodologies as outlined in this study, to afford enthusiastic learning of students in the classroom environment.

ACKNOWLEDGMENTS

We wish to express our gratitude to the CMC, Vellore, India, for providing an opportunity to carry out this work. We also place our thanks on record to the staff of medical education department for the clerical assistance, the students of Allied health courses from BOT, BPT, B. Sc MLT, and B. Sc neuro electro physiology for their consent and involvement in this study.

REFERENCES

1. Association of Schools of Allied Health Professionals. Available from: [https://www.asahp.org.what is allied health?](https://www.asahp.org.what%20is%20allied%20health?) [Last accessed on 2014 Mar 06].
2. Available from: [https://www.sruahs.com/home/view/renal-dialysis-technology/renal dialysis technology-allied health sciences](https://www.sruahs.com/home/view/renal-dialysis-technology/renal%20dialysis%20technology-allied%20health%20sciences) [Last accessed on 2022 Nov 12].
3. Available from: [https://www.differentmedicalcareers.com/list-of-medical-careers/list of medical careers](https://www.differentmedicalcareers.com/list-of-medical-careers/list%20of%20medical%20careers) [Last accessed on 2022 Nov 12].
4. Shenwai MR, Patil KB. Introduction of structured oral examination as a novel assessment tool to first year medical students in physiology. *J Clin Diagn Res* 2013;7:2544-7.
5. Vyas R, Jacob M, Faith M, Isaac B, Rabi S, Sathishkumar S, *et al.* An effective integrated-learning programme in the first year of the medical course. *Natl Med J India* 2008;21:21-6.
6. Ganesan S, Mahalakshmy T, Parida PK, Sundaraj AN, Zayapragassarazan Z, Gopalakrishnan S. Perception of nursing students toward integrated methods of teaching the ENT clinical examination in South India. *Int J Health Allied Sci*

- 2012;1:104-8.
7. Ghosh S, Pandya HV. Implementation of integrated learning program in neurosciences during first year of traditional medical course: Perception of students and faculty. *BMC Med Educ* 2008;8:44.
 8. Faith M, Jared SR, Selvakumar D, Vyas R. Application of horizontal integration module within traditional teaching to enhance active learning of first year allied health science students. *Natl J Physiol Pharm Pharmacol* 2020;10:122-8.
 9. Wuensch KL. Available from: <https://www.core.ecu.edu/psyc/wuenschk/stathelp/likert.htm>. what is a likert scale and how do you pronounce likert? [Last accessed on 2022 Nov 12].
 10. Available from: <https://www.statisticshowto.com/cohen-kappa-statistic> [Last accessed on 2022 Nov 12].
 11. Brecht DH, Ogilby SM. Enabling a comprehensive teaching strategy: Video lectures. *J Inf Technol Educ Innov Pract* 2008;7:71-86.
 12. Skinner DE, Saylor CP, Boone EL, Rye KJ, Berry KS, Kennedy RL. Becoming lifelong learners: A study in self-regulated learning. *J Allied Health* 2015;44:177-82.
 13. Zimmerman BJ. Becoming a self-regulated learner: An overview. *Theory Pract* 2002;41:64-70.
 14. Bhadre R, Sathe A, Bhalkar M, Mosamkar S. Comparison of objective structured viva voce with traditional viva voce. *Int J Healthc Biomed Res* 2016;5:62-7.
 15. Anbarasi M, Rajkumar G, Krishnakumar S, Rajendran P, Venkatesan R, Dinesh T, *et al.* Learning style-based teaching harvests a superior comprehension of respiratory physiology. *Adv Physiol Educ* 2015;39:214-7.

How to cite this article: Jared SR, Faith M, Selvakumar D, Vyas R. Innovation in teaching-learning methods with an effective application of adult learning principles for the first year of allied health science courses. *Natl J Physiol Pharm Pharmacol* 2023;13(08):1678-1683.

Source of Support: Nil, **Conflicts of Interest:** None declared.