



## The effectiveness of self-directed learning (SDL) for teaching Biochemistry to first-year medical students

Dr Pooja Devi<sup>1</sup>, Dr Poonam Agrawal<sup>2</sup>, Nitu<sup>3</sup>, Nisha<sup>3</sup>, Dr Shinky<sup>3</sup>, Ravi Prakash Jha<sup>4</sup>

1. Assistant Professor, Department of Biochemistry, Dr BSA Medical College and Hospital, New Delhi
2. Professor & Head, Department of Biochemistry, Dr BSA Medical College and Hospital, New Delhi
3. Tutor, Department of Biochemistry, Dr BSA Medical College and Hospital, New Delhi
4. Statistician cum Tutor, Department of Community Medicine, Dr BSA Medical College and Hospital, New Delhi

Submitted: 01-05-2021

Revised: 15-05-2021

Accepted: 18-05-2021

### ABSTRACT

**Introduction:** Self Directed Learning (SDL) is one of the key components of adult learning theory proposed by Malcolm Knowles. SDL is an important tool for making medical students' [1] lifelong learners so that they are competent to identify their learning needs, allocate resources, and evaluate the learning process throughout their career. Recently, the Medical Council of India has introduced SDL as an essential component of the competency-based medical education curriculum and has allocated fixed hours for SDL in all undergraduate MBBS students. Self-directed learning (SDL) has become popular in medical curriculum and has been advocated as an effective learning strategy for medical students to develop competence in knowledge acquisition.

**Aim:** The proposed study aimed to assess students' performance before and after discussion in an SDL module in small-group teaching-learning method and compare the performance scores.

**Materials and Methods:** Out of the total 125 students, a total of 62 students who have attended both the sessions were included in the study. Study was divided into five Batches A-25, B-25, C-25, D-25, E-25, students. The topic selected for the SDL module was "Iron Metabolism." The module was conducted over two contact sessions, Session 1 and Session 2, which were conducted 5 days apart. The pre-discussion and post-discussion assessment questionnaire were also prepared. Session 1 was conducted during a 1-h SDL slot. A gap of 4 days was given to students for doing self-study and to learn the topic. The pre-discussion questionnaire consisting of 10 multiples-choice questions related to the topic was shared with the students a day before the second contact session. Session 2 was conducted during the 2-h tutorial slot (over 2 consecutive days for five batches of the class, Batch A, B, C, D, E respectively). small-group

teaching-learning was done followed by post-discussion questionnaire. Related sample Wilcoxon signed rank test was applied to check the difference in the pre-discussion and post-discussion scores.

**Results:** The questionnaire was analyzed, and it was observed that the overall mean performance of students improved considerably (55.37%–79.83%) in the questions related to the core concept. We found that there was significant increase in the mean performance score in the questions related to core concept (pre-assessment score =  $3.32 \pm 1.02$ , post-assessment score =  $4.79 \pm 1.38$ ,  $p < 0.001$ ). The overall performance was also increased significantly when considering all set of questions (pre-assessment score =  $5.85 \pm 1.64$ , post-assessment score =  $7.26 \pm 2.16$ ,  $p < 0.001$ ).

**Conclusion:** For first-year medical students, SDL is an effective teaching strategy for learning Biochemistry. We conclude that the SDL module should be meticulously planned keeping in mind the topic selected and the availability of infrastructure and workforce. Peer discussion is a very important aspect of the SDL module, and it shows improvement in learning outcomes in an SDL module.

**Keywords:** Curriculum, Education, Medical, Clinical Competence, Students, Medical

### I. INTRODUCTION:

Self-Directed Learning (SDL) is one of the key components of adult learning theory proposed by Malcolm Knowles. SDL is described as "A process where learner takes his or her own initiative for learning process, determines the learning need, sets the learning goals [1], identify resources for learning process, learn and finally assess the learning outcome". In other words, learner in SDL programme is primarily responsible for their own learning and evaluation. [2] The new MCI CBME curriculum has strengthened the need



of implementation of SDL in medical education by proposing 20 hours of SDL in biochemistry in 1st year MBBS programme. The prime purpose of it is to produce medical graduates who are self-directed, independent, confident, and goal oriented so that they are better decision maker in their career to meet day to day challenges

Currently medical education aims to make students self-directed learners it is also a great need to boost the integration skills in medical undergraduate students [3]. Numerous studies have proved that SDL activity valuable in terms of knowledge acquisition for learning biochemistry [4]. Hosting such innovative strategies could be challenging for the faculty due to time constraints and to verify and validate the concept linkers presented by students [3]. However, if teachers accept this with an open mind to blend and change the traditional didactic lectures, it can prove to be very rewarding to the students. This has led to a lot of apprehension among medical faculty regarding “When” the SDL is to be implemented, for “What” topic it is to be implemented, and more importantly “How” it is to be implemented for it to be most effective.

SDL has been advocated by many as an important tool for making medical students’ lifelong learners so that they are competent to identify their learning needs, allocate resources and evaluate the learning process throughout their career to better equip themselves with the latest advancements in the world of medicine.[11] Health professionals need to be self-directed learners so as to increase their independence, self-confidence, self-discipline and make them more goal oriented to keep pace with exponentially increasing medical knowledge .[5]

**Aim:** The proposed study was aimed to assess students’ performance before and after discussion in an SDL module in small-group teaching–learning method and to compare the performance score.

## II. MATERIALS AND METHODS:

The SDL session was conducted in the department of Biochemistry as per the latest guidelines of MCI Competency Based Medical Education curriculum. Student participation was voluntary and consent was taken. Out of the total 125 students, a total of 62 students who have attended both the sessions were included in the study. Study was divided into five Batches A -25, B-25, C-25, D-25, E-25, students. The topic selected for the SDL module was “Iron Metabolism.” The module was conducted over two contact sessions, Session 1 and Session 2, which

were conducted 5 days apart. The topic chosen for SDL was” IRONmetabolism’. The SDL was implemented in two sessions as follows: Session 1 incorporated all 125 students. It was conducted during a one-hour SDL session slot. A case scenario of Iron metabolism was presented to the students as follows

A Six-year-old boy came to the OPD with complain of loss of appetite, early fatigue and lethargy. Mother complained that boy gets tired very soon while playing and suffer with headache frequently. On examination nail were flat and brittle and pallor of face was seen.

Blood investigation revealed following findings

Hb: 9.0 g/dl

Serum iron: 41 ng/dl [ normal= 50 to 150 ng/dl]

Serum ferritin: 40 µg/dl [normal = 50 to 200 µg/dl]

TIBC [total iron binding capacity]: 470µg /dl [Normal=250 to 450µg /dl]

MCV: 75 mm<sup>3</sup>/FL

Peripheral smear showed hypochromic, microcytic picture

Questions

What may be the probable diagnosis?

What are the important causes which will lead to this disorder in Indian scenario?

What dietary compounds have rich amount of iron?

A 60-year-old diabetic, non-smoker and non-alcoholic male came with complain of brown discoloration of skin of back and arm. He has no history of blood transfusion and is not on iron pills. He denies the cooking of food in iron vessels. This patient was diagnosed to have Primary hemochromatosis on liver biopsy.

Questions:

What are the causes of iron overload?

What is the difference between terminology hemochromatosis and hemosiderosis?

What is Bronze diabetes?

What is Bantu siderosis

Students were asked to formulate learning objectives. They were guided by a facilitator. Students were instructed to brainstorm in small groups of 25 students each. The objectives formulated by each group and six specific learning objectives (SLO’s) were finalized. At the end of the SDL session, the 1st phase student should be able to

**SPECIFIC LEARNING OBJECTIVES OF IRON METABOLISM**



Mention Dietary sources and RDA of iron

Functions of Iron

Describe the absorption, transport and storage of iron in the body

Explain clinical conditions resulting from deficiency & excess of Iron

List the tests used in laboratory evaluation of iron status

At the end of session 1, the students were provided resource materials which included links to relevant pubmed articles and references from standard text books of Biochemistry. A WhatsApp group was created which was used both to motivate the students for self-directed learning and for clarifying any doubts from the students. The students were given four days to learn the topic on their own and regular reminders of the timeline were posted on the group. The pre-discussion questionnaire consisting of 10 multiples-choice questions related to the topic was shared with the students a day before the second contact session. Out of the 10 questions asked, three questions (Q1, Q3, Q5, Q6, Q7 & Q10) were related to the core concept of the topic and 4 questions (Q2, Q4, Q8 and Q9) were other than core concept questions. The students were asked to respond before attending the second session and the responses were compiled. Session 2 was conducted during the 2-h tutorial slot (over 2 consecutive days for five batches of the class, Batch A, B, C, D, E

respectively). small-group teaching-learning was done followed by post-discussion questionnaire. small group discussion was incorporated and all the students were given ample opportunity to discuss the topic learned by them under supervision and guidance by the facilitator. After the discussion was over, the assessment of pre-discussion and post-discussion questionnaire responses was done, and the results were compiled. Data was entered into MS-Excel. Related sample Wilcoxon signed rank test was applied to check the difference in the pre-discussion and post-discussion scores. All the analysis was done on SPSS. A p-value of <0.05 was considered to be significant.

**Results:** Out of 125 students, 62 students have given both pre as well as posttest. All the analysis has been done on those 62 students who has given both the tests.

The percentage of students scoring below 50% marks was seen to decline from 13% to 6% in post-discussion assessment compared to pre-discussion assessment. It means that the low scorers were reduced in post-discussion group, and they were shifted to high-score groups. There was a considerable increase in the percentage of students scoring in the 50%–60%, 70%–80%, and also in >90% score range in the post-discussion assessment compared to the pre-discussion assessment (4% vs. 14%, 13% vs. 10%, and 25% vs. 2%, respectively. [Table 1]

**Table 1:** Number and percentage of students scoring within specified score ranges in pre- and post-discussion assessments

	Pre-discussion assessment	Post-discussion assessment
< 50	13 (20.97)	6 (9.68)
50-60	14 (22.58)	4 (6.45)
60-70	13 (20.97)	5 (8.06)
70-80	10 (16.13)	13 (20.97)
80-90	10 (16.13)	9 (14.52)
>90	2 (3.23)	25 (40.32)



**Table 2:** Classification of assessment questions into two groups and comparison of the number (percentage) of students who answered each question and both groups of questions correctly in pre- and post-discussion assessments, respectively

Question	Type of question	Correct in pre-discussion assessment	Correct in post-discussion assessment
1	Core Concepts from Biochemistry	16.13 (10/62)	64.52 (40/62)
3		95.16 (59/62)	90.32 (56/62)
5		50.00 (31/62)	62.90 (39/62)
6		40.32 (25/62)	83.87 (52/62)
7		41.94 (26/62)	83.87 (52/62)
10		88.71 (55/62)	93.55 (58/62)
<b>Mean Performance in above questions</b>		55.37 %	79.83 %
2	Other questions	43.55 (27/62)	51.61 (32/62)
4		48.39 (30/62)	46.77 (29/62)
8		69.35 (43/62)	80.65 (50/62)
9		91.94 (57/62)	82.26 (51/62)
<b>Mean Performance in above questions</b>		63.30 %	65.32 %

The questionnaire was analyzed, and it was observed that the overall mean performance of students improved considerably (55.37%–79.83%) in the questions related to the core concept (Q1, Q3, Q5, Q6, Q7 and Q10). On further observation, we noted that the percentage of students who correctly answered questions 3 showed a slight decline in the post-discussion assessment as compared to the pre-discussion assessment, but in

questions 1,6 and 7, the percentage of students who answered correctly shows a sharp increase from 16 % to 64.5%, 40% to 84% and from 42% to 84% respectively [Table 2]. Similarly, in the questions related to the clinical aspects of the topic, the mean performance of students showed considerable improvement from pre-discussion to post-discussion assessment.[Table 2]

**Table 3:** Classification of assessment questions into two groups and comparison of the score in pre- and post-discussion assessments

Question	Type of question	Mean Score for pre-assessment	Mean Score for post-assessment	p value
1	Core Concepts from Biochemistry	0.16 ± 0.37	0.65 ± 0.82	<0.001
3		0.95 ± 0.22	0.90 ± 0.30	0.257
5		0.50 ± 0.50	0.63 ± 0.49	0.157
6		0.40 ± 0.49	0.84 ± 0.37	<0.001
7		0.42 ± 0.50	0.84 ± 0.37	<0.001
10		0.89 ± 0.32	0.94 ± 0.25	0.366
<b>Mean Performance in above questions</b>		3.32 ± 1.02	4.79 ± 1.38	<0.001
2	Other questions	0.44 ± 0.50	0.52 ± 0.50	0.369
4		0.48 ± 0.50	0.47 ± 0.50	0.853
8		0.69 ± 0.47	0.81 ± 0.40	0.162
9		0.92 ± 0.28	0.82 ± 0.39	0.134
<b>Mean Performance in above questions</b>		2.53 ± 1.00	2.61 ± 0.89	0.740
<b>Performance in all questions (Q1 to Q10)</b>		5.85 ± 1.64	7.26 ± 2.16	<0.001

Related sample Wilcoxon signed rank test has been applied to check whether there were any significant changes in the score post assessment. We found that there was significant increase in the

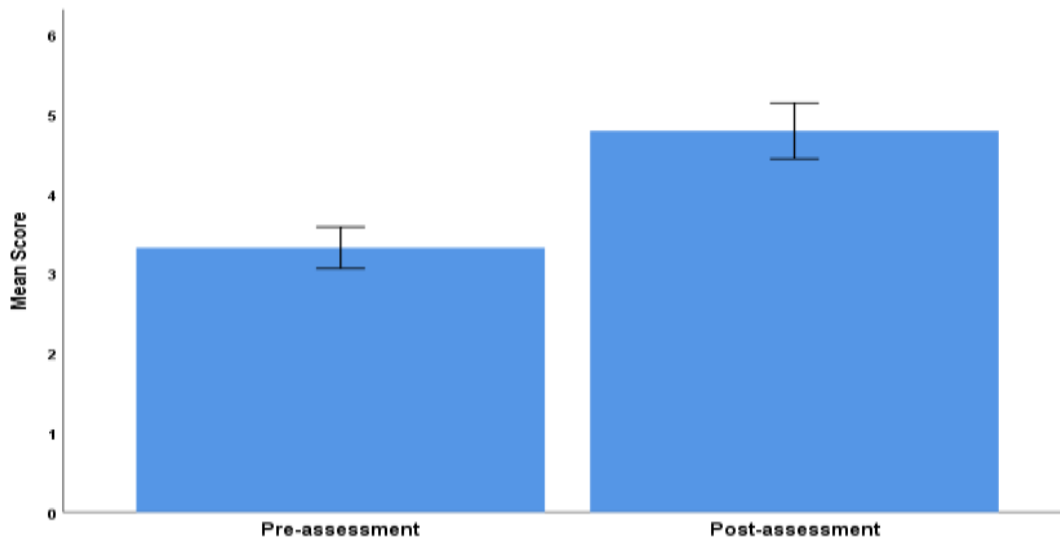
mean performance score in the questions related to core concepts of biochemistry (pre-assessment score=3.32 ± 1.02, post-assessment score=4.79 ± 1.38, p<0.001).[Table 3, Fig 1] The overall



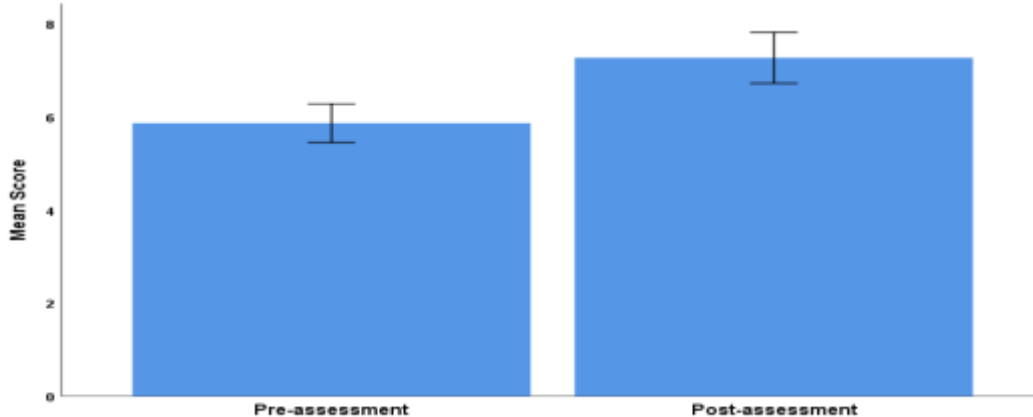
performance was also increased significantly when considering all set of questions (pre-assessment

score= $5.85 \pm 1.64$ , post-assessment score= $7.26 \pm 2.16$ ,  $p < 0.001$ ). [Table 3, Fig 2]

**Fig 1:** Mean score of pre and post assessment along with its 95% C.I. for Core Competency questions



**Fig 2:** Mean score of pre and post assessment along with its 95% C.I. for all set of questions



### III. DISCUSSION

On comparing the scores of the post-discussion assessment with the pre-discussion assessment, we noted that there was an improvement in the overall mean scores of the students. This signifies improved learning outcomes. However, there was a considerable variation when the scores are classified into discrete score ranges. As shown in Table 1, the percentage of students scoring low marks (<50%) reduced considerably from 21 % to 10% after attending group discussion. It shows that low scorers were benefitted from the discussion in the peer group, which must have clarified many important concepts related to the topic. Many a times, low- scoring students are afraid to ask and

clarify doubts from the faculty. However, in group discussion, they felt comfortable in discussing the topic with their peers, and this must have given them the confidence to seek the help of their classmates to clarify all their doubts related to the topic.

The percentage of students scoring >70% marks showed an increase from 35% to 75%, whereas those scoring >90% increased from 3% to 40%. This shows that even the high-scoring students were benefitted by attending the small-group discussion because many of their concepts got clearer after discussion with their peers, thus improving their performance. The improved learning outcomes among both low and high scorers can also be due to the fact that the group discussion allows revision and reinforcement





of the important concepts [6] and is a more interesting way of learning than simply reading the resource materials.[7] While the self-learning component allows both read/write and visual learners to gain knowledge, the discussion component allows even aural learners to understand the topic by listening and participating in the discussion.[8] The performance of students in clinical correlation questions (questions 3 and 10) showed significant improvement in the post-discussion assessment. This shows that the small group discussion method of teaching-learning is a useful method to introduce clinical integration in 1st-year MBBS students[6] We are of the opinion that while the core concepts of any subject can be theoretically learned by the students through self-study during the SDL sessions, group discussion in a small-to-medium group setting is essential to understand the clinical correlation of the core concepts of preclinical and para-clinical students. Similar findings have been reported by many other studies in the past;[9],[10] however, more studies are required across the country and across multiple MBBS students to corroborate this assumption [10].

#### IV. CONCLUSION

We conclude that the SDL module should be meticulously planned keeping in mind the topic selected and the availability of infrastructure and workforce. Peer discussion is a very important aspect of the SDL module, and it shows improvement in learning outcomes in an SDL module.

Incorporation of a group discussion among peers is beneficial not only for the low-scoring students who show promising results post discussion, but also for high scorers who show better performance in the post-discussion assessment. Clinical concepts can be explained better in such sessions, and aural learners can learn better by listening to and discussing the topic. Perhaps, increased awareness of the learning styles of our students is the need of the hour. While we have included group discussion technique in our module, we encourage faculty members across the country to incorporate different innovative small-, medium-, or large-group teaching-learning methods to facilitate discussion and improve learning outcomes from SDL. If possible, short PowerPoint presentations and/or patient encounters can also be included as they will ensure better participation of visual and kinesthetic

learners and make the SDL modules even more inclusive and interactive.

**Financial support and sponsorship:** None.

**Conflicts of interest:** None declared.

#### REFERENCES:

- [1]. Knowles M. Self-Directed Learning: A Guide for Learners and Teachers. Chicago, IL: Follett Publishing; 1975. p. 1-135.
- [2]. Davis J. Education through self-directed learning. Aust Nurs Midwifery J 2015;23:26-7
- [3]. Greveson GC, Spencer JA. Self-directed learning the importance of concepts and contexts. Med Educ 2005;39:348-9.
- [4]. Abraham RR, Upadhya S, Ramnarayan K. Self-directed learning. Adv Physiol Educ 2005;29:135-6
- [5]. Arroyo-Jimenez Mdel M, Marcos P, Martinez-Marcos A, Artacho-Pérula E, Blaizot X, Muñoz M, et al. Gross anatomy dissections and self-directed learning in medicine. Clin Anat 2005;18:385-91
- [6]. Pai KM, Rao KR, Punja D, Kamath A. The effectiveness of self-directed learning (SDL) for teaching physiology to first-year medical students. Australas Med J 2014;7:448-53.
- [7]. Ainoda N, Onishi H, Yasuda Y. Definitions and goals of "self-directed learning" in contemporary medical education literature. Ann Acad Med Singapore 2005;34:515-9
- [8]. Fleming N. VARK: A Guide to Learning Styles. Available from: <http://www.vark-learn.com/english/index.asp>. [Last accessed on 2019 Dec 27].
- [9]. Anderson SM, Helberg SB. Chart-based, case-based learning. S D Med 2007;60:391, 393, 395, 397, 399. Holmboe ES, Prince L, Green M. Teaching and improving quality of care in a primary care
- [10]. Poonam Agarwal, Niket verma, Perception analysis of students and faculty of a self-directed learning module in biochemistry in a north Indian medical college Journal of Education Technology in Health Sciences December 2019 6(3) 72-76.
- [11]. Poonam Agarwal, Niket verma, Implementation of a self-directed learning module for undergraduate medical students in biochemistry: sharing of an experience January 2020 International Journal of Advances in Medicine 7(2):361