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

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RESEARCH

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ABSTRACT

Background
Self-directed learning (SDL) has become popular in medical curricula and has been advocated as an effective learning strategy for medical students to develop competence in knowledge acquisition.

Aims
The primary aim was to find out if there was any benefit of supplementing self-directed learning activity with a traditional lecture on two different topics in physiology for first-year medical students.

Method
Two batches of first-year Bachelor of Medicine and Bachelor of Surgery (MBBS) (Batch A and Batch B) comprising 125 students each, received an SDL session on *Morphological classification of anaemia*. The students belonging to Batch A received a one-hour lecture on the same topic three days prior to the SDL session. The students were given a 10 multiple choice questions (MCQ) test for a maximum of 10 marks immediately following the SDL session. The next topic, *Conducting system of the heart, disorders and conduction blocks* was taught to both batches in traditional lecture format. This was followed by an SDL session on the same topic for Batch A only. The students were evaluated with a MCQ test for a maximum of 10 marks.

Results
The mean test scores on the first topic were 4.38 ± 2.06 (n=119) and 4.17 ± 1.71 (n=118) for Batch A and Batch B, respectively. The mean test scores on the second topic were 5.4 ± 1.54 (n=112) and 5.15 ± 1.37 (n=107) for Batch A and Batch B, respectively. There was no significant difference between the groups.

Conclusion
For first-year medical students, SDL is an effective teaching strategy for learning physiology. However, no additional benefit is gained by supplementing SDL with a lecture to facilitate learning physiology.

Key Words
lecture, self-directed learning, physiology, medical education

What this study adds:

1. What is known about this subject?
Student-centred learning and self-directed learning have gained popularity in medical curricula as effective learning methods for knowledge acquisition by medical students.

2. What new information is offered in this study?
For the first-year MBBS students studying physiology, SDL was equally effective as traditional lectures and there was no additional gain by combining the two methods. For first-year medical students, SDL can be used as an alternative for lectures to access and process information.

3. What are the implications for research, policy, or practice?
These findings indicate that medical educators can consider SDL as an alternative to lectures for teaching physiology to

first-year medical students. Further research is required to demonstrate the effectiveness of mixed methods teaching in later year students.

Background

The traditional didactic lecture in medical education generally involves a single lecturer delivering a class to a large audience of students with support from audiovisual aids such as a blackboard or PowerPoint presentation. With emphasis on students taking the initiative in learning, new learning methods like problem-based learning (PBL) and self-directed learning (SDL) have emerged in medical curricula over the past few decades.[1] In addition, the hybrid forms of lecture and self-directed methods are also practised where the role of lecture is reduced.[2,3] SDL has been emphasised as a process in which individuals ideally take initiative and responsibility for their own learning.[4] SDL also enables health professionals to continue learning and updating knowledge during their careers.[5]

SDL has been conducted with different approaches. It is desirable if the objectives are concrete so that learners do not find it difficult to achieve them when they have to learn for themselves.[6] One form of SDL exercise practised is to give case-based scenarios and guide the learners with questions, leading them to answers using recommended learning resources.

SDL has been advocated for effective and efficient training of medical students.[7] Numerous studies have proved SDL valuable in terms of knowledge acquisition for learning gross anatomy and physiology.[8,9] Further, in the field of nursing, SDL enabled independent decision making and improved communication skills.[10,11] There have been several attempts to compare lecture with self-directed alternate forms of learning. Although a few studies suggest self-learning groups performed better than traditional large group lectures,[12–15] other studies have reported self study-group to be equivalent to group plus traditional classroom teaching.[16–18]

Studies examining whether supplementing SDL with lectures on the same content area benefits students are currently lacking. Given the mixed results of previous studies and lack of literature on the benefit of supplementing SDL with traditional lecture, we were motivated to do this study to explore two questions: 1) Can SDL be considered as an alternate form of learning in knowledge acquisition?; and 2) What is the benefit of supplementing SDL with a lecture conducted on a topic?

This study was therefore undertaken to compare the effects of lecture plus an SDL (with the same content area) with SDL or lecture only, on two different topics in the physiology curriculum for first-year medical students.

Method

In the Bachelor of Medicine and Bachelor of Surgery (MBBS) programme offered by Kasturba Medical College, Manipal University, India, students learn anatomy, physiology, and biochemistry in their first year of study. The curriculum includes didactic lectures, tutorials, and practical demonstration exercises. The 250 students enrolled into the first year are randomly divided into two batches of 125 each (Batch A and Batch B) for the didactic lecture sessions. The students are exposed to clinical practice only from the second year after completing the professional examination at the end of year one.

Inclusion criteria

Students had to be enrolled full-time in the MBBS programme. A total of 119 students from Batch A and 118 students from Batch B participated in the study. Participation was voluntary.

Study design

This cross-sectional study was conducted following approval by an Institutional Ethics Committee, Kasturba Hospital Manipal (313/2013). At the time of the study, the students had completed the first four months of the first-year MBBS programme. To know whether the two batches (A and B) were comparable, their first sessional examination scores were compared. The examination scores showed similar average scores between the two batches.

The topics for the study involved the application of basic physiological concepts in clinical settings through case-based scenarios. The cases constructed for SDL were such that the guiding questions were focused to make the students learn about relevant physiological concepts.

Methodology: Session I

Topic: *Morphological classification of anaemia*
1. Preparation of SDL material
2. SDL session
3. Assessment of SDL

1. Preparation of SDL material
The material for SDL was prepared by constructing 10 short and specific case histories, which covered the area of haematology, specifically with respect to *morphological classification of anaemia*. Each case was followed by three to four questions, answers for which could be found by the student using the references that were given under each

case. References given were picked from the standard textbooks recommended at the beginning of the course (Guyton & Hall Textbook of Medical Physiology, 12th Edition, and Ganong's Review of Medical Physiology, 24th Edition).

The questions were grouped into the following contexts:

- Analytical and problem solving
- Calculations
- Interpretation of data

2. SDL session

The students were divided into batches of 15, and a tutor guided each group during the session. Fifty per cent of students (all students belonging to Batch A) had received a lecture on the *Morphological classification of anaemia* three days prior to the SDL session. The students had also completed relevant haematology practical exercises. During the SDL session, the students were asked to go through each case independently and to find the answers for the questions. The interaction between the students in each group was kept to a minimum. The tutor for each group followed the students' discussion closely and encouraged critical thinking; however, he/she acted only as a facilitator of learning without giving answers. The session lasted for 45 minutes, after which a multiple choice question (MCQ) test was administered to all the students.

3. Assessment of SDL

The students were given a MCQ test immediately after the SDL session. The test involved 10 MCQs (to be answered in 10 minutes) for a maximum of 10 marks and covered the same content areas as the SDL session. The MCQ papers were collected and evaluated manually with no negative marking. The results were tabulated.

Methodology: Session II
Topic: *Conducting system of the heart, disorders and conduction blocks*
1. Lecture and SDL
2. Evaluation

1. Lecture and SDL

The two batches (A and B) were taught the *Conducting system of the heart, disorders and conduction blocks* in a single one-hour lecture. After three days, the SDL session was conducted to Batch A only on the same topic. The SDL material consisted of eight case histories with each case quoting a clinical history and electrocardiogram (ECG) findings from Lead II. Each case was followed by two to three relevant questions for which the students were guided by references given from standard textbooks. The

questions demanded analytical and problem-solving skills. During an ECG demonstration, as part of practical training, the students had learnt ECG analysis.

2. Evaluation

The students were evaluated by a MCQ-based test. The test was conducted after the SDL session for Batch A. The Batch B students received the test without the SDL session. The test involved 10 MCQs (to be answered in 10 minutes) for a maximum of 10 marks and covered the same content areas as the lecture and SDL session, respectively. The MCQ papers were collected and evaluated manually with no negative marking.

In the first session, the SDL was common to both batches, while the lecture was exclusive to Batch A only. The test conducted at the end of session assessed the benefit of supplementing SDL with lecture (for Batch A). In the second session, the lecture was common to both batches, while the SDL session was exclusive to Batch A. The test conducted on Batch A students would judge the impact of an added SDL session to the lecture, whereas on Batch B students it would assess how much the students retained and applied the knowledge gained from the lecture. An overview of the study design is depicted in Figure 1.

Figure 1: Study design showing the activities in two batches

Topic: *Morphologic classification of anaemia*

Group	Lecture	SDL
Batch A	Yes	Yes
Batch B	No	Yes

Topic: *Conducting system of the heart, disorders and conduction blocks*

Group	Lecture	SDL
Batch A	Yes	Yes
Batch B	Yes	No

Analysis

The test scores of the two groups were compared using an independent sample t-test. A Kolmogorov-Smirnov test was performed prior to the t-test to confirm the normal distribution of the test scores. The scores (maximum of 10) obtained by the students were further grouped into high (score>7), medium (score=4-6), and low (score<4). A Chi-Square test was used to compare the difference in proportion for high, medium, and low scorers between the two groups. A *p* value of less than 0.05 was considered to be statistically significant. The data were analysed using SPSS for Windows version 16.0, Chicago, SPSS Inc.

Results

The mean test scores on the first topic were 4.38±2.06 (n=119) and 4.17±1.71 (n=118) for Batch A and Batch B, respectively (Table 1). The mean test scores on the second topic were 5.4± 1.54 (n=112) and 5.15±1.37 (n=107) for Batch A and Batch B, respectively (Table 3). There was no statistically significant difference between the mean test scores of the two groups (Tables 1 and 3). When the high, medium, and low scorers were compared between the two groups, there was no statistical significance (Tables 2 and 4).

Table 1: Mean scores following two different learning methods for the topic *Morphological classification of anaemia*

	Batch A (lecture plus SDL) (n=119)		Batch B (SDL only) (n=118)	
	Mean	SD	Mean	SD
Test score	4.38	2.06	4.17	1.71

p=0.399, test scores when compared between two groups

Table 2: Different levels of scorers between the two groups for the topic *Morphological classification of anaemia*

Score	Batch A (lecture plus SDL) (n=119)	Batch B (SDL only) (n=118)	Total
Low (1–3)	42 (35.3%)	44 (37.3%)	86 (36.3%)
Medium (4–6)	57 (47.9%)	63 (53.4%)	120 (50.6%)
High (7–10)	20 (16.8%)	11 (9.3%)	31 (13.1%)
Total	119 (100%)	118 (100%)	237 (100%)

p=0.236 with Chi-Square test to compare the difference in proportion between two groups

Table 3: Mean scores following two different learning methods for the topic *Conducting system of the heart, disorders and conduction blocks*

	Batch A (lecture plus SDL) (n=112)		Batch B (lecture only) (n=107)		
	Mean	SD	Mean	SD	*p* value
Test score	5.40	1.54	5.15	1.37	0.202

Table 4: Different levels of scorers between the two groups for the topic *Conducting system of the heart, disorders and conduction blocks*

Score	Batch A	Batch B	Total
Low (<1–3.5)	19 (17%)	17 (15.90%)	36 (16.4%)
Medium (4–6.5)	72 (64.3%)	74 (69.2%)	146 (66.7%)
High (7–10)	21 (18.8%)	16 (15.0%)	37 (16.9%)
Total	112 (100%)	107 (100%)	219 (100%)

p value=0.70 by Pearsons Chi-Square test

Discussion

In the first topic, Batch A students, who were exposed to an independent SDL session, scored similar to Batch B, who were supplemented with a lecture to SDL. This suggests that the additional lecture delivered to one batch of students failed to make the SDL session more effective for learning the topic. There was no significant difference in the number of students with high, medium, or low scores between the two groups. Hence, the different learning methods employed did not influence different levels of scores between the two groups.

In the present study, SDL has proved to be sufficient for knowledge acquisition for first-year medical training. It has been earlier documented that SDL is an effective strategy especially in increasing learners' knowledge. Further, previous studies also proved self-learning to be helpful in increasing knowledge about clinical medical management and a self-directed curriculum reflected in improving quality care of patients.[19, 20]

For the second topic, *Conducting system of the heart, disorders and conduction blocks*, Batch A did not perform significantly better than Batch B in the MCQ test. Batch A, which had received an SDL session, did not show significant improvement in scores compared to Batch B, who answered the test without an SDL session. The topic probably demands an instructor-driven, interactive small group discussion, lecture, or workshop as pointed out by Simon et al. and Tobias et al.[21,22] Batch A could not capitalise on an SDL session because the topic involved a more difficult task of correlating the basics with a clinically oriented case and ECG analysis.

The role of SDL is probably reduced in a first-year setting where certain topics demand to integrate basic with applied physiology, where a faculty-guided discussion might work better. Murad et al. recommends considering SDL as an effective strategy for more advanced learners (e.g., those in the later years of medical school or residency and doctors in practice).[23] Though it is advisable to adhere to recommended textbooks, other learning resources like

handouts from reference books and excerpts from online learning resources can be considered to be included in an SDL session.[24]

The observation that students in Batch B who received either lecture or SDL only performed equivalent to the Batch A students who underwent two training methods for each topic suggests that both methods are equally effective with regard to knowledge gain for first-year physiology in medical education. However, the present study has limitations, namely, that it was conducted for a short duration with limited portions in physiology. In addition, alternate learning resources other than textbooks can be taken into account during an SDL session.

Conclusion

Self-directed learning can be considered as an alternate form of learning in knowledge acquisition. As SDL was equally effective as lecture, it is not necessary to supplement one instructional approach with the other. However, in this study, SDL sessions could cover only a few topics area from the total content areas in the curriculum of the first-year MBBS programme. A study of longer duration with wide-ranging content area needs to be done to ascertain the impact of SDL on traditional curriculum.

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CONFLICTS OF INTEREST

The authors declare that they have no competing interests.

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