Analytical Study of Self-directed and Problem-Oriented Learning Sessions in Cardio-Respiratory Physiology

Suchitra Palve* and Sachin Palve

1Department of Physiology, Symbiosis Medical College for Women, Symbiosis International (Deemed University), Pune, Maharashtra, India.
2Department of Community Medicine, Symbiosis Medical College for Women, Symbiosis International (Deemed University), Pune, Maharashtra, India.

Authors’ contributions
This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Background: Learner-centred methods for teaching knowledge in the undergraduate medical curriculum utilizing an integrated approach include active learning approaches such as Problem-oriented learning and self-directed learning are two types of education.

Aim and objectives: The study aimed to see if self-directed learning and a problem-solving approach to physiology may benefit first-year medical students.

Material and methods: 250 students enrolled in Phase I MBBS for two physiology modules: CVS and RS, were involved in this cross-sectional study. Group A (n=125) received self-directed learning sessions for similar topics, whereas Group B (n=125) received problem-oriented learning sessions. An objective evaluation of all subjects covered was done after each SDL and POL session, and the results were analyzed using an unpaired t-test.

Results: Cardiovascular physiology self-directed learning sessions, 25.6% (32/125) of students...
received maximum scores (group A), whereas 21.6% (27/125) received moderate grades. 31.2% (39/125) of problem-oriented sessions received maximum points, whereas 47.2% (59/125) of pulmonary system module (group A) sig. SDL sessions received intermediate points. The p values (n=0.008) (n=0.009) for both modules indicated a significant difference between 32.8% (41/125) of those who earned maximum scores and 48% (60/125) of those who received intermediate grades. With p values of 0.0192, 0.0190, and 0.01179, respectively, pupils achieving 80–89%, and 70–79% in both SDL and PBL, had significant variations in their total scores in their internal evaluation when SDL and POL were compared to their overall scores.

**Conclusion:** Self-directed learning sessions are less successful than problem-oriented learning sessions at communicating concepts. It takes time to raise learner's awareness and prepare them for active; Techniques for learning that are centered.

**Keywords:** Learner; Physiology; self-directed problem-oriented problem; techniques for learning, self-directed learning.

### 1. INTRODUCTION

Medical students in India are being trained in various fields, most of which are cognitive, according to Bloom's taxonomy, psychomotor, and emotional domains [1]. The current medical curriculum, which was implemented in 2019, prioritizes the student over the educator. The new curriculum calls for active participation on the part of the student and innovative teaching approaches that will encourage active participation and engagement [2]. Lectures have dominated medical education as the most commonly employed mode of instruction for medical students during the previous few decades. Self-directed learning, problem-based learning, and other newer or contemporary techniques of teaching and learning that emphasize active student engagement are regarded as successful approaches for conveying and explaining basic and challenging ideas that result in improved learning [3]. By current curricular needs, the current condition of medical education indicates that large-group didactic lectures are becoming less significant, and active learning approaches are gradually substituting didactic lectures. Several studies have shown that learning fundamental medical science such as anatomy, physiology, and biochemistry on your own is beneficial. Self-Directed Learning (SDL) employs a variety of methods. Various modalities can provide self-directed learning instructions for undergraduate students' active involvement in the sessions [4]. As long as the sessions are practical and practicable, several self-directed learning approaches are successful. This method helps with communication, decision-making, teamwork, and self-governance. Students that need to learn independently may benefit from using SDL modalities [5]. Presenting a case scenario related to the topic and asking multiple objective questions, and offering appropriate learning materials that may be used to answer the supplied question is one technique for self-directed learning [6]. Self-directed learning can be a successful active learning method in medical education. In a recent study, the benefits of self-directed learning over traditional lectures were underlined [7]. Because it ensures active participation of the learner through the use of various instructional methods, such as the creation of a problem for a given topic for a small group to discuss and derive accurate and desired solutions, problem-oriented learning is also considered an active form of learning and a valuable form of group education. The facilitator serves as a moderator and supervisor in this type of teaching and learning [8]. Because it ensures active participation of the learner through the use of various instructional methods, such as the construction of a problem for a given topic for a small group to discuss and derive accurate and desired solutions, problem-oriented learning is also regarded as an active form of learning and a valuable form of group education. In this kind of teaching and learning, the facilitator works as both a moderator and a supervisor [9]. Students are encouraged to use self-directed learning to understand the subject or topic better, improve knowledge retention, and improve critical thinking skills, all of which are important in today's world, according to the current curriculum, which asks for at least a third of horizontal and vertical alignment and integration [10]. This research looked into the advantages of active learning in physiology classrooms.

### 2. METHODOLOGY

The circulatory and respiratory systems were studied in a comparative study involving 250
students at the Mahatma Gandhi Medical College Hospital Puducherry's department of physiology. Two groups of pupils are formed. For similar topics, Self-directed learning sessions were given to group A \((n=125)\), whereas problem-oriented learning sessions were given to group B \((n=125)\).

### 2.1 Preparation of Learning Material

For various aspects of the cardiovascular and respiratory systems, case-based scenario workshops were developed. The cardiovascular and respiratory systems included the following topics:

1. Acute myocardial infarction
2. Heart failure
3. Cardiogenic shock
4. High Blood Pressure
5. Autonomic Nervous System
6. Respiratory distress syndrome
7. asymptomatic-tuberculosis
8. Chronic Obstructive Pulmonary Diseases (COPD)
9. low blood oxygen
10. Pneumonia

The SDL and POL sessions have different material and objectives. The problem-solving sessions addressed pathophysiology, lab tests, differential diagnoses, various treatment modalities, etiology risk factors, pathogenesis, and one or more scenarios. When designing self-directed learning sessions, the notion and limited options for addressing a topic that couldn't be handled any other way were considered.

### 2.2 SDL Session Preparation

We devised briefcase scenarios that yielded good learning outcomes. There were a few books that were suggested. These sessions were held on alternate days in the afternoons, during the regular hours of the SDL and POL physiology courses. All students were required to attend class [11].

As previously indicated, group A received an SDL session. Students were provided case situations using a learning management system. After reading the case scenarios, students reviewed the learning objectives with the facilitator, who advised and coached them on using the appropriate materials. These pupils were divided into ten groups, with each group having its facilitator [12]. Students conducted research, produced reports, and discussed their results with their facilitators. The module's moderator went over each scenario individually the next day, at the start of the next session, and graded it using ten objective questions.

### 2.3 Example of Self-Directed Learning Session

After falling owing to dizziness, a 48-year-old man was taken to the emergency department. The patient's sensorial had been altered, and he had no pulse in his upper and lower limbs, with a blood pressure of 60/50 mm Hg and a heart rate of 150 beats per minute [13]. The ECG indicated with a heart rate of 140 beats per minute, a PR interval of 110 milliseconds, and a QRS length of 70 milliseconds, you have sinus tachycardia aids to find the causes of the current issue that result in the best plan of action.

### 2.4 Learning Objectives for Self-Directed Learning Session

1. What is the definition of shock?
2. Do you want to talk about the different sorts of shocks?
3. Describe the pathophysiology and compensatory mechanisms of shocks in a few words.
4. In a few words, describe the procedures of basic and advanced life support.

### 2.5 Question for Assessment Example

Several reasons can cause shock (lower than 60 mm Hg mean blood pressure). The intravascular volume being down,

A. The output of Cardiac is low,
B. pleural effusion
C. Low intravascular volume causes decreased peripheral vascular resistance and other symptoms.

### 2.6 Preparation of Session for Learning Which Is Problem-Oriented

The B set of students \((n=125)\) was divided into 10 to 12-person groups for this session. A facilitator will lead each group. Case scenarios were created instead of self-directed learning sessions. Each POL was planned for two sessions. In the first session [14], the facilitator and students addressed the case and learning
goals, laboratory tests, and differential diagnosis for the illness. During session II, all students in group B were required to sit in a single class with one representative from each group and the facilitators and moderator to discuss the learning outcomes. A ten-question objective structured evaluation followed the session. The facilitators were all from the physiology, anatomy, and biochemistry departments.

2.7 Example of Problem-Oriented Learning Session

Mr. Aniket, a forty-six-year-old Hispanic male diagnosed with a case of hypertension, is a software engineer. He used to become breathless while climbing the stairs of his office. He had a history of smoking of 3 cigarette packets per day for about 15 years. While playing with his son, Mr. Aniket felt like burning sensation in the left side of the arm, chest, and jaw one fine day. He collapsed and lost consciousness. He was immediately hospitalized an electrocardiogram was recorded, which showed S-T segment depression indicating myocardial infarction. Lab investigations showed: pH value of 7.25. Lactate analysis was 3.6mEq/L, the myocardial element containing creatinine phosphokinase was 61%, creatinine phosphokinase levels were 70mU/ml, the lactate dehydrogenizes levels were 130 U/ml, the levels of serum Aspirate amino transferees were around 50 U/ml.

2.8 Learning Objectives for Problem-Oriented Learning Sessions

1. Describe the blood supply of the heart and its clinical significance
2. To know basic knowledge the incidence, etiology, and pathophysiology of MI
3. List the cardiac biomarkers and explain their kinetics in the myocardial infarct.

2.3 Analysis

Having no negative grading system on the following week, having each type of session, the evaluation consisted of 10 questions. On the grades received by each group member, the grades were compared and are categorized as follows:

- (score < 8) is considered high (scoring 6 or 7) is considered moderate.
- (score < 6) is considered low, while (scoring <5) is considered extremely low.
- The P-values were having <0.05 is known as significant.
- Using windows version 17.0 (SPSS), this statistical analysis is done

3. RESULTS

According to the objective evaluation, 25.6% (32/125) of participants in the self-directed learning session for the cardiovascular system module received the highest possible score, while 21.6 percent (27/125) received moderate grades. 31.2 percent (39/125) of problem-solving sessions earned the highest possible score, while 47.2 percent were average. Problem-oriented sessions got average ratings of 23.5 percent (29/125), maximum marks in 32.8 percent (41/125), and moderate marks in 48 percent (60/125); the difference was significant (n=0.008) (n=0.009) as seen in Table 1 for further information. 0.0192, 0.01184, 0.0190, and 0.01179, respectively, are the given p values. There was a significant difference between those who scored 80–89 % in SDL and PBL on their internal assessment exam and those who scored 70–79 % in both SDL and PBL. [Section II].

Table 2 shows that the Students are divided into groups based on their SDL and POL scores and their total cardiovascular module scores. Table 3 shows the SDL and POL scores and the total Respiratory module scores.

4. DISCUSSION

The undergraduate medical school curriculum in India is meant to develop "Indian Medical Graduates” who thirst information, skills, attitudes, beliefs, and adaptability. The new undergraduate medical curriculum, which began in 2019, is competency-based and emphasizes learners’ learning experience, preparing them to face real-world difficulties. According to these standards, didactic lectures should account for no more than one-third of a subject's entire curricular calendar, with the remaining two-thirds being interactive sessions, practical, clinical, or group discussions. During clinical encounters, prioritize bedside teaching, a problem-oriented approach to measuring the severity of health concerns, case studies or scenario-based training, and community health-care activities. The physiology topic covered in the first year of medical school is about the basic physiological processes that sustain them. It can also function as a connection between basic scientific
Table 1. In both CVS and RS modules, each group received a certain amount of points and a certain proportion of marks for SDL and PBL

| Module              | Tool  | High, n (%) | Moderate, n (%) | Low, n (%) | Very low, n (%) | t-test |
|---------------------|-------|-------------|-----------------|------------|-----------------|--------|
| Cardiovascular system | SDL   | 20.3% (37)  | 26.9% (32)      | 28% (41)   | 3.2% (17)       | 0.00732** |
|                     | POL   | 31.2% (39)  | 47.2% (59)      | 21.4% (22) | 9.8% (11)       |        |
| Respiratory system  | SDL   | 21% (27)    | 21.2% (24)      | 24% (36)   | 22.4% (28)      | 0.00734** |
|                     | POL   | 28.2% (37)  | 48% (60)        | 22.6% (24) | 7.2% (9)        |        |

** Using the t-test, calculate the P-value. POL stands for problem-oriented learning, whereas SDL stands for self-directed learning.

Table 2. Students are divided into groups based on their SDL and POL scores, as well as their total Cardiovascular module score

| Score       | Tool  | High, n (%) | Moderate, n (%) | Low, n (%) | Very low, n (%) | p-value using independent t-test |
|-------------|-------|-------------|-----------------|------------|-----------------|--------------------------------|
| ≥90         | SDL   | 7           | 6               | 4          | 3               | 0.3704                         |
|             | POL   | 11          | 2               | 1          | 3               |                                 |
| 80-89       | SDL   | 5           | 8               | 10         | 3               | 0.9100*                        |
|             | POL   | 31          | 11              | 10         | 5               |                                 |
| 70-79       | SDL   | 11          | 14              | 25         | 11              | 0.09117*                       |
|             | POL   | 20          | 16              | 3          | 7               |                                 |
| 60-69       | SDL   | 2           | 5               | 6          | 3               | 0.3123                         |
|             | POL   | 1           | 9               | 9          | 1               |                                 |
| <60         | SDL   | 1           | 4               | 3          | 4               | 0.4024                         |
|             | POL   | 5           | 1               | 2          | 1               |                                 |

*The student groups that scored 80–89 percent on SDL and POL and those who scored 70–79 percent on SDL and POL had significant differences. SDL stands for self-directed learning, whereas POL stands for problem-oriented learning.

Table 3. SDL and POL scores and the total Respiratory module score are used to categorize students

| Score       | Tool  | High, | Moderate | Low   | Very low | p-value using independent t-test |
|-------------|-------|-------|----------|-------|----------|---------------------------------|
| ≥90         | SDL   | 7     | 6        | 4     | 3        | 0.3704                          |
|             | POL   | 11    | 2        | 1     | 3        |                                 |
| 80-89       | SDL   | 5     | 8        | 10    | 3        | 0.9100*                         |
|             | POL   | 31    | 11       | 10    | 5        |                                 |
| 70-79       | SDL   | 11    | 14       | 25    | 11       | 0.09117*                        |
|             | POL   | 20    | 16       | 3     | 7        |                                 |
| 60-69       | SDL   | 2     | 5        | 6     | 3        | 0.3123                          |
|             | POL   | 1     | 9        | 9     | 1        |                                 |
| <60         | SDL   | 1     | 4        | 3     | 4        | 0.4024                          |
|             | POL   | 5     | 1        | 2     | 1        |                                 |

** The student groups that scored 80–89 % on SDL and POL and those who scored 70–79 % on SDL and POL had significant differences. SDL stands for self-directed learning, whereas POL stands for problem-oriented learning.
information and its application in understanding the origins and development of illness by linking the underlying physiologic systems.

Due to a lack of adequate preparation and sensitization of the students, our study revealed that POL is still the most popular and successful way to teach essential ideas compared to self-directed learning. Adult teaching techniques such as self-directed learning are popular in health professions education. According to Murphy et al., SDL is unsuccessful for learning and understanding anatomy because students confessed that their recall knowledge was based on didactic lectures rather than active learning methods. Pai et al. found no difference in how the subject was taught using SDL vs. using it in conjunction with didactic lectures; both groups of students performed equally well on exams. Problem-solving sessions are considered an essential element of active learning since they demand the learner to engage actively. In an integrated curriculum, problem-based learning sessions are crucial, according to the findings of this study, which are based on assessment data. The importance of problem-solving activities in improving learning outcomes has been established in previous studies, and these findings support that.

Ten students had poor to meager SDL results compared to the high-scoring groups, emphasizing the need for good SDL preparation and administration. SDL sessions have lower impacts than POL sessions because the learner may not have comprehended the instructions or learning objectives or disengaged. This emphasizes the importance of tailoring SDL sessions to the needs of students. In his research, Blumberg observed that PBL sessions helped students apply their SDL skills. According to several studies, the facilitator should encourage and support students' active involvement in SDL. These researchers also discovered that these activities aid in the development and learning of clinical abilities. Experts believe that if SDL is correctly designed with intended objectives at each level or phase of the curriculum, it may be successfully incorporated into the current curriculum. SDL sessions are required under the new curriculum. However, there must be clarity in establishing learning objectives, facilitator-led talks with learners, and group discussions by dividing students into smaller groups and assessing their learning styles. To get better results, things must be put into action.

5. CONCLUSION

Self-directed learning is a requirement of today's curriculum that emphasizes topic synchronization and integration and can aid a student's understanding of the subject's fundamental principles. However, based on our findings, we believe that with appropriate preparation and enhanced instructional approaches, SDL sessions will be more helpful. Problem-oriented learning sessions are more successful than self-directed learning sessions at conveying the concept. Time is required to raise student awareness and preparation for these types of learner-centered active learning approaches. Students exposed to a PBL curriculum demonstrated SDL abilities during the third-year family medicine clerkship by taking increased initiative and control of their learning activities, according to our observation and experience. They also showed more enthusiasm at the outset of the clinical rotation. They were typically eager to notify their preceptors about the kind of cases they had or had not encountered in the clinic, allowing them to identify learning issues and requirements more quickly and effectively.

LIMITATION OF THE STUDY

For each session, the corresponding techniques need significant planning and sufficient facilitator training. To make greater use of the time given, the facilitators must be trained to achieve the intended learning results in completing the interdepartmental coordination. To promote active participation, the learning material should be supplied to the student ahead of time. Students can reply more rapidly by using clickers and flashcards.

CONSENT AND ETHICAL APPROVAL

According to the Mahatma Gandhi Medical College Pondicherry's institute ethics committee's judgment, this study was exempt from ethical assessment. All study participants gave their previous informed permission.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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