

Research Article

Evaluating the Effectiveness of Self-Directed Learning Activity in Microbiology for Second Year MBBS Students

Roopa. C¹, Jayasheela Bagi², Sravanthi Brungi¹, Ramavath UshaRani¹, Sunil Kumar Jada¹, Raja Ratna Reddy¹, Sreeja vamsi¹, Ramchandra Reddy¹, Molla Mahaboob Subhani^{1*}

¹Department of Microbiology, SVS Medical College & Hospital, Mahabubnagar, Telangana, India

²Department of Physiology, JNMC, Belagavi, Karnataka, India

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Corresponding Author: **Mahaboob Subhani Molla** Email: docs.subhani@gmail.com

ABSTRACT

Introduction: Self-directed learning (SDL) is a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs. **OBJECTIVES:** To evaluate SDL readiness, assess the learning outcome, evaluate the levels of self-directedness and compare the effectiveness of SDL by case-based discussion and SDL by small group discussion with role-play.

Materials and Methods: It was a prospective observational study with a total of 150 second year MBBS students in department of Microbiology. A questionnaire containing socio-demographic parameters and SDLR (Self - directed Learning Readiness) scale was used to assess SDL readiness. The 150 students were divided and 75 students each participated in SDL sessions by case-based discussion and small group discussion with role-play. Self-Rating Scale for SDL Learning (SRSSDL) tool was used to assess SDL level. Performance of students was assessed by OSPE and MCQs. Statistical analysis was performed by SPSS software. Analysis of variance was calculated by the chi square test and unpaired T test and significance was tested at $p < 0.05$ at 95% confidence interval.

Results: The total number of participants was 150 students and out of them, 66% were female students and 34% were male students. The mean age of the study participants was 20.13 ± 0.95 years. The mean scores of OSPE and faculty feedback for SDL activity with role play was higher when compared to SDL activity with case-based discussion.

Conclusion: Higher level of self-directedness in majority of students shows that students are identifying their own learning goals and strategies. Future studies are needed before considering the SDLR and SRSSDL scales as tools for surveys in medical education.

Keywords: SDLR, SRSSDL, SDL Assessment, CBD, SGD with role-play

1. INTRODUCTION

Self-directed learning (SDL) is a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes. The Competency Based Medical Education (CBME) introduced by National Medical Commission (NMC) and implemented since 2019 is organized around competencies or pre-defined abilities as outcomes of the curriculum [1]. This approach

demands that students should work in team, focus on active learning, and have self-reflection and develop self-directed learning skills [2].

SDL is an important skill required for lifelong learning in medical graduates and readiness for the same needs to be evaluated. SDL readiness (SDLR) scale developed by Fisher comprises of 29 questions and total score of 145 points, covering self-management, desire for learning and self-control domains. SDLR score will reflect the overall disposition of the students towards SDL [3, 4, 5].

SDL activity for implementation needs to be planned meticulously by first establishing

learning goals by the students, locating and accessing appropriate resources, adopting relevant learning activities and lastly monitoring and evaluating the performance of students. Another SDL readiness scale, Self-Rating Scale for SDL Learning (SRSSDL) tool developed by Williamson can be utilized to identify the learner's levels of self – directedness in learning in higher education. This scale comprises of 60 questions categorized under five broad areas of self-directed learning including awareness, learning strategies, learning activities, evaluation and interpersonal skills. This scale aids in reassessing learning strategies for effective implementation of SDL in medical students [6]. The increasing trend of self-paced learning in medical students demands for the evaluation and implementation of self-directed learning leading to higher metacognition which is a requisite for a lifelong learner [7]. This study aims to evaluate effectiveness of SDL learning activity in microbiology for second year MBBS students. The objectives for this study were to evaluate readiness for SDL in microbiology using the Abridged SDLR scale and to assess the learning outcome in selected topic in microbiology. The levels of self-directedness were evaluated using SRSSDL tool after completion of learning activity and the efficiency was compared between the groups using case-based discussion and role play.

2. MATERIALS AND METHODS

This was a prospective observational study which was conducted in Department of microbiology in a tertiary care institute in Telangana from September 2024 to January 2025 (5 months) after ethical committee approval. This study was carried out as a project to fulfill the requirements of JNMC, Belagavi's Advanced Course in Medical Education (ACME). After being proposed as a study concept for the ACME application, this protocol was selected for further investigation and implementation. The competency identified for this study was "MI 1.5: Choose the most appropriate method of sterilisation and disinfection to be used in specific situations in laboratory, in clinical and surgical practice" [8]. According to the CBME-

recommended UG curriculum, a second-year MBBS student should be more knowledgeable about sterilization and disinfection techniques and capable of discussing and evaluating the best approach in a variety of laboratory, clinical, and surgical settings. Small group and case-based discussions can be used to teach this ability, and viva voce and OSPE can be used to evaluate it. Additionally, there are many online learning materials available for this subject, making it a good choice for self-directed learning.

Various methods of sterilisation and disinfection was covered by didactic lecture for Phase 2 MBBS students and they also received a review of the study's concepts, learning objectives, resources, and adoption of learning activities. All teaching faculty of Microbiology department were trained for implementation of the project. Informed consent was obtained from 150 participants out of 151 students of second year MBBS batch. One student did not consent for participation in study due to health issues.

Participants were asked to fill a questionnaire containing socio-demographic parameters such as age, gender, residence, state from which they passed pre-university course, medium of higher education, mode of admission to MBBS and regarding their schooling experience. Further they were assessed for readiness for SDL by using Abridged SDLR scale. Abridged SDL readiness (SDLR) scale developed by Fisher comprising of 29 questions and a total score of 145 points, covering self-management, desire for learning and self-control domains. Response for each question was recorded on a Likert scale from 1 to 5 with 1 being almost never true and 5 almost always true. Based on the score, the students were categorized as below average (score of <73), average (score of 74-109), and above average (score of >110) [1, 2]. The 150 students were divided into 10 groups of 15 students and each group was further divided into 3 smaller subsets of 5 students each and assigned to one faculty for conducting small group discussions. Each group was given a variety of clinical, laboratory, and surgical scenarios along with the appropriate sterilization or disinfection techniques. They were then required to analyze and discuss the scenarios and explain why the

chosen sterilization or disinfection technique was the most suitable. These small group discussion sessions were conducted for duration of two hours and were utilized to establish learning goals in the selected competency. For the next two days, all faculties worked on locating and accessing appropriate resources about sterilization and disinfection methods in at least five various situations and the learning resources were shared with the students. The students were given an inter-session period of one week and instructed to read the given resources and return back for the learning activity in the second session.

Five of the ten groups (75 students) had case-based discussions during their second SDL session, while the other five groups (75 students) had a faculty-led role play. For the several scenarios covered in the previous session, faculty members directed case-based discussions and the students were invited to actively participate in the group discussions and the optimum sterilization and disinfection technique for each case scenario was finalized. Among the five groups for the SDL with roleplay, the various situations were divided, and each group was requested to act out the scenario before deciding on the optimal sterilization and disinfection technique for the given circumstance.

Feedback from faculty members regarding SDL session participants was documented based on the following factors, including necessary prior knowledge, active participation and contribution in the discussion, behavior during the session, completion of tasks assigned, and evidence of learning the topic, the students were rated as "not satisfactory=1," "satisfactory=2," and "very good=3." Each student had to demonstrate the optimal sterilization and disinfection approach for at least five scenarios-two clinical, two surgical, and one lab scenario-during an objective structured practical examination (OSPE). Each student received five marks based on a checklist. The faculty performed OSPE at different locations using five OSPE checklist. Lastly, a Google form with ten recollection and ten scenario-based analysis types of multiple-choice questions was used to assess students' performance for twenty marks. Additionally, the

students were requested to complete a questionnaire using the Self-Rating Scale for SDL Learning (SRSSDL) tool, which makes it easier to determine how self-directed a learner is. The 60 questions on this scale were divided into five main categories related to self-directed learning: awareness, learning techniques, learning activities, evaluation, and interpersonal skills. A Likert scale ranging from 1 (nearly never true) to 5 (almost always true) was used to record each question's response. The students were divided into three categories based on their scores: low level (60–140), moderate level (141–220), and high level (221–300) of self-directed learning [6].

Students were asked closed-ended questions using a 5-point Likert scale, with 5 representing strongly agree and 1 representing strongly disagree, to provide feedback on how beneficial or effective the SDL sessions were for learning, whether they were fascinating, engaging, or stressful [9]. Reflective writing of the SDL activity's execution and efficacy was gathered. Students' OSPE and MCQ scores in each category were examined to evaluate performance and compared to determine how effective the SDL activity was.

Statistical Analysis

Statistical analysis was performed by systematically entering data in to excel software and imported into SPSS codes to calculate descriptive statistics. Analysis of variance was calculated by the chi square test and unpaired T test and significance was tested at $p < 0.05$ at 95% confidence interval.

3. RESULTS AND DISCUSSION

Of the 150 students that participated in the study, 34% were male and 66% were female. The study participants' average age was 20.13 ± 0.95 years (Table 1).

Table 1: Age distribution of the participants

Age range	Number	Percentage	Mean $\pm$ SD
19-21 years	129	86%	20.13 ± 0.95 years
22-24 years	21	14%	22.14 ± 0.96 years
Total	150		

Of the 150 students, 124 came from urban regions and 26 from rural ones; 82.66% were

admitted under the Government Quota and 17.33% under the Management Quota. Of the 150 pupils, 6.66% were from other states and 93.33% were from Telangana.

Table 2: Self-Directed Learning Readiness Scale with sections and percentages of students who believed this statement was always true

S.No	SDLR Scale	Percentage (%)
Section 1 - Self management		
1	I prioritize my work	22.66
2	I manage my time well	9.33
3	I set strict time frames	10.66
4	I am systematic in my learning	17.33
5	I am responsible	29.33
6	I set specific times for my study	14
7	I am self-disciplined	28
8	I am organised	28
9	I am methodical	11.33
Section 2 - Desire for learning		
1	I am willing to change my ideas	20
2	I will ask for help in my learning when necessary	36
3	I am willing to accept advice from others	42.66
4	I am open to new learning opportunities	48.66
5	I am open to new ideas	45.33
6	When presented with a problem I cannot resolve, I will ask for assistance	24
Section 3 - Self control		
1	I like to solve (answer) puzzles/questions	24.66
2	I am able to focus on a problem	22
3	I need to know why	38.66
4	I critically evaluate new ideas	19.33
5	I have high beliefs in my abilities	39.33
6	I am confident in my ability to search out information	30
7	I enjoy a challenge	28.66
8	I want to learn new information	32.66
9	I enjoy learning new information	42
10	I am logical	20.66

Table 5: Mean scores of various components of SRSSDL scale for gender

Mean $\pm$ SD					
Gender	Awareness	Learning strategy	Learning activities	Evaluation	Interpersonal skills
Male	3.66 $\pm$ 0.87	3.66 $\pm$ 0.87	3.64 $\pm$ 0.87	3.62 $\pm$ 0.85	3.61 $\pm$ 0.86
Female	4.0 $\pm$ 0.87	3.93 $\pm$ 0.86	3.90 $\pm$ 0.86	3.90 $\pm$ 0.85	3.91 $\pm$ 0.86

Table 6: Mean scores of various components of SRSSDL scale for age

Mean $\pm$ SD					
Age	Awareness	Learning strategy	Learning activities	Evaluation	Interpersonal skills
19-21 years	3.88 $\pm$ 0.87	3.84 $\pm$ 0.86	3.80 $\pm$ 0.86	3.79 $\pm$ 0.85	3.80 $\pm$ 0.86
22-24 years	3.88 $\pm$ 0.86	3.82 $\pm$ 0.87	3.89 $\pm$ 0.86	3.88 $\pm$ 0.86	3.83 $\pm$ 0.87

11	I prefer to set my own criteria on which to evaluate my performance	24
12	I can find out information for myself	19.33
13	I need minimal help to find information	15.33
14	I like to make decisions for myself	45.33

Fifty percent were above average and fifty percent were average based on the SDLR score. Table 2 shows the SDLR scale responses with sections and percentages. Tables 3 and 4 provide the mean scores of the several SDLR scale components for age and gender, respectively. In the SDLR scale's self-management area, 29.33% of students said, "I am responsible." According to the SDLR scale's desire for learning portion, 48.66% of students said, "I am open to new learning opportunities." In the SDLR scale's self-control section, 45.33% of students said, "I like to make decisions for myself."

Table 3: Mean scores of various components of SDLR scale for gender

Mean $\pm$ SD			
Gender	Self-management	Desire for learning	Self-control
Male	3.44 $\pm$ 0.99	3.85 $\pm$ 0.97	3.77 $\pm$ 0.96
Female	3.64 $\pm$ 0.99	3.99 $\pm$ 0.97	3.84 $\pm$ 0.96

Table 4: Mean scores of various components of SDLR scale for age

Mean $\pm$ SD			
Age	Self-management	Desire for learning	Self-control
19-21 years	3.54 $\pm$ 0.99	3.93 $\pm$ 0.97	3.81 $\pm$ 0.96
22-24 years	3.79 $\pm$ 0.99	4.02 $\pm$ 0.97	3.90 $\pm$ 0.96

According to the Self-Rating Scale for SDL Learning (SRSSDL) instrument, 37% of participants showed a moderate level of self-directedness and 63% showed a high level.

Tables 5 and 6 provide the mean scores of the different SRSSDL scale components for age and gender, respectively.

Table 7 shows the percentages and SRSSDL scale responses for the "Awareness" segment. "I consider teachers as facilitators of learning rather than providing information only," according to the majority of pupils in this area. Table 8 shows the percentages and responses to the "Learning strategies" section. The majority of students in this area said, "I find inter-active teaching-learning sessions more effective than just listening to lectures." Table 9 shows the percentages and responses to the "Learning activities" section. In this part, the majority of students said, "I prefer to take any break in between any learning task." Table 10 shows the percentages and responses from the "Evaluation" section. The majority of students thought that "I am able to monitor my learning progress" in this section. Table 11 shows the percentages and responses to the "Interpersonal skills" part. The majority of students said that "I find easy to work in collaboration with others" in this area.

Table 7: SRSSDL scale section 1 and percentages of students who believed this statement was always true

S.no	Section 1 – Awareness	Percentage (%)
1.1	I identify my own learning needs	25.33
1.2	I am able to select the best method for my own learning	28.66
1.3	I consider teachers as facilitators of learning rather than providing information only	43.33
1.4	keep up to date on different learning resources available	19.33
1.5	I am responsible for my own learning	39.33
1.6	I am responsible for identifying my areas of deficit	29.33
1.7	I am able to maintain self-motivation	23.33
1.8	I am able to plan and set my learning goals	24.66
1.9	I have a break during long periods of work	23.33
1.10	I need to keep my learning routine separate from my other commitments	21.33
1.11	I relate my experience with new information	24.66
1.12	I feel that I am learning despite not being instructed by a lecturer	19.33

Table 8: SRSSDL scale section 2 and percentages of students who believed this statement was always true

S.No	Section 2 - Learning Strategies	Percentage (%)
2.1	I participate in group discussions	12
2.2	I find peer coaching effective	22.66
2.3	I find 'role play' is a useful method for complex learning	28
2.4	I find inter-active teaching-learning sessions more effective than just listening to lectures	34
2.5	I find simulation in teaching-learning useful	21.33
2.6	I find learning from case studies useful	30
2.7	My inner drive directs me towards further development and improvement in my learning	23.33
2.8	I regard problems as challenges	16.66
2.9	I arrange my self-learning routine in such a way that it helps develop a permanent learning culture in my life	25.33
2.10	I find concept mapping is an effective method of learning	25.33
2.11	I find modern educational interactive technology enhances my learning process	29.33
2.12	I am able to decide my own learning strategy	28.66

Table 9: SRSSDL scale section 3 and percentages of students who believed this statement was always true

S.No	Section 3 - Learning Activities	Percentage (%)
3.1	I rehearse and revise new lessons	19.33
3.2	I identify the important points when reading a chapter or an article	22
3.3	I use concept mapping/outlining as a useful method of comprehending a wide range of information	30.66
3.4	I am able to use information technology effectively	16
3.5	My concentration intensifies and I become more attentive when I read a complex study content	23.33
3.6	I keep annotated notes or a summary of all my ideas, reflections and new learning	24
3.7	I enjoy exploring information beyond the prescribed course objectives	27.33
3.8	I am able to relate knowledge with practice	22.66
3.9	I raise relevant question(s) in teaching-learning sessions	20
3.10	I am able to analyse and critically reflect on new ideas, information or any learning experiences	16.66
3.11	I keep an open mind to others' point of view	26.66
3.12	I prefer to take any break in between any learning task	32.66

Table 10: SRSSDL scale section 4 and percentages of students who believed this statement was always true

S.No	Section 4 – Evaluation	Percentage (%)
4.1	I self-assess before I get feedback from instructors	14
4.2	I identify the areas for further development in whatever I have accomplished	24
4.3	I am able to monitor my learning progress	28
4.4	I am able to identify my areas of strength and weakness	22.66
4.5	I appreciate when my work can be peer reviewed	22
4.6	I find both success and failure inspire me to further learning	27.33
4.7	I value criticism as the basis of bringing improvement to my learning	18.66
4.8	I monitor whether I have accomplished my learning goals	20
4.9	I check my portfolio to review my progress	18.66
4.10	I review and reflect on my learning activities	18
4.11	I find new learning challenging	26
4.12	I am inspired by others' success	27.33

Table 11: SRSSDL scale section 5 and percentages of students who believed this statement was always true

S.No	Section 5 - Interpersonal skills	Percentage (%)
5.1	I intend to learn more about other cultures and languages I am frequently exposed to	22
5.2	I am able to identify my role within a group	17.33
5.3	My interaction with others helps me to develop the insight to plan for further learning	22
5.4	I make use of any opportunities I come across	17.33
5.5	I need to share information with others	26.66
5.6	I maintain good inter-personal relationships with others	24.66
5.7	I find easy to work in collaboration with others	28
5.8	I am successful in communicating verbally	22
5.9	I identify the need for inter-disciplinary links for maintaining social harmony	21.33
5.10	I am able to express my ideas effectively in writing	24
5.11	I am able to express my views freely	23.33
5.12	I find it challenging to pursue learning in a culturally diverse milieu	20.66

Table 12: Students' feedback

Sl No	Question	Strongly agree (Number & %)	Agree (Number and %)	Neutral (Number and %)	Disagree (Number and %)	Strongly disagree (Number and %)
1	SDL sessions helped me to understand my strengths	27 (18%)	90 (60%)	30 (20%)	1 (0.66%)	2 (1.33%)
2	SDL sessions require facilitators motivation	24 (16%)	92 (61.3%)	29 (19.33%)	3 (2%)	2 (1.33%)
3	SDL sessions were engaging and interesting	39 (26%)	72 (48%)	30 (20%)	7 (4.66%)	2 (1.33%)
4	SDL sessions help in effective utilization of available resources	51 (34%)	66 (44%)	28 (18.66%)	3 (2%)	2 (1.33%)
5	SDL sessions help to perform better in assessments	48 (32%)	71 (47.33%)	27 (18%)	3 (2%)	1 (0.66%)
6	SDL sessions are time consuming	15 (10%)	32 (21.33%)	62 (41.33%)	33 (22%)	8 (5.33%)
7	SDL sessions are stressful	7 (4.66%)	24 (16%)	46 (30.66%)	52 (34.66%)	21(14%)
8	SDL sessions improve my further understanding of topic	40 (26.66%)	89 (59.33%)	16 (10.66%)	3 (2%)	2 (1.33%)
9	SDL is an effective teaching learning method	60 (40%)	68 (45.33%)	20 (13.33%)	1 (0.66%)	1 (0.66%)

Students were asked closed-ended questions based on a 5-point Likert scale, with 5 representing strongly agree and 1 representing strongly disagree, to provide feedback on how beneficial or effective the SDL sessions were for learning, whether they were fascinating, engaging, or stressful. According to the input gathered, the majority of students (40%) strongly agree that SDL is a successful teaching and learning approach, and 61.3% agree that motivation by facilitators were required for SDL sessions.

The pupils were rated as below expectations (below 2.5 marks), meets expectations (above 2.5 to 3.5 marks), and exceeds expectations (above 3.5 to 5 marks) by the teachers using a 5-point rating system. Table 13 shows the results of students who took part in the role-playing and case-based discussion SDL activities. Compared to SDL activity by case-based discussion (40%), students who engaged in SDL activity with role play (42.6%) received higher grades.

Table 13: Grading by faculty

Type of SDL activity	Below expectations (Number and %)	Meets expectations (Number and %)	Exceeds expectations (Number and %)
SDL with CBD	32 (42.6%)	13 (17.3%)	30 (40%)
SDL with roleplay	24 (32%)	19 (25.3%)	32 (42.6%)

Table 14 compares the OSPE, multiple-choice questions, and faculty feedback ratings of students who took part in SDL activities with role-playing and case-based discussion. The OSPE and faculty feedback mean scores for the role-playing SDL activity were higher than those for the case-based discussion SDL activity.

A total of 150 students participated, with 66% of them being female and 34% being male. This is because our institute's recent admissions have showed a notable increase in the proportion of female students. Fifty percent were above average and fifty percent were average based on the SDLR score. Alradini's. *et al.*, study yielded similar results. Age and gender did not significantly affect SDL preparedness in our study, which only included second-year MBBS students [10]. Similar findings have been

demonstrated by a study by Kiran *et al.*, and a mixed methods study done by Kalyani *et al.*, where they compared the various factors affecting the readiness for SDL in medical students at CMC Vellore and they identified influence of culture and family on SDL readiness [11, 12]. This study displayed lower level of readiness in first year medical students compared to final year medical students

Table 14: Comparison of OSPE marks, MCQs and Faculty feedback scores among SDL activities

Type of SDL activity	OSPE	MCQs	Faculty feedback scores
SDL with CBD	4.0±1.40	17±3.77	3.2±1.36
SDL with roleplay	4.29±1.05	17±4.51	3.4±1.37

Under the self-management section of SDLR scale, 29.33% students believed that; "I am responsible". Under the desire for learning section of SDLR scale, 48.66% students believed that; "I am open to new learning opportunities". Under self-control section of SDLR scale, 45.33% students believed that; "I like to make decisions for myself" which is similar to study by Deepak Anil *et al.*, [13].

According to the Self-Rating Scale for SDL Learning (SRSSDL) instrument, 37% of participants showed a moderate level of self-directedness and 63% showed a high level. Age and gender did not significantly correlate with SDL levels. According to the feedback gathered, the majority of students (40%) strongly agree that SDL is an effective teaching and learning approach. This is consistent with a study conducted by Jiazhen Qian *et al.*, that found SDL can boost medical students' creativity and self-efficiency [14]. Compared to SDL activity by case-based discussion (40%), students who engaged in SDL activity with role play (42.6%) received higher grades. The OSPE mean ratings for the role-playing and case-based discussion SDL activities were 4.29±1.05 and 4.0±1.40, respectively. The average faculty feedback scores for the role-playing and case-based discussion SDL activities were 3.4±1.37 and 3.2±1.36, respectively. Although the OSPE and faculty feedback mean scores for the role-playing SDL activity were higher than those for the case-based discussion SDL activity, statistical significance needs to be further investigated

because the sample size is lower and restricted to second-year MBBS students. SDL through role-playing was found to be a more effective approach in our study than case-based discussion. A study by Kiran M. et al. showed similar results, concluding that role play is an effective strategy for complex learning [11].

4. CONCLUSION

Higher level of self-directedness in majority of students shows that students are identifying their own learning goals and strategies. The students who participated in SDL activity by small group discussion with role play scored better in OSPE and MCQs. Future studies are needed before considering the SDLR and SRSSDL scales as tools for measuring SDL readiness and SDL levels. Measuring students' SDL readiness and levels are crucial for effective SDL activity implementation and motivating learners and facilitators to improve further.

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CONFLICT OF INTEREST

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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ETHICAL INFORMATION

Ethical approval was obtained from institutional ethics committee before conduct of study. (Approval no: IEC/DHR-05/(02)/2024)

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