Various Methods of Self-Directed Learning in Medical Education

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Abstract
Self-directed learning (SDL) is a form of education where the student or the learner plays an active role in knowledge, skill, and attitude acquisition. Medical Education requires a student to be familiar with the concepts of self-directed learning and this helps a graduate prepare himself to be a lifelong learner. It is mainly of two types: Facilitated learning, where the teacher plays the role of a facilitator, designs the learning process, teaches when necessary, corrects when wrong, and assesses the learner at the conclusion; and self-paced learning, in which the learner has a more active role in choosing his material of study, learns at his own pace and attends assessments guided by a teacher. The types of facilitated learning include Audio-video lectures, Small group discussions, donut rounds, flipped classrooms and the types of self-paced learning include online courses and digital or e-books. This review makes an effort to delve into the core aspects of self-directed learning in each of these types, their unique methods, benefits and disadvantages, and modes of assessments.

Keywords: Medical Education, Learning, Teaching Rounds, Students

Background
Learning is a method of acquisition of knowledge, skill, and attitude for a particular purpose. Imparting knowledge is the main crux of teaching. Benjamin Bloom introduced the Taxonomy of Educational Objectives in 1956, famously known as Bloom’s Taxonomy. It was further revised in 2001 to include a more dynamic conception of classification which highlighted the use of action words to describe the cognitive process which underlies a particular aspect of learning.¹ These action words help in defining and organizing objectives and thus help in designing appropriate learning objectives, assessments, and learning resources for the students. These levels help to identify various stages and aspects of teaching and learning.

There are various methods of teaching and are broadly divided into Teacher-centered and Student-centered approach.² In the former, the Teacher is the main authority figure and the students passively gain knowledge. Direct instruction, flipped classrooms (use of pre-recorded lectures), and kinesthetic learning are examples of Teacher-centered learning. In student-centered learning, both the students and the teacher play an equal role in the process. These include differentiated instruction, inquiry-based learning, expeditionary learning, personalized learning, and game-based learning. Learning methods can also be divided as high-Tech and low-Tech methods, based on the level of technology used. Self-directed learning is an essential component of student-centered learning.

Self-Directed Learning
Self-directed learning (SDL) or autodidacticism is a method of learning without guidance from a teacher or an institution. It is an active process in which the learner has to
plan, select, and be motivated enough to take charge of their learning process. It revolves around the idea of developing a motivation to learn something new and qualify self for more superior skills in the student’s subject of interest. The four key stages in SDL are being ready to learn, setting learning goals, engaging in the learning process, and evaluating learning. With the introduction of the new Competency-based Medical Education in 2019, which describes an Indian Medical Graduate’s role as a lifelong learner, there is immense scope for self-directed learning (SDL). The Medical Council of India (MCI) mandates around 250 hours of self-directed learning during the entire MBBS course. The material may be designed by a teacher or an institution and can be easily made available to the student through printed material or computer-assisted online methods. An increase in the availability of various types of online content and improvements in available software further potentiate the use of SDL. A mixed-method study conducted in a teaching hospital in 2015 in Vellore, a town in Southern India revealed that the self-directed learning readiness score among medical students decreases with passing years during their undergraduate course. They concluded saying that there is a need to address the skills among Medical students regarding SDL. There is a need to explore the methods of delivering the content to the students, assess their learning, and compare various methods.

The Necessity of Self-Directed Learning in Medical Education

Medical students are required to excel in their performance as doctors and be lifelong learners which may not be achieved solely by passive imbibition of information. Medicine is an ever-evolving science which needs the learner to be flexible and be able to plan his learning according to the present requirements. Medical education should be delivered in a way to carve a naive student to a clinician capable of making pertinent clinical judgements through his continued experience while undergoing undergraduate and postgraduate training. Metacognition, an unconscious awareness of one’s cognition, is an important requisite of a medical student and includes procedural knowledge, declarative, and conditional knowledge. The metacognitive skills in a group of first-year MBBS students were found to increase significantly after one year of formal education. Self-directed learning requires the learner to plan their learning and set task-specific goals and thus is one of many methods that help in developing metacognitive skills, which help a good learner translate into a good clinician. Thus, development of metacognitive skills during a graduate’s learning period is imperative.

Designing A Self-Directed Learning Method

Facilitated learning and self-paced learning are broad subdivisions of SDL. In the former, the content needs to be delivered through a teacher or a facilitator. There may be communication between the teacher and the learner through the mail, discussion, and online forums. Self-paced learning, on the other hand, needs the learner has to have the motivation, orientation towards learning, is required to know the available content, and is competent to choose a suitable course. The learning methods are made available in the form of lectures or notes and assessments are provided. There is a freedom to choose the learning paths and time is not a restriction.

The method used for SDL can be designed based on the characteristics of the learner and the opportunities that the institution is willing to offer.

Various Methods to Conduct Facilitated Learning

Audio-Video lectures

When a series of information is presented through either a visual system or an audio system, the processing capacity of the cognitive system may be overwhelmed and this leads to cognitive overload. According to the Dual-coding theory put forth by Mayer, and according to his Multimedia theory, the human brain collects information from different media of presentation and logically reconstructs these elements. This can be achieved through audio-video lectures. Audio-video lectures are a means of self-directed learning with the pre-recorded voice of a teacher and a presentation with relevant text and images, and animations and clinical videos where required. The use of audio-video aids during a lecture has been considered a useful way in many studies, but a study done in 2016 in Grenada regarding the use of pre-recorded audio-video lectures found that over 50% of students felt that the use of additional audio-video lectures did not benefit their learning. In the aforementioned studies, the lecture was delivered verbally by the teacher, and audio-video aids were given as an additional learning experience.

Methods of delivering an AV lecture: A meta-analysis of online lectures in undergraduate medical education by Tang et al reveals the most common methods used in delivering these lectures as slide decks along with narration, followed by narration and videos. Flipped classrooms are another method of facilitated learning in which audio-video lectures are used to teach students or learners at their residence, while the discussion of concepts is done in a conventional didactic lecture.

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Role of facilitator and student: The role of a facilitator cannot be overemphasized. The lecture may be presented by the facilitator in person or through distance education. The preparation of the learning material based on the concepts explained above, the use of adequate language, speed of talking, accent used, fluency, and tone of the voice play an important role in making a worthwhile presentation. The role of the student is in active participation in the understanding of the lecture based on the various animations, videos and narrations presented. As this method is similar to a didactic lecture, it is still teacher-centric. However, in pre-recorded lectures, as the students are at liberty to use the material at their convenience, it forms a type of self-directed learning.

Methods of assessments: After attending a lecture delivered through audio-video assistance, the students may be assessed in various methods. If the lectures are presented to a set of students, then an interactive assessment may be difficult in distance learning. They can be assessed by long essays, short essays, multiple-choice questions, and other ways of summative assessment. When the course is delivered to a single person, multiple assessments in the form of questions, multiple-choice questions, match the following and other conventional techniques can be used. Questions can be made to pop up in between the lectures and the lectures can be made more interesting. The use of pre-tests before the lecture and a post-test at the conclusion with the degree of certainty of answering-constructed response questions- helps the learner identify their unconscious competence and lack of knowledge, and thus, helps in greater understanding. The students can be made to create flow-charts, posters, or perform role-plays, after the AV lecture which further increases interest and their communication skills.

Designing these learning materials needs to be done to decrease cognitive overload by taking into consideration Mayer's theories and is depicted in table 1.

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Method to Reduce Cognitive Overload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type 1</td>
<td>If the visual channel is overloaded more than its capacity</td>
<td>Off-loading, move some information from visual channel to the auditory channel</td>
</tr>
<tr>
<td>Type 2</td>
<td>Both channels are overloaded more than the cognitive capacity</td>
<td>Segmentation: presentation of content in smaller segments</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PERTAINING: provide pertaining in names and characteristics of components</td>
</tr>
<tr>
<td>Type 3</td>
<td>Both channels are overloaded by essential and extraneous information</td>
<td>Weeding: providing concise and coherent narration by removing embellishment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Signaling: when removal of embellishment is not possible, the learner is given cues to select and organize learning</td>
</tr>
<tr>
<td>Type 4</td>
<td>Same as type 3, but the essential and extraneous materials are not demarcated</td>
<td>Alignment: placement of labeling material close to the images</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eliminate redundacy: avoiding presentation of an identical stream of spoken and printed words</td>
</tr>
<tr>
<td>Type 5</td>
<td>Overload of working memory during essential processing</td>
<td>Synchronizing: eliminate the need for working memory and present narration and video together</td>
</tr>
</tbody>
</table>
Benefits and problems while conducting AV lectures: Video presentations have an obvious benefit as more information can be presented in less time, simplify concepts, grab greater attention, and helps to conceptualize learning. However, the technical aspects of playing a video at the venue of learning may cause a major hindrance. The faculty or the student should have basic knowledge of the video player and also know to deal with accidental technical glitches. They ensure flawless video presentations, three P’s are recommended: Preliminary actions, Prepare for the worst and Practice with the actual equipment.[17]

Small group discussion

Small group discussions are conducted by a facilitator. In this type of learning, all the learners have an equal opportunity to speak, the group members can hear others’ opinions, put through their partially formed thoughts, agree and disagree without being dominated by the teacher. [18] The basic steps in a small group discussion include Forming (interaction among members of the group), Norming (bringing a set of norms and rules for the group), Storming (leaders emerge and identify participants with special talents), Reforming (Decisions about the task) and Disbanding (summarizes the activity).[19]

Methods of conducting small group discussion: During a small group discussion, a virtual situation may be created to the learners and open-ended questions are put forth. A usual small group consists of 6-8 students.[20] They may be given reading material or online resources before the beginning of the discussion or midway of the discussion. Open-ended questions bring in more and more debates and arguments which help the students to develop critical thinking and case-based learning. Small group discussions can also be concept-based or fact-based, as designed by the facilitator. The role of the facilitator in these discussions is to make sure every student gets a fair chance to speak, allow various ideas to be expressed, correct the students based on his clinical judgment and experience, provide conceptual direction to the flow of discussion and finally make a formative assessment based on their participation. The new CBME allots many topics in the curriculum for small group discussion, thus giving scope for self-directed learning.[20-22] Several methods are designed in small group discussions. They can be broadly classified as discussions, mediated activity, and independent activity.[23] Discussions include buzz sessions which are brainstorming discussions centering a small topic within a lesson and tutorial seminars where there are discussions in-depth. The mediated activity includes problem-solving sessions and Feedback sessions. In Problem-based learning, the students or learners are provided with a range of games, simulations, or participative exercises like case studies and role-plays. Feedbacks sessions interactive classes for skill development and micro-teaching. Independent activities include laboratory and field projects. They are mainly for skill development. After selecting the desired method of discussion, the facilitator provides the students with adequate time for thinking and learning by providing materials for the same. Following this, a discussion is brought about by the mediation of the facilitator.

In a study conducted in Dharwad, small group discussion was designed for I year students by dividing them randomly into small groups and projecting an image of a specimen in Anatomy on the screen. The students were instructed to explain the picture on the screen to the other groups. This exercise was felt by the students that it significantly enhanced their understanding of topics in Anatomy better, helped change their attitude towards studying, and improved problem-solving ability.[23]
Role of facilitator and student: The facilitator plays an important role by beginning and mediating the discussion.\[20\]

- Preparation is the first step towards small group learning. The facilitator has to decide the topic that can be learned by discussion and the essential method of performing the discussion.
- Asking questions or placing options is an important part of the thinking process. They can be narrow or broad. Narrow questions demand a brief response whereas broad questions help in initiating a conceptual discussion. The questions can also be based on memory, comprehension, or problem-solving. The facilitator has a role in prompting the students for answers, encouraging them to take part in the discussion, and also probing them at appropriate intervals.
- Listening to the students’ opinions and arguments give an insight into their depth of knowledge to the teacher. There are many levels of listening-skimming, surveying, sorting, searching, and studying.
- Responding to the students at necessary points in time helps to give a proper direction to the discussion and also correct the factual mistakes.

The students are the active component in a small group discussion. Their roles include gaining understanding, critical thinking, reasoning, problem-solving, decision making, and creative thinking.\[20\]

Methods of assessment: After the discussion, the students may be assessed by multiple ways like essay questions, multiple-choice questions, assessment of a skill or a task performed, objective structured clinical examination, case assessments, logbooks, and so on.\[20\] Another creative method of skill assessment is kinesthetic learning where the students have to perform a required task or demonstrate a skill to be certified. Students can also be assessed by asking them to create a crossword puzzle from the terms and concepts learned during the session.

Benefits and drawbacks: Discussions promote thinking, exploring new ideas, and reflecting upon experiences.\[20\] Many studies have found small group discussions to be more effective in learning a subject when compared to a didactic lecture.\[27,29\] They have been reported by students to be better methods to express their thoughts, increases peer interaction, found to create higher application-based knowledge, and creating interest while learning.\[29\] The drawbacks of this process include the requirement of a high teacher-student ratio and the need for more time.\[26\] Also, the teacher has to be proficient in these methods of discussion.

Doughnut or Donut Rounds

This is an innovative approach in which students are made to form two concentric circles facing each other.\[30\] The students exchange their views about a particular subject they were instructed to learn about. When signaled by the teacher or facilitator, the inner circle moves clockwise, and now each student has a new partner. The students now exchange views with the new partner. With further repetition of the steps, each student would have interacted with all students.

Role of facilitator and students: The facilitator’s main role is to assemble the students into the donut formation, topic selection, and provision of learning resources. The facilitator decides the timing and speed of the donut round (change positions after a particular period) and plays the role of a teacher by imparting knowledge at the end of the session. The students are actively learning in this method and thus, they have to be more prepared for the event by going through required sources.

Methods of assessments: Assessments can be conducted similar to small group discussions.

Benefits and problems: In a randomized trial conducted in Oxford, it was found that Donut rounds are as good as lectures in imparting factual knowledge to a group of medical students.\[31\] Another study that used Donut rounds for learning Anatomy, found that >50% of students perceived it as a valuable session and 40% of the students felt they gained appropriate anatomical knowledge while attending this session.\[32\] Donut rounds were also found to be enjoyable in learning by more than 90% of students in learning a portion of Anatomy in another study. Also, they felt that this method improved their communication skills and peer-to-peer interaction.\[31\] However, the disadvantage is that this method is time consuming and needs more faculty in order to bring many students to perform the rounds.

Self-Paced Learning

In this type of learning, the learner has control over choosing the subject or topic of his choice, controls the amount of material that has to be learned and the time during which learning happens is also decided by the learner. The teacher plays a minor role in creating content and assessment in this type of self-directed learning. A systematic review of self-directed learning revealed that when the learner was responsible for selecting his learning
resource, the knowledge gained was significantly high.\textsuperscript{[34]} In another study, it was found that self-learning was found to be better than didactic lectures in students who had a higher rank in terms of merit.\textsuperscript{[35,36]}

Features of a high-quality self-paced program include\textsuperscript{[37]}

- Designed to target small discrete learning objectives, one at a time
- Carefully selected resources and activities
- Assessment of the learner at each step and confirmation of the learner’s mastery over the topic
- Immediate feedback to the learner when in doubt.

Methods of self-paced learning

a. Online courses: The Internet is a powerful tool for the dissipation of knowledge. With the ever-developing nature of the Internet and various software, the learner has an overwhelmingly wide web of knowledge available at his disposal. A variety of web-based online courses are available for continuing medical education which can also be accessed on a cellular smartphone or a tablet. In a study in Australia, the students were given an online course inclusive of audio-video lectures, skills development programs, doctor-patient interaction videos, and a video on feedback procedures.\textsuperscript{[38]} More than 90% of the students found it enjoyable and found it very useful in improving their knowledge and skills. Some of the websites which offer online medical education are Harvard University, Coursera, EdX, Medvarsity, OpenWHO (WHO management of Health services delivery), DocMode, Medigrad, etc. Some websites offer a congregation of courses through various websites and their comparisons by tabulating them.\textsuperscript{[39]} The usual method of presentation is through video lectures by an experienced specialist with narrations. The assessments are in the form of multiple-choice questions, or case-based scenarios. One might wonder that online courses merely provide knowledge-based materials, but there are some websites which even offer online ultrasound training.\textsuperscript{[40]}

b. Digital books: These are online reading material or textbooks that have an electronic format. There may be complementary videos. Many websites offer downloads of electronic book formats. Some others have interesting wholesome information and reference images about particular specialties, including Ophthalmology\textsuperscript{[41]} and Radiology.\textsuperscript{[42]} These can never be substitutes for reference textbooks, but their easy availability and meticulous corrections by revered authors make them dependable sources. A study conducted at the University of Pittsburgh found that electronic books were preferred by almost half of the study participants and students or learners preferred textbooks in the form of printed material and other learning resources like references, research protocols in the form of electronic format.\textsuperscript{[43]}

Role of teacher and student in self-paced learning: In this type of learning, the teacher designs the course and assessment, without the knowledge of student requirements and characteristics. The study material is designed based on accepted curriculum or contemporary interests. However, the student’s role is in selecting the topic of interest and the appropriate website. He has to have the self-motivation to complete the course and answer the required assessments.

Benefits and drawbacks: Online courses offer the candidate to acquire knowledge from his workplace. Several free online courses have been offered concerning COVID-19 during the outbreak of the pandemic.\textsuperscript{[44]} An enthusiastic learner and a not-so-enthusiast can complete the course at their own pace, based on time availability. The self-reliance and personal responsibility required by learners during self-paced learning may be inculcated into every step in their journey in the course of their medical profession.\textsuperscript{[45]}

The barriers to online learning include poor motivation, poor technical skills, time constraints, inadequate infrastructure, and lack of institutional strategies.\textsuperscript{[45]} Other limitations are learning may become monotonous and uninteresting, coordination between the support team is needed at all times, lack of self-discipline, and motivation may be a great hindrance to self-paced learning and the preparation of a self-paced learning material may be expensive and painstaking.\textsuperscript{[37]}
Methods of assessments in self-paced learning: The assessments tend to be of multiple choice questions and very few courses offer questions which require essay answers. Also, as the student needs to be honest to his efforts, objective assessments are the method of choice. Most of the assessments for online resources are web-based which may be interactive or otherwise. It can be in the form of essays or multiple-choice questions. Online assessments are better suited for knowledge assessment and reported to be more objective.[46]

Conclusion
Self-directed learning has many advantages regarding knowledge acquisition, retention, and the development of metacognitive skills. They are an essential component of medical education. Many types of self-directed learning are available for a teacher and a learner. Each method has its pros and cons. The teacher has to carefully choose and design a learning resource to train a student. Also, the options for self-paced learning for an enthusiastic learner in medical education are endless. The knowledge of each type of learning method and assessment will help in gaining a stronger hold over the concepts in the life-long course of a medical practitioner.

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