Self-directed Learning in Health Professions Education

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Abstract

Introduction: Self-directed learning has been recommended as a promising methodology for lifelong learning in medicine. However, the concept of self-directed learning continues to be elusive, with students and educators finding difficulty in defining it and agreeing on its worth. Methods: In this paper we review the literature of self-directed learning in health professions education and present a framework based on Malcolm Knowles' key components of self-directed learning. Results: The key components of self-directed learning are: the educator as a facilitator, identification of learning needs, development of learning objectives, identification of appropriate resources, implementation of the process, commitment to a learning contract and evaluation of learning. Several but not all of these components are often described in the published literature. Conclusion: Although the presented framework provides some consistency for educators interested in applying SDL methods, future studies are needed to standardise self-directed learning curricula and to determine the effectiveness of these components on educational outcomes.

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Key words: Independent study, Medical education, Self-assessment, Self-directed learning, Self-education

Introduction

More than 600,000 new citations were published in MEDLINE in 2005; this raised the total number of indexed citations to more than 14 million citations.[1] In a study be Williamson et al,[2] 2 out of 3 primary care physicians described the volume of literature as unmanageable, and 1 out of 5 reported that they were not using or were unaware of the 6 selected recent clinical advances in medicine. In addition, physicians' knowledge declines with time, which may result in lower quality of care.[3] Ramsey et al[4] showed that the knowledge of internists inversely correlated with the number of years elapsed since their board certification, with a sharp decline noted after 15 years.

Textbooks and review articles lag chronologically behind the current evidence. A meta-analysis by Antman et al[5] demonstrates significant discrepancy between treatment recommendations for myocardial infarction in textbooks and review articles, compared to the preponderance of evidence produced by several multicentre randomised controlled trials. Furthermore, systematic reviews of continued medical education programmes (CME) demonstrate that most of these programmes are not effective in changing physicians' behaviour, do not affect patients' outcomes, and are generally not based on learners needs.[6-8]

Self-directed learning (SDL) has been suggested as a promising methodology for lifelong learning in medicine. The Liaison Committee on Medical Education (LCME) endorsed accreditation standards in 2004 that promote flexibility and innovation in learning and provide medical students with skills necessary for self-directed learning.[9] The Accreditation Council for Graduate Medical Education (ACGME) recommended that residents should become self-directed learners, evaluate their learning with innovative tools such as computerised diaries and portfolios, and facilitate the learning of others.[10] The American Board of Internal Medicine (ABIM) recommends that a basic component of the maintenance of certification programme is that physicians become lifelong learners and be involved in a periodic self-assessment process to guide continuing learning.[11]

However, the concept of self-directed learning continues to be elusive, with students and educators finding difficulty in defining it and agreeing on its worth.[12,13] Only 8% of SDL articles published between 2000 and 2004 provided a clear

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working definition of SDL.[14] The term SDL has been used widely in the literature to describe various concepts in learning such as self-planned learning, learning projects, self-education, self-teaching, autonomous learning, autodidaxy, independent study, and open learning.[15] In addition, SDL has been frequently used interchangeably with problem-based learning (PBL).[16-21] By means of this paper, we aim to: a) review the literature of self-directed learning in health professions education, and b) recommend a framework for the application of SDL in medical education.

Methods

We searched MEDLINE through the OVID interface using the keywords self-directed learning, adult education and self-assessment. Articles were eligible for inclusion in this review when: 1) authors explicitly identified their methodology as self-directed learning, 2) educational interventions targeted health professionals, 3) articles were published in English, and 4) articles were original research (review articles, commentaries and letters were excluded).

We considered SDL to consist of 7 key components as described by Malcolm Knowles (Table 1). Knowles[22] defined SDL as 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. We evaluated the included articles to determine how often educators applied these SDL components in their programmes and whether these components were effective compared with traditional didactics.

Results

We identified 926 articles that met eligibility criteria. The abstracts, titles and keywords of these articles were reviewed and 106 of them were deemed relevant and reviewed in full text. Twenty articles were included and qualitatively described in this review.[23-42] These articles are described in Table 2 and categorised by level of learner training, curriculum content, results, and components of SDL present in the educational intervention.

Key Principles of Self-directed Learning

The educator as a facilitator: Although self-directed learning may imply the lack of the need for an educator, learners often need an expert to introduce them to the basics of SDL including the appraisal of educational needs, adoption of a theoretical construct and development of learning goals.[43] Therefore, teachers in SDL programmes are seen as a source for skills rather than a source of content, and they assume the role of facilitators or consultants to the learner.[44] There are several examples of this in the medical education literature. Abraham et al[23] described a self-directed physiology course designed for medical students, in which a subject expert served as a course facilitator and guided the students to focus on learning objectives when they deviated from them. Allen et al[24] designed a self-directed systems-based practice curriculum for Internal Medicine residents, in which a faculty mentor spent 1 to 5 hours per mentee to assist with formulation of learning objectives and allocation of appropriate resources and relevant contacts. Students' knowledge as measured by exam scores in the first course and self-reported knowledge in the second curriculum increased as a result of the interventions.

Table 1. Key Components of Self-Directed Learning

1. The educator as a facilitator
2. Identification of learning needs
3. Development of learning objectives
4. Identification of appropriate resources
5. Implementation of process
6. Commitment to a learning contract
7. Evaluation of learning process

Identification of learning needs: Educational needs are the discrepancy between the present level of competency and the required level of competency (or the difference between aspiration and reality).[45] Identification of learning needs is an integral component of SDL. Beckert et al[46] demonstrated that learning activities based on student's needs and self-drive are more likely to be successful than activities dictated by extrinsic sources. Knowles[45] also suggested that the more explicitly learners identify learning needs and the more harmonious their needs are with societal, organisational or academic aspirations, the more likely effective learning will take place. Borduas et al[27] utilised questionnaires given to over 200 participants in previous CME activities to identify learning needs for a self-directed interactive workshop about the topic of arterial hypertension. General practitioners who participated in this activity demonstrated increased knowledge scores (from 5.5 to 8.3 out of 10; $P < 0.05$) and reported a high satisfaction rate for the event.

Development of learning objectives: Learning objectives are the desired outcomes of learning and are derived from the pool of needs generated by learners. Learners translate needs into objectives and ideally, would choose the ones that are higher on their priority list and are measurable to facilitate learning evaluation.[45] Stuart et al[34] described a pilot programme in which paediatric residents and faculty utilised individualised written commitments to learning to record their own learning goals and objectives for self-directed learning. Despite facing difficulties in establishing and working with learning goals, residents who utilised this

learning method reported that it was helpful in providing a framework or a focus for learning and increased their awareness of the learning process.

Commitment to a learning contract: A learning contract is a formal document prepared by learners in consultation with a subject expert to demonstrate "what is to be learned, how it is to be learned, and how learning will be verified".[40] Thus, learning contracts acknowledge learners' self-directedness and specify learning objectives, resources, strategies and evidence of accomplishment.[22] In a study by Parker et al,[41] a learning contract-based intervention increased the knowledge of physicians practising in community hospitals (correct answers increased from 64% to 87%; $P < 0.01$) and made more than 50% of them institute changes in patient care. Statistical significance of knowledge gains was again demonstrated with repeat testing 3 months after the intervention. Similarly, Pereles et al[42] reported geriatricians who made a written commitment to change their practice after an educational course made more changes and affected more patients when compared with counterparts in a control group. In undergraduate medical education, first- and second-year medical students who used learning contracts were able to accomplish more SDL tasks, demonstrated more positive attitudes regarding SDL, and scored higher on the self-directed learning readiness scale (SDLRS).[40]

Resource identification: Knowles[22] advocated direct involvement of learners in the allocation of learning resources. Learners in consultation with a subject expert, choose the appropriate resources based on their preferred method of learning and the type of learning objectives. He suggested that cognitive objectives are best learned by lectures, written resources, interviews, colloquy and panel discussions; behavioural objectives are best learned by experience-sharing, role-playing, sensitivity training and case-based learning and psychomotor objectives are best learned by skill practice exercises, role-playing, simulation and drills. SDL interventions designed for health professions education describe the use of written materials (e.g. articles, workbooks), computerised modules, web sites, audio-visual aids (e.g. videos) and mannequins for teaching procedural skills.[28,30,33,43,47] Beckert et al[46] showed that when medical students designed and ran their own OSCE's (objective structured clinical examination), they scored higher on the end of year examinations compared with previous years, and compared with students from other schools who took identical examinations in the same year. Similarly, in 2 other studies, Internal Medicine and Pediatric residents undertook self-directed curricula in systems-based practice and ambulatory medicine, consulted their mentors and chose the learning resources that they considered suitable for their learning styles and learning contents.[24,34] Although the studies did not report learning outcomes, through open-ended qualitative questionnaires, residents commented that their learning experiences were positive.

Implementation process: To build rapport and set the climate for SDL, facilitators should conduct introductory meetings with learners. These meetings emphasise the partnership between learners and educators, rather than dependency of students on teachers. Subsequent meetings can be utilised to identify learning needs, goals, learning plan and evaluation means.[22] Learners may experience initial negative feelings such as confusion and dissatisfaction; however, transformation to positive feelings as SDL progresses is expected.[48] Coombe et al[49] recommended an incremental approach to SDL to allow gradual acquisition of SDL skills prior to graduation; they considered the need for SDL is more critical after graduation. They routinely conducted workshops for nursing students to ease their transition from pedagogic learning methods, with which students are familiar, to andragogic methods. In graduate medical education, spontaneous incremental utilisation of SDL activities has been noted by paediatric residents as they progressed from interns to senior residents.[50] For learners who lack SDL skills, a cooperative model, as described in the nursing literature, can be considered. The educator in this model adopts a proactive role to enable introduction of SDL skills using pedagogic methods.[51]

Learning evaluation: Learning portfolios that demonstrate the acquisition of knowledge, skills, attitudes and achievements have been recommended for health professionals undertaking SDL.[52] Learning portfolios enable learners to control the educational process, maintain autonomy, promote reflective thinking, increase SDL skills and evaluate learning outcomes.[52] Portfolio computerisation can further enhance their role by providing better accessibility, ease of use and security features for confidential information.[38,39] Fung et al[39] described the use of an Internet-based learning portfolio by residents in obstetric and gynaecology to record patient encounters (e.g. a procedure), critical incidents of learning (elements of surprise outside the area of knowledge and experience), the domain of learning (e.g. cognitive), and the stimulus of learning (e.g. patient interaction). Residents were assessed by 2 instruments (the SDLRS and another instrument designed to assess future learning practices) and were compared with residents in 3 other programmes that did not utilise portfolios. Residents that used the portfolio reported higher perception of SDL, believed that future learning would less likely be derived from didactics, CME or textbooks; and more likely from online resources (*P* values <0.05).

In addition to portfolios, SDL can be evaluated by

multiple choice questions, OSCE, and qualitative and quantitative self-reported measures of competency.[22,34,35,49,53] Trevena et al[35] designed a self-directed course in population health for third year medical students that consisted of student-led group discussions, web-based resources and field experiences. Students were assessed formatively and summatively by multiple-choice and modified-essay questions. In addition, instructors assessed the students' ability to explore a population health topic by evaluating the student-led tutorials they presented to their peers on their selected topics. In a study of 4 different measures of self-directed clinical learning in undergraduate medical education, Dornan et al[53] compared a quantitative instrument measuring satisfaction with the learning process and environment; free text responses to questions about the quality of students' learning experiences; a quantitative self-report measure of real patient learning; and OSCE with written progress test results. They concluded that free text responses about the quality of learning experiences and quantitative self-report of real patient learning had the best evidence of validity.

Effectiveness of SDL

Educational programmes that utilised SDL methodologies have been described in various health professions such as medicine, nursing and dentistry, as well as other non-medical disciplines such as engineering[54] and K-12 classrooms[55] (kindergarten through 12th grade). In health professions education, SDL has been used in a variety of content areas including Chemistry, Physiology, Microbiology, Anatomy, Pharmacy, Evidence-based Medicine, Systems-Based Practice and Population Health (Table 2). In general, there is paucity of evidence to document the efficacy of SDL compared with traditional didactics. In this review, we found most studies to be mainly focused on evaluating learner's acceptability and satisfaction with SDL as well as feasibility of SDL projects rather than studies providing information on the impact of SDL learning outcomes. The 2 papers that had all the 7 components of SDL as described by Knowles were non-controlled and did not report learning outcomes.[34,37] Some of the studies that documented educational outcomes are described below.

Abraham et al[23] described a self-directed course in physiology that consisted of presentations and group discussions led by medical students; exam scores of SDL sessions were significantly higher than lecture exam scores (76 ± 0.21 vs. 72 ± 0.40; *P* not reported). Arroyo-Jimenez et al[26] designed a course in anatomy for medical students in Spain that included self-study, presentations to peers, and laboratory time. The course resulted in a trend of increased mean percentage of successfully dissected items that did not reach statistical significance. Bradley et al[28] randomised medical students undertaking a course in evidence-based medicine to a self-directed group (computer-assisted independent study) and a workshop format group. Both groups were similar in scores of knowledge, skills and attitudes. Peng[31] randomised students admitted to a medical school in China to a self-directed group (limited didactics to less than 30%, open library access, self-study and group discussions) and a control group (didactics, limited library access). Students in the SDL group had significantly higher exam scores in basic knowledge in Inorganic Chemistry, Biochemistry and Microbiology, applied knowledge in Human Anatomy, and total knowledge in Biochemistry. In all other classes, the two groups scored similarly.

Education Theory and SDL

SDL is consistent with several educational concepts and theories including the theory of adult education, humanism, constructivism, empowerment, the Schön model, and the Kolb learning cycle.[44] The theory of adult education assumes that adult learners display attributes of maturity, independence, self-direction, responsibility and individuality; and that their learning is related to their social roles and previous experiences. Thus, it may be more appropriate for adult learners to use less paternalistic learning models that promote partnership between the learner and the teacher, such as SDL.[44,45,56]

The humanist approach to learning is consistent with SDL in that the locus of learning relates to the needs of the learners and the motivation for learning is self-actualisation and self-fulfillment.[44,57] SDL is also consistent with constructivism in that learning is not acquired by transplanting knowledge in an empty reservoir; it is rather built by learners based on their prior knowledge, experiences, cultural and psychosocial background.[58] In addition, SDL empowers learners. Learners who have been personally, educationally, socially or politically oppressed, take control of their own learning and experience a liberating effect by using SDL.[59,60]

The Schön and the Kolb learning models resonate well with the philosophy of SDL. After encountering a question that requires knowledge, skills or attitudes that learners do not possess in their "zone of mastery", learners face a "surprise" that provokes learning. The problem that instigates learning can be a specific problem (a question that pertains to an individual situation) or a general problem (a gap in knowledge or skill that can be applied to in a variety of situations). Learners then progress through stages of acquiring the new knowledge or skill and return to the first stage to start a new cycle.[27,44,61,62]

Table 2. Review of key components of SDL in health professions education

Study	Learners	Study design	Learning content	Educational strategies	Findings	Explicit SDL definition	Described key principles of SDL							
							Learner's assess needs	Learner's formulate objectives	Learning contract	Learners identify resources	Well-defined Implementation plan	Self-assessment		Educator as a facilitator
												Process	Content	
Practicing physicians (CME)														
Borduas et al 2001[27]	Practicing physicians	Descriptive, non controlled	Knowledge about hypertension	Interactive workshop, group discussion	Increased knowledge about hypertension on pre- and post-intervention questionnaires	X	X	X			X	X		X
Campbell et al 1996[38]	Practicing physicians (various specialties)	Descriptive	Patient care	Computerised learning portfolio	49% of participants stated they will change their practice (patient management, practice audit, review literature, teach, research)		X	X		X				
Parker et al 1992[41]	Practicing physicians in community hospital	Descriptive, non controlled	Various topics in Internal Medicine	Learning contract	Intervention increased participants' knowledge and caused change in patient care		X		X	X	X	X	X	X
Perles et al 1996[42]	Practicing physicians	Randomised controlled	Geriatric medicine	Learning contract	Participants made more changes in patient care and affected more patients at 3 months after intervention				X					
Strasberg et al 2003[33]	Practicing physicians	Non controlled	Clinical questions	Computerised search for clinical queries	Programme was successful and feasible. No comparison group		X							
Graduate medical education														
Allen et al 2005[24]	Senior residents	Descriptive, non controlled	Systems based practice	Meetings with mentors, presentations, independent study	Residents reported increased knowledge of content and SDL skills		X	X		X	X	X	X	X

Table 2. Contd.

Study	Learners	Study design	Learning content	Educational strategies	Findings	Explicit SDL definition	Described key principles of SDL							
							Learner's assess needs	Learner's formulate objectives	Learning contract	Learners identify resources	Well-defined Implementation plan	Self-assessment		Educator as a facilitator
												Process	Content	
Bravata et al 2003[29]	Residents and Faculty	Randomised-controlled	Acquisition of SDL skills	Independent study, group study, identification of role models	Increased learners' ability to identify learning goal (P = 0.001), building learning plan (P = 0.04)		X	X		X	X	X	X	X
Fung et al 2000[39]	Residents in Obstetrics and Gynecology	Controlled, non-randomised	Obstetrical and gynaecologic skills	Computerised learning portfolio	Intervention increased residents' perceptions of their SDL (P <0.05)					X	X	X		
Stuart et al 2005[34]	Pediatric residents and faculty	Descriptive, non-controlled	Clinical topics	Individualised learning plan	60-90% of residents utilised programme; barriers identified		X	X	X	X	X	X	X	X
Undergraduate Medical Education														
Abraham et al 2005[23]	Medical students	Descriptive, non-controlled	Physiology	Presentations and group discussions	SDL sessions Exam scores were significantly (no P value reported) higher than lecture exam scores	X		X			X	X		X
Arroyo-Jimenez et al 2005[26]	Medical students	Descriptive, non-controlled	Anatomy	Self-study, group discussions, lab time, presentations to peers	Increased number of successful dissections between first and second year (P <0.001)			X		X	X	X		X
Bradley et al 2005[28]	Medical students	Randomised controlled	Evidence-based medicine (EBM)	Computer assisted independent study compared to workshops	SDL and non-SDL groups were similar in EBM knowledge, skills and attitudes (P values 0.8, 0.5, 0.5, respectively)					X				

Table 2. Contd.

Study	Learners	Study design	Learning content	Educational strategies	Findings	Explicit SDL definition	Described key principles of SDL							
							Learner's assess needs	Learner's formulate objectives	Learning contract	Learners identify resources	Well-defined implementation plan	Self-assessment		Educator as a facilitator
												Process	Content	
Done et al 2002[30]	Medical students	Descriptive, non-controlled	Basic life support skills	Reading materials, video tapes, manikins, practice in pairs	Programme was successful and feasible. No comparison group.						X			X
Fox et al 1983 [40]	Medical students	Descriptive, non-controlled	Gerontology	Learning contracts	Increased motivation to learn about gerontology, attitudes regarding SDL and ability to execute SDL	X	X	X	X		X	X	X	X
Peng 1989[31]	Medical students	Randomised controlled	Basic sciences	Reduce didactics for intervention group by 30% to allow library use; group discussions, review questions and exercises	Scores of SDL group were equal or better than control group					X	X			
Trevena et al 2002[35]	Medical students	Non-controlled	Population health	Student-led group discussion; web-based resources; field experience	Programme was successful and feasible. No comparison group.					X	X	X	X	X

Study	Learners	Study design	Learning content	Educational strategies	Findings	Explicit SDL definition	Described key principles of SDL							
							Learner's assess needs	Learner's formulate objectives	Learning contract	Learners identify resources	Well-defined Implementation plan	Self-assessment		Educator as a facilitator
												Process	Content	
Other Health Professions Education														
St. Clair 1990[32]	Nurses	Non-controlled	Basic critical care nursing	Independent study	Improved knowledge on post-test compared to pre-test (P = 0.01)						X	X	X	X
Yunek 1980[37]	Nurses	Non-controlled	Diabetes patient education	Written and audiovisual references; workshops	Programme was successful and feasible. No comparison group.	X	X	X	X	X	X	X	X	X
Aly et al 2003[25]	Undergraduate and postgraduate dental students	Descriptive, non-controlled	Dental curriculum	Software package that enables self-study and self-evaluation	98% of learners favoured the educational strategy to traditional didactics						X	X	X	
Villani 1996[36]	Students in chiropractic, osteopathy, health education and human movement	Non-controlled	Physiology	Self-study; feedback tutorials; frequent testing	80% of students preferred SDL to traditional didactics						X	X	X	X

SDL: self-directed leaning; PBL: problem-based learning; SDLRS: self-directed learning readiness scale; CME: continued medical education

Limitations of SDL

The application of SDL in health professions education is limited by the heterogeneity in the implementation and definitions of SDL by educators. In addition, only a few randomised studies document the efficacy of SDL. There is also a lack of evidence on the content that is most appropriate for SDL.

Furthermore, there is no standardised method to assess learners' readiness for SDL. The most widely used and studied scale is the SDLRS, developed by Guglielmino in 1977. Despite the good convergent, divergent and criterion validity, the SDLRS is criticised for reliance on self-report instead of objective data and for its inability to predict future learning behaviour.[44,63] Other readiness scales, such as the Oddi continuing learning inventory (OCLI), which emphasises personality traits enabling for SDL, and the Ryan's questionnaire, which emphasises students' perceptions of SDL, have little evidence of validity.[63-65] The accuracy of learners' self-assessment of learning needs and learning outcomes has been doubted repeatedly in the literature. Inaccurate self-assessment was described in medical students, residents and practising physicians and has been demonstrated across the various medical specialties and in different task formats.[66-71]

SDL and PBL have often been used interchangeably in the literature, often erroneously. Since SDL is often initiated after encountering an educational challenge or a "problem",[27] SDL has been linked with problem-based learning (PBL) in the literature. PBL is defined by Barrows et al[72] as learning that results from the process of working towards the understanding of a resolution of a problem; the problem is encountered first in the learning process.[72] Therefore, PBL curricula often include components of SDL. This occurs when the teacher assumes the role of facilitating learning process rather than being a content source, when the teacher fosters SDL skills and behaviours, when learners' formulate their own objectives, identify learning resources and perform self-assessment. However, this is not always the case, and PBL curricula can contain learning objectives dictated by teachers and course organisers and can also include didactics.[73,74]

In addition, the evidence regarding SDL activities in PBL curricula is conflicting. On one hand, some studies showed that medical students[16,19] and paediatric residents[18] who participated in PBL curricula exhibited more SDL skills and behaviours. They had higher scores on the SDLRS scale, utilised learning resources such as libraries and electronic medical databases more frequently, and spent more time on independent study. On the other hand, a study by Lloyd-Jones et al[17] concluded that the learning experience of medical students using a PBL curriculum was not self-directed and was dependent on faculty resources. Similarly, pharmacy and nursing students' readiness for SDL as measured by the SDLRS scale did not improve or even declined after participating in PBL curricula.[20,21]

SDL has been advocated within conventional educational settings in rigid institutions as well as when access to academic settings is limited[32] and despite scarcity of evidence, we believe it is compatible with several educational frameworks, particularly, PBL and experiential learning. Moreover, there is a debate regarding whether SDL can be taught or is it an inherent personal trait. We found ample evidence to show that SDL can be taught. In fact, in at least 4 of the studies included in this review, it was clearly demonstrated that the interventions used led to increase in learner's knowledge about SDL, SDL skills, ability to identify learning goals, develop learning contracts, execute SDL, as well as improved perceptions and attitudes about SDL.[24,29,39,40]

There is no high-quality evidence to determine learner's characteristics most suitable for SDL. Knowles and others implied that it is more suitable for adult learners who already have a reservoir of knowledge and can apply their learning immediately to their practices, and recommended it for heterogeneous groups of learners with different past experiences.[22,45,60] Similarly, it was found that the more residents advanced in training, the more they utilised SDL resources.[50] Yet, SDL is described as effective in children and in preliminary and secondary education.[55] Therefore, the issue of learner characteristics most suitable for SDL is in need for further studies.

We acknowledge several limitations of this review paper. Studies that did not overtly describe SDL were not included in this review. Since our intention was to describe what educators considered to be SDL, we used a search strategy that was more specific and less sensitive than what would be typically used in a systematic review of the literature. Therefore, we did not search for keywords such as autodidaxy, independent study or open learning. The second limitation relates to the fact that none of the 20 articles included showed SDL to be inferior to traditional didactics. Hence, publication bias has clearly affected the results of this review making it difficult to determine which strategies are not effective in SDL and should be avoided.

Conclusion

SDL is a potential methodology to promote lifelong learning in medical education. With the explosion of new content, competency based education that requires SDL, e.g., the Practice-Based Learning and Improvement competency (PBLI) and the requirements for the Maintenance of Certification by the ABIM,[10,11] there has been increasing interest in SDL among educators. To date, the most comprehensive description of SDL is the one by

Malcolm Knowles, which includes the components of the educator as a facilitator, identification of learning needs, development of learning objectives, identification of appropriate resources, implementation of the process, commitment to a learning contract and evaluation of learning process. Numerous medical educational programmes have applied some or all of these components, although in general there is a lack of evidence to document the efficacy and salience of the individual components of SDL. Further research is necessary to evaluate the effectiveness of SDL in medical education, to establish the content and learner characteristics that are most appropriate for SDL (level of training, prior experience and skills), and to assess learners' readiness for SDL.

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