Does Medical Training Promote or Deter Self-Directed Learning? A Longitudinal Mixed-Methods Study

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Abstract

Purpose

The School of Medicine, University of Saskatchewan curriculum promotes self-direction as one of its learning philosophies. The authors sought to identify changes in self-directed learning (SDL) readiness during training.

Method

Guglielmino's SDL Readiness Scale (SDLRS) was administered to five student cohorts (N = 375) at admission and the end of every year of training, 2006 to 2010. Scores were analyzed using repeated-measurement analysis. A focus group and interviews captured students'

and instructors' perceptions of self-direction.

Results

Overall, the mean SDLRS score was 230.6; men (n = 168) 229.5; women (n = 197) 232.3, higher than in the average adult population. However, the authors were able to follow only 275 students through later years of medical education. There were no significant effects of gender, years of premedical training, and Medical College Admission Test scores on SDLRS scores. Older students were more self-directed. There was a significant drop in scores at the end of year one for each of the cohorts ($P < .001$), and no

significant change to these SDLRS scores as students progressed through medical school. Students and faculty defined SDL narrowly and had similar perceptions of curricular factors affecting SDL.

Conclusions

The initial scores indicate high self-direction. The drop in scores one year after admission, and the lack of change with increased training, show that the current educational interventions may require reexamination and alteration to ones that promote SDL. Comparison with schools using a different curricular approach may bring to light the impact of curriculum on SDL.

Self-directed learning (SDL) has been accepted as an important educational principle in the context of higher education. With the growing use of online and distributed education, there is increasing focus on the concept of SDL, which is defined in many ways. Campbell et al[1] define SDL as *behaviors* that range from participation in programmed learning to the self-initiated, self-planned activities of such highly directed self-learners as Maslow's self-actualizing individuals.[2,3] Hammond and Collins[4] describe SDL as a *process* in which learners take the initiative, with the support and collaboration of others. But we believe the concept of SDL is best captured by Knowles[5] as a process in which individuals take the

initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes.

Background

SDL has been shown to elevate the student's confidence and facilitate independence in learning in dynamic and challenging educational and work environments. SDL allows learning to progress beyond mere knowledge acquisition to being a memorable and motivating experience.[6,7]

Why is SDL important in medicine?

Undoubtedly, health professionals need to be self-directed to obtain the knowledge, skills, and attributes essential for professional growth, as they will be practicing in a gamut of surroundings and no single education program can expose them to the variety of challenges they will be facing in the health care system.[8] SDL has been increasingly emphasized in the medical field. For instance, the scholar role of the

CanMEDS 2005 Physician Competency Framework emphasizes SDL by requiring physicians to demonstrate a lifelong commitment to reflective learning,[9] and both the American Board of Medical Specialties and the World Federation for Medical Education include SDL as a characteristic that should be evaluated during medical education.[10,11]

The Accreditation Council for Graduate Medical Education, too, identifies practice-based learning (a form of SDL) and improvement as one of its six core competencies.[12] In addition, continuing medical education for physicians is based on the assumption that physicians are self-directed leaders who can accurately predict their own learning needs, set goals, engage in appropriate learning activities, and regularly and accurately assess the outcomes.[13,14]

Competencies of SDL

The competencies of SDL have been described by many.[5,15,16] They include proficiency in assessment of learning gaps, evaluation of self and others, reflection, information management, critical thinking, and critical appraisal.[15] Although all these characteristics seem

to indicate autonomy, SDL involves interaction with peers and teachers to exchange information.[17]

Can SDL be taught?

Whereas the advantages of being self-directed and the characteristics of a self-directed learner are well documented, it is still debatable whether self-direction can be taught and/or used in all situations and at all educational levels in higher education. SDL is often described as a continuum, present in all individuals to some extent, with those who are least self-directed being totally dependent on the teacher for learning.[5,16] The other end of the spectrum is the totally self-directed learner, who independently determines what is to be learned, identifies the resources, solves problems, and evaluates. It should be noted that a person who is highly self-directed in a particular situation may be very much less self-directed in a new and unfamiliar context.[18] Grow,[16] in his staged SDL model, describes the learner, at any given time or learning situation/context, to be in one of four stages: dependent (stage 1), interested (stage 2), involved (stage 3), and self-directed (stage 4). He gives examples of strategies that teachers can use in each of the stages to promote learning, such as the teacher as a coach using lecture and drill, among others, in stage 1, to the teacher as a consultant using strategies such as internship, dissertation, and a self-directed study group in stage 4. Educators need to diagnose the learner's stage of self-direction and prepare the learner to advance to higher stages. According to Grow, although learning in a dependent mode goes against the principle of student-centered styles of teaching and adult learning, there is nothing demeaning or destructive in promoting temporarily dependent relationships as long as the purpose is to advance learners to higher stages.

Measuring SDL readiness

There are several instruments that have been developed to measure SDL readiness.[15,19–23] The more widely used instruments are Guglielmino's[15,24] Self-Directed Learning Readiness Scale (SDLRS), Oddi's[19,20] Continuing Learning Inventory (OCLI), Ryan's[23] ability and importance scores, and Fisher and colleagues'[18] SDL readiness scale. Guglielmino's SDLRS, the instrument

used in this study, is described in detail in the Method section below.

SDL and the College of Medicine, University of Saskatchewan

The College of Medicine, University of Saskatchewan, has adopted an educational philosophy that encourages cooperative, active, self-directed, and experiential learning (CASE) in its undergraduate medical curriculum and strives to use these learning strategies throughout training. Student enrollment has steadily increased, as in other Canadian medical schools, from 60 students (2007), to 84 (2008), to 100 (2012). In the four-year curriculum, students spend the first 2.5 years primarily gaining foundational knowledge, skills, and attitudes. A large part of their time is spent in large- and small-group (cooperative) sessions and in the anatomy laboratory. Wherever possible, active learning strategies (such as student response systems, mind map, discussions, etc.) are used. Some interprofessional case discussions also occur. In year one, most afternoons are designated for SDL. Assessment is typically done using written examinations.

The last half of year three and the fourth year of the four-year curriculum are primarily spent in the clinical setting. Students rotate through eight core areas (anesthesia, emergency medicine, family medicine, internal medicine, obstetrics–gynecology, pediatrics, psychiatry, and surgery) and electives. The 13-week elective time is spent in clinical areas of individual students' interests. In clinical settings, students actively participate in managing patients under supervision and in small-group teaching sessions. Assessment is done using patient logs, preceptor evaluations, and both written examinations and objective structured clinical examinations.

Although our curriculum promotes the CASE philosophy, it is not known whether our students are indeed self-directed and if and how our curriculum promotes self-direction. Therefore, the purpose of our study was to measure the self-directed readiness of medical students at admission and to observe trends in that trait as students progress through medical school.

Method

The instrument

The SDLRS consists of a self-report questionnaire of 58 questions and is one of the most common instruments used to assess SDL readiness.[24] It measures eight constructs:

- Openness to learning opportunities
- Self-concept as an effective learner
- Initiative and independence in learning
- Informed acceptance of responsibility to one's own learning
- Love of learning
- Creativity
- Positive orientation to the future
- Ability to use basic study and problem-solving skills

It uses a five-point Likert scale (1 = almost never true of me, I hardly ever feel this way; 5 = almost always true of me, there are very few times when I do not feel this way). SDLRS scores range from 58 to 290, with an average adult score of 214 (range: 189–240.17).[24] The scores are interpreted as 58 to 201 (below-average SDL readiness), 202 to 226 (average SDL readiness), and 227 to 290 (above-average readiness). The scores obtained by an individual indicate the current level of readiness for SDL, with scope for raising levels through appropriate educational interventions.

The instrument has a test–retest reliability of 0.829 and 0.79,[25,26] a Pearson split-half reliability estimate of 0.94, and a Cronbach alpha reliability coefficient of 0.87.[15] The validity of the instrument has also been studied extensively.[24,27,28] This instrument is considered to be accurate and useful for measuring readiness for SDL.

Participants

After obtaining approval from the university behavioral research ethics board and gaining informed consent from participating students, the SDLRS (described above) was administered at admission to five cohorts of students (in 2006, 2007, 2008, 2009, and 2010) enrolled in the undergraduate medicine (MD) program, a total of 375 students. Prior to administration, the purpose of the study was explained, and the protocol for administration, as given by

the SDLRS developers, was followed. Because of the importance of this study to the curricular mandate of the College of Medicine, all students admitted into the medical program were encouraged to participate in the study. The SDLRS was administered to each group at their admission (i.e., within one week of starting classes in the first year) and then every year during the final semester of completing course work. Time was specifically allocated within the undergraduate program for administering the questionnaire. The SDLRS was administered in paper form to most students. Students who were absent at the time of in-class, face-to-face administration were given the option to attempt the SDLRS online.

Because of funding constraints, the last assessment was performed in April 2011. The MD program at the University of Saskatchewan is a four-year program. In April 2011, the 2008 cohort were in the third year of their program; thus, the SDL scores at the end of the program (i.e., scores at the end of the fourth year) were not available at that time. Similarly, for the 2009 and 2010 cohorts, who were in the second and first years of their programs in April 2011, the only assessments we were able to record up to that point were ones up until the end of the second and first year of their programs, respectively.

Data analysis

In this mixed-method study, we used a distinct quantitative and qualitative approach. During data analysis, only students who were registered full-time on a continuous basis, with successful clinical rotations, were included in the study.

Quantitative. Logistic regression and model-building strategies were used to identify which covariates were significant. SPSS (Statistical Package for Social Sciences–Version 19, Chicago, Illinois) was used for analysis. Paired t tests/ ANOVA were used to investigate whether means of the scores differed between genders, ages at admission, and years of premedical university education. All results were analyzed using $\alpha = 0.05$.

SDLRS scores were also compared with Medical College Admission Test (MCAT) scores in the biological sciences section.[29] MCAT scores have been shown to be an indicator of academic preparation for medical school and predictors of performance in the United States Medical Licensing Examination step scores.[30] Because there is emphasis on the biological sciences in medical schools, for our study, the scores obtained in the biological sciences (MCAT-BS) were considered most appropriate and relevant for comparison with SDLRS scores.

Qualitative. At the end of the study, all instructors in the medical school were invited to participate in interviews. Six instructors volunteered, and we conducted semistructured interviews with them.

Student volunteers from the first and second years of study were recruited via e-mail from each cohort to participate in a focus group. This group used semistructured questions (shown in Appendix 1) and consisted of five students. This focus group was formed to gain a better understanding of what facilitates and deters SDL. The recorded interviews and focus group discussions were transcribed. The transcriptions were independently examined for common themes by three coders (K.P., A.B., and another qualitative research expert). Repeated discussions were held until agreement among coders was attained.

Results

At admission, the average SDLRS score of all 375 students in the five groups was 230.58. There were no significant differences between the mean scores of each of the cohorts at admission except for the 2007 cohort's mean score, which was significantly lower (226.9). Some of these students did not complete the questionnaires in the following years of training. As a result, we followed 275 students longitudinally for much of their medical education and were able to observe the entry-to-exit scores of two admission intakes, in 2006 and 2007, a total of 126 students.

Gender and SDL readiness

Table 1 provides the overall mean SDLRS scores of all 375 of the students in the five cohorts. There were no significant differences between the scores of men and women overall and in each of the cohorts.

SDL readiness and age at admission

Table 2 compares the SDLRS scores of the five cohorts of students on the basis of age at admission. Age was considered to be a continuous variable in this study, and an increase in one year of age at admission had an overall positive impact on SDLRS scores. Overall, students who were older had significantly higher scores ($P = .002$) than did younger students.

SDL readiness and MCAT-BS scores

The MCAT-BS scores of individual students were compared with their SDLRS scores at admission. There was no correlation between the two scores.

SDL and years of premedical university education

The scores of students with five or more years of premedical university education were used as a reference to compare students with fewer years of education. The results obtained are tabulated in

Table 1

Mean Self-Directed Learning Readiness Scale (SDLRS) Scores of Male and Female Medical Students in Five Cohorts on the whole, for all assessments, University of Saskatchewan College of Medicine, 2006 to 2010*

Cohort	Male students		Female students		P value
	n	Mean score (SD)	n	Mean score (SD)	
2006	32	230 (25.7)	27	235 (18.54)	.262
2007	38	224.5 (19.27)	29	222.2 (21.75)	.582
2008	33	231.9 (21.07)	51	235.3 (23.66)	.438
2009	32	230 (29.91)	51	229.1 (35.75)	.826
2010	37	232.1 (22.72)	45	238.2 (17.39)	.140
Total	172	229.5 (21.95)	203	232.3 (22.33)	__

*The SDLRS questionnaire was administered to all first-year medical students (N = 375) in each of the study years within a few weeks of admission. Some students did not complete the questionnaires in the following years of training; as a result, 275 students were studied. The scores are interpreted as 58 to 201 (below-average SDL readiness), 202 to 226 (average SDL readiness), and 227 to 290 (above-average readiness).

Table 2

A Comparison of the Self-Directed Learning Readiness Scale (SDLRS) Scores of Medical Students in Five Cohorts at Admission, Based on Their Age at Admission and Premedical University Education, University of Saskatchewan College of Medicine, 2006 to 2010*

Cohort	Estimate	P value	Mean age, years (SD)	P value	Years of premedical education								
					Two years			Three years			Five years or more		
					No. of students	Mean score (SD)	P value	No. of students	Mean score (SD)	P value	No. of students	Mean score (SD)	P value
2006	0.38	.58	23.7 (3.6)	n/a	12	234.7 (17.23)	.80	13	228.1 (20.74)	.24	15	236.6 (22.49)	Reference†
2007	1.27	.022‡	22.27 (3.6)	n/a	7	230.7 (15.91)	.763	21	217.3 (19.70)	.027‡	20	228.6 (17.57)	Reference†
2008	1.7	.008§	23.55 (3.69)	n/a	4	230 (11.18)	.355	24	231.9 (24.1)	.153	29	239.6 (23.22)	Reference†
2009	0.44	.548	23.45 (3.27)	n/a	11	236.1 (19.34)	.191	26	229 (23.88)	.706	24	226.9 (27.00)	Reference†
2010	0.9	.199	23.2 (2.88)	n/a	20	229.4 (24.49)	.51	18	236 (20.49)	.686	17	235 (17.90)	Reference†
Overall	0.92	.002§	22.65 (2.95)	n/a	54	232.2 (19.36)	.734	102	228.01 (22.99)	.057	105	232.98 (22.82)	Reference†

*The SDLRS questionnaire was administered to all first-year medical students (N = 375) within a few weeks of admission. Some students did not complete the questionnaires in the following years of training; as a result, 275 students were studied. The scores are interpreted as 58 to 201 (below-average SDL readiness), 202 to 226 (average SDL readiness), and 227 to 290 (above-average SDL readiness).
†"Reference" refers to the scores of students with five or more years of premedical education, which were used as references.
‡P = .05.
§P = .01.

Table 2. Overall, there was no correlation between years of education and SDL. Those with three years of premedical university education had significantly higher scores in the 2007 cohort, and the average scores of students in all cohorts with three years of preuniversity education almost reached significance ($P = .057$).

Changes in SDL readiness of medical students from admission to graduation.

Table 3 and Figure 1 indicate the mean SDLRS scores obtained by students in the five cohorts (2006–2010) as they progressed through the four-year medical school program. The scores of two cohorts (2006, 2007) were obtained until the end of training. Four of the possible five scores, three of the possible five scores, and two of the possible five scores were obtained for the 2008, 2009, and 2010 cohorts, respectively. There was a significant drop ($P < .001$) in SDLRS scores in all cohorts one year after admission. The scores of all cohorts continued to be significantly lower than that at admission throughout training and at graduation. The mean SDLRS scores of the 2006 cohort were used to calculate the effect size. The effect sizes of the score at admission versus end of year 1, admission versus end of year 2, and admission versus end of year 4 were 2.997, 1.841, and 3.064, respectively. A similar trend was seen for the other cohorts.

The results of the focus group and instructor interviews provided interesting and important insights into their understanding of SDL and curricular activities that promote or deter SDL.

Definition of SDL

Both students and instructors were asked to provide their definitions of SDL. Of the six instructors interviewed, five defined SDL in a narrow way as students having choice over the resources they use, and where and how they learn what is required of them within the curriculum. The following quotations of two of the instructors illustrate general perceptions:

> It would be learning [what] a student does, in which he or she seeks out the learning resources and usually does it in a way that he or she chooses sort of when and how the learning happens.

> [Instructors] set the students parameters for learning: the reason or clear objective of what's required at the end, and then (students) set off to find their own way towards the objective.

Table 3
Changes in Self-Directed Learning Readiness (SDLR) of Medical Students in Five Cohorts From Admission to Graduation, University of Saskatchewan College of Medicine, 2006–2010*

| Cohort | When SDLR scale questionnaire was taken | | | | | | | | | |
| | At admission | | After 1 year of training | | After 2 years of training | | After 3 years of training | | At end of program | |
	Mean score (SD)	P value	Mean score (SD)	P value	Mean score (SD)	P value	Mean score (SD)	P value	Mean score (SD)	P value
2006	239.7 (19.38)	—	227.8 (21.67)	.004†	230.2 (23.37)	.074	Missing data	—	223.8 (25.26)	.003†
2007	226.9 (20.12)	—	220.6 (20.19)	.081	Missing data	—	225.3 (19.62)	.677	219.9 (21.30)	.01†
2008	239.9 (18.77)	—	231.6 (23.69)	.021‡	230.7 (24.04)	.014†	229.4 (23.20)	.008†	Not available§	—
2009	238.6 (16.70)	—	225.7 (23.37)	<.0001¶	229.9 (26.35)	<.0001¶	Not available§	—	Not available§	—
2010	239.6 (18.05)	—	230.1 (21.58)	.004†	Not available§	—	Not available§	—	Not available§	—
Overall	237.2 (estimate)	—	227.4 (estimate)	<.0001¶	227.1 (estimate)	<.0001¶	227.4 (estimate)	<.0001¶	227.4 (estimate)	<.0001¶

*The SDLRS questionnaire was administered to all first-year medical students (N = 375) in each of the study years within a few weeks of admission. Some students did not complete the questionnaires in the following years of training; as a result, 275 students were studied. The scores are interpreted as 58 to 201 (below-average SDL readiness), 202 to 226 (average SDL readiness), and 227 to 290 (above-average SDL readiness).

†P = .01.

‡P = .05.

§Because of funding constraints, the last assessment was performed in April 2011. The MD program at the University of Saskatchewan is a four-year program. In April 2011, the 2008 cohort was in the third year of its program; thus, the SDL scores at the end of the program (i.e., scores at the end of the fourth year) were not available at that time. Similarly, for the 2009 and 2010 cohorts, who were in the second and first years of their programs in April 2011, the only assessments the authors were able to record up to that point were the ones until the end of the second and first years of their programs, respectively.

¶P = .001.

The definition was not very different in the eyes of students. Students, too, wanted a clear framework within which they choose how and when to learn. The emphasis of SDL was only in how and where the learning occurs—not on what. It was an expectation that the "what" would be provided by the instructors to students, as one student remarked:

> The objectives are all laid out for you and the docs/professors present the basics of it and you're expected to get more of the information on your own.

Activities in the current curriculum that promote SDL

The instructors and students identified some of the activities within the current curriculum that promote SDL: The time allocated for SDL—especially in the first year—was considered valuable. As part of the curriculum, a few hours of every afternoon in year 1 is earmarked for SDL. However, it was felt that being given time, without direction and monitoring, deterred SDL. As one instructor put it:

> Maybe in the early stages students really need more guidance, and if we don't give them that guidance in those early stages, then I think that's a real barrier to self-directedness. It's really about having a facilitated and guided approach to their self-direction in the early stages, giving that feedback when they have engaged in self-directed opportunities and having the students reflect on it. I think that is going to facilitate better long-term self-direction, not just "You need to be a self-directed learner." What does that even mean and how is that even fostering better learning?

Students put forth their views on activities that promoted SDL:

> It's important to have an outline of what you should learn, what's important to learn, etc.

> To have a good debriefing at the end; [an overview per se] to sort of "assess" if the goals were achieved.

> A need for "available time" in the schedule.

> Group projects that give time and foster accountability.

Other activities identified by students and instructors that foster SDL were integrative case sessions, opportunities to shadow health care professionals, students being able to choose electives during the
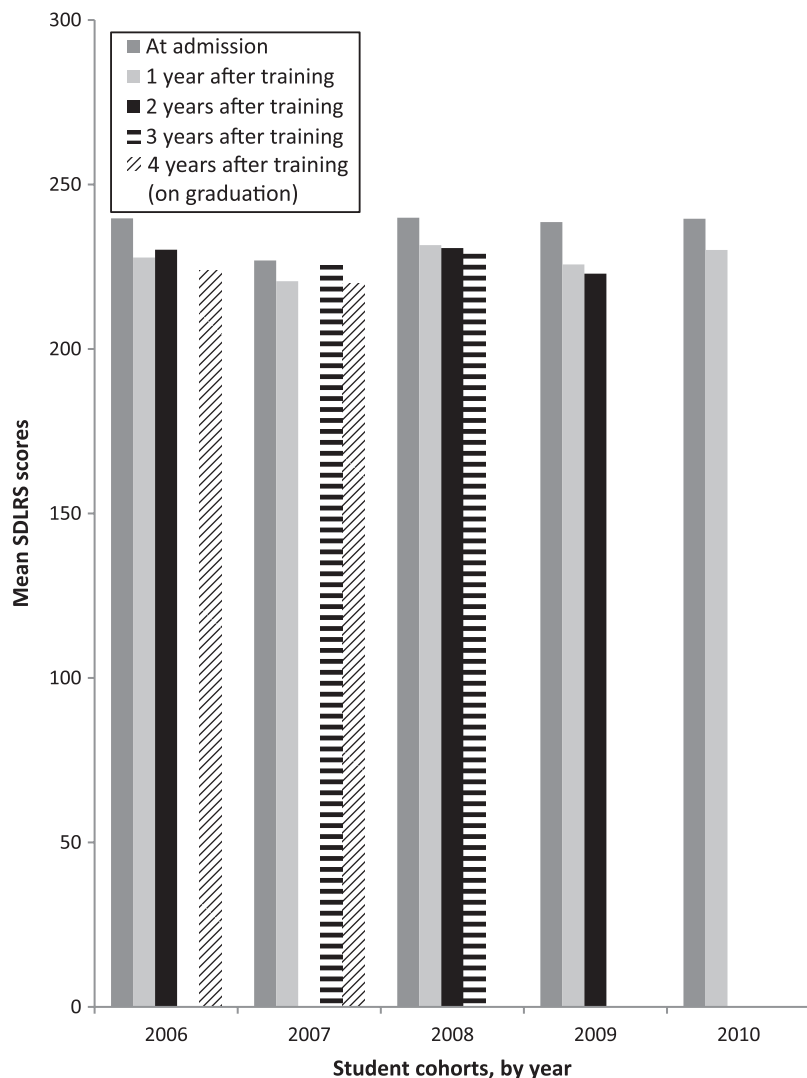
Figure 1 Comparison of Self-Directed Readiness Scale (SDLRS) scores of medical students in five cohorts with students' years of medical training. At the School of Medicine, University of Saskatchewan, the SDLRS questionnaire was administered to all first-year medical students (N = 375) in each of the study years at admission and then every year during the final semester of completing course work. Some students did not complete the questionnaires in the following years of training; as a result, 275 students were studied. The scores are interpreted as 58 to 201 (below-average self-directed learning readiness), 202 to 226 (average self-directed learning readiness), and 227 to 290 (above-average readiness). See also Table 3 for another view of these data.

third and fourth years, extracurricular activities such as participation in committee work, student interest groups, and SWITCH (Student Wellness Initiative Toward Community Health), a student-led community clinic.[31]

Factors that facilitate/deter SDL

As part of the interview/focus group, participants were asked to reflect on factors that facilitate or deter SDL. Two themes clearly emerged: one related to the learning culture and environment and the other related to assessment.

Instructors felt that the planned learning activities were still lecture based and that

enough opportunities were not presented to students. It is important to have SDL as a longitudinal theme:

> I think there are just not enough opportunities. We provide too much and don't expect them to do any SDL.

> I think one of the things that we do to get in the way is that we fill up people's time with all kinds of compulsory things. They don't actually have time to go and pursue their interests.

Instructors felt that SDL has to be a theme throughout the curriculum, not introduced in just one or two courses. In addition, the entire organization has to consider SDL valuable:

The whole thing is in silos, right. Still first year, second year, and third year. I don't see a thread of continuity, which there should be.

The entire organization has to value it, not just one course and one activity. It has to be a component throughout the whole year of the curriculum.

I think … there is sort of a culture within the school coming from sort of what they are learning from students in upper years and what they are learning from teachers, and also a culture established prior to coming into our program from their largely basic sciences, undergraduate backgrounds. I think that culture exists to a certain extent at our school: that if it's not on a PowerPoint slide, you don't need to know it; you're not responsible for learning it. I think that culture is a deterrent to self-directed learning, and it basically leads the students to expect that the only stuff they need to learn is what's on a PowerPoint slide.

SDL was thought to be a guided process, and skills in SDL had to be taught. Instructors said:

> Well, it's my opinion that being self-directed is a natural progression, that everybody is self-directed to some extent or another, and that we move towards relative independence in our learning as we learn more about something. So we need to help them become very competent at a basic level in things and then from there they can select areas in which they may want to learn more. That's important. We need to provide the time for them and the encouragement as well.

Both students and instructors felt that the type of assessment played an important role in SDL. Students felt that when examinations focused on memorization, it deterred SDL:

> We have examinations that are very focused on specific objectives, so our assessment system maybe could be changed to include a portfolio where people could show what they learn in particular areas over and above what the curriculum did and to demonstrate their interest and competence in another area. That's one thing I think that could be done and one place where I think we deter. We push them into so much assessment in particular areas that we've already identified that they don't have time to do the other.

Instructors also identified the faulty examination system to be a major deterrent to SDL:

And I think very much [that] the expectation that it's only going to be assessed if it's taught in the class, definitely is a deterrent … to sort of exploring other areas that may be interesting or important to that student.

Towards the end of the focus group/interviews, students and instructors were told that preliminary findings of this study seemed to indicate that SDL readiness was decreasing with increasing years. Both groups were not surprised at the findings:

It's unfortunate, but not surprising.

I think it would be … because students feel overwhelmed by the volume of material that is coming at them and they want to try to learn it in a way that seems easiest and most efficient, which might just be sitting in a class and reading notes again and again.

In summary, SDL was defined as relating to the process of identifying the time and resources for learning knowledge, skills, and attitudes already identified by the instructor. There were not enough opportunities within the curriculum for SDL, and the culture and environment have to foster SDL. It was felt that SDL has to be taught and is a guided process requiring feedback. The current overloaded curriculum, with little time to pursue one's own interests, coupled by the type of assessments that focused on clearly defined objectives, seemed to deter SDL, and participants were not surprised that SDL readiness may be diminishing following admission into medical school.

Discussion

Reflections on the major findings

SDLRS scores, adult population, other health professions, other medical schools. The average score of the medical students at admission was 237.2 and on the whole, for all assessments was 230.58—higher than 214, the national mean score for general adults.[32] Our findings are similar to those of other studies[32–34] of adult health professionals' programs. For instance, scores reported for nursing students had a group mean of 234.77[34]; medical students at an osteopathic school, 244.16[33]; and at the University of Texas Medical Branch at Galveston, 235.81.[32]

Interestingly, on comparing the scores at admission between cohorts, the

average scores of the 2007 cohort were lower than those of the other cohorts. The only major change introduced that year was the admission system. In 2007, multiple mini-interviews (MMIs)[35] were used for the first time in our institution for selecting candidates. Prior to 2007, panel interviews with representatives from different stakeholders, such as students, family physicians, community, and faculty as panel members, were used, along with MCAT scores and scores obtained in undergraduate training. Although there are discussions raised about the personality qualities of candidates selected with MMIs,[36] if the low scores are to be attributed to the selection process, one would expect low SDLRS scores in the subsequent cohorts 2008–2010. Because this is not the case, reasons for the significantly lower scores cannot be explained by the introduction of the MMI alone. It may be of interest to compare SDLRS scores at admission between medical schools that use MMIs and those that don't to see whether performance in MMIs correlates with SDL readiness.

SDL readiness and gender. There were no significant differences in the scores obtained by men and women. These findings are in line with several other studies[37–39] and differ from those of a previous study which reported a higher SDLRS score by women than by men.[40]

SDL readiness and age. Older students had significantly higher scores than younger students. This is consistent with the findings of Reio and Davis[38] and Kell and Van Deursen[41] and lends further support that SDL has a positive developmental trajectory until the 50s, consistent with SDL theory.[42,43] The learning preference has been attributed to previous learning experience and confidence in controlling the learning process.[44]

SDL readiness and premedical training

In our study, the number of premedical years of training was not shown to be a significant predictor of SDLRS scores. This finding is in contrast to that of Harvey et al,[39] who found a significant positive trend in SDL scores (using SDLRS, the Oddi Continuing Learning Inventory [OCLI], and Ryan's [ability] scores) associated with the highest level of premedical education

achieved (undergraduate only, master's, or doctoral). For admission into our College of Medicine, a minimum of two years' undergraduate training is required as a prerequisite. One of the admission criteria is a minimum of 78% average academic score over two years for in-province candidates and 92.5% for out-of-province candidates. The final acceptance is weighted as 35% academic score and 65% MMI performance. Given that academic scores play an important part at admission, great importance is given by aspiring students to obtaining high marks in undergraduate courses. Almost all undergraduate courses that are taken by these students are highly structured, lecture-oriented, taught in large classes, and assessed using multiple-choice questions, with minimal scope for self-direction. This academic environment may be a deterrent for SDL in students.

SDLRS scores with increased medical training. Our findings indicate that SDL readiness scores decreased significantly at the end of one year. Though there is a slight increase in the SDLRS scores as students progress through medical school, they do not reach the scores that they had at admission (see Table 3 and Figure 1). The findings of our study differ from those of a previous study done on MD students at Dalhousie University that reports no difference in SDLRS scores when measured longitudinally over a period of one year after making major changes to the curriculum.[14] Although there are no other studies that followed SDL readiness throughout undergraduate medical training, our findings are similar to the findings of researchers at the University of Toronto Faculty of Medicine, who did a cross-sectional study on first- and second-year medical students (N = 280). Of the three instruments that they used (SDLRS, OCLI, and Ryan), the scores obtained with Ryan's instrument showed a decrease with more training.[39] Similarly, a decrease in SDLRS scores was found in pharmacy students at the University of Mississippi Medical Center who took the assessment three times over the course of a 16-week semester after the introduction of a one-year problem-based learning (PBL) curriculum.[45]

Interestingly, a longitudinal study on nursing students of a PBL program showed an increase in SDLRS scores

with training, indicating that a number of factors, including curriculum delivery strategies, play a role in promoting SDL readiness.[46]

How can these differences be explained?

How can the differences in SDLRS scores with training be explained? Knowles[5] describes learning as a continuum with teacher-directed (pedagogical) learning at one end and self-directed (androgogical) at the other. This continuum can be explained in terms of how much control the learner has over learning and the amount of freedom given to evaluate and implement strategies to achieve learning goals. In medicine, the learning environment tends to keep students in the pedagogical end of the spectrum. For instance, to be self-directed in a specific content area, a person must possess a certain level of knowledge. The readiness for SDL is variable in any given student population, as each student enters medicine with a different academic background. When students have a low level of knowledge, they prefer a high degree of structure. It has been shown that there is a definite inverse correlation between SDL readiness and student preference for structured teaching sessions.[47,48] Throughout undergraduate training, students are overloaded with information. Moreover, the competencies required are well defined by regulatory bodies, and there is very little time for students to pursue their own interests. As our faculty note, it is therefore not surprising that SDLRS scores decrease with training.

According to Knowles,[5] both teachers and students have to possess the skills necessary for the implementation of an SDL-based curriculum. The teachers need to assume the role of facilitators more than that of transmitters of knowledge. Teachers need to create a learning environment that is collaborative rather than competitive. They must have the skills to diagnose learning needs or, more important, the ability to help learners diagnose their own needs.[5] Evaluation of students has to promote reflection on learning. Teachers do not acquire these skills automatically. Training plays a key role in helping teachers focus on students' acquisition of content rather than teachers' transmission of content.

When promoting SDL in the curriculum, student preparation is equally important. Teachers need to describe and explain the purpose and methodology of SDL, and students require a cognitive understanding of the SDL process before they can engage in it.[49]

Proper student orientation is required. During the course of our focus group discussion as well, students expressed concern that just giving time for SDL is not enough and that they need to be oriented:

> The professors rely too much on SDL too soon. It makes you feel like you're left out "in the blue" because you're coming in with a lack of experience and they think we can figure it out by ourselves.

Apart from lack of teacher and student preparation, other factors may serve as barriers to SDL. Shokar et al[50] list some of these barriers as "restrictions imposed by professional, curricular, legal, and institutional requirements, statutory educational regulations, time constraints, and the need to ensure that specific content is covered."

One must also remember that not all situations are applicable for SDL. SDL may not be appropriate in situations where the student is new or has very little previous experience of the subject and when the focus of learning is on the content (e.g., specific learning objectives) rather than the subject itself.[47] In undergraduate medical training—especially in the first year—most students have very little foundational knowledge. It is therefore understandable that students are more teacher-dependent and require that the education program be more structured.

Given the complexity of factors that influence SDL, a number of models have been proposed to represent SDL. Garrison's[51] model focuses on three psychological constructs: self-monitoring (cognitive responsibility), self-management, and motivation (see Figure 2). Self-monitoring refers to the ability of learners to monitor both their cognitive and metacognitive processes. Self-management focuses on goal setting, use of resources, and external support for learning. Motivation has two dimensions: entering and task motivation. Entering motivation is what compels the learner

to participate in the learning process, whereas task motivation is what keeps the learner on task and persisting in the learning process. To promote SDL, each of these constructs needs to be addressed.

Brocket and Hiemstra's[52] model of SDL (see Figure 2) focuses on learner control of responses to a situation even if there is no control over the circumstances; the model considers SDL and learner self-direction as two dimensions, with personal responsibility connecting the two. To facilitate SDL, focus on promoting personal responsibility is required.

Candy's[53] SDL model (see Figure 2) illustrates two interacting laminated (layered) domains. One dimension relates to the amount of control within an institutional setting, with one end of the continuum showcasing teacher control and the other learner control. The second dimension relates to amount of control over informal learning: autodidaxy. In this model, one needs to help the organization and its teachers choose appropriate strategies based on the content and level of knowledge of students, and to facilitate movement of students along the continuum.

From the different SDL models it can be deduced that a multipronged approach has to be taken to promote SDL in students. Francom[54] summarizes four principles instructors can use to help students move along the SDL trajectory:

- Match the level of SDL required in learning activities to student readiness

- Progress from teacher to student direction over time

- Support the acquisition of subject matter knowledge and SDL skills together

- Have adults practice SDL in the context of learning tasks

Hiemstra[55] describes six foundational roles that instructors need to take on to enable students to adopt personal responsibility for their learning:

- Content resource (sharing expertise and experiences using various forums)

- Resource locator (locating and sharing various resources to meet student needs)
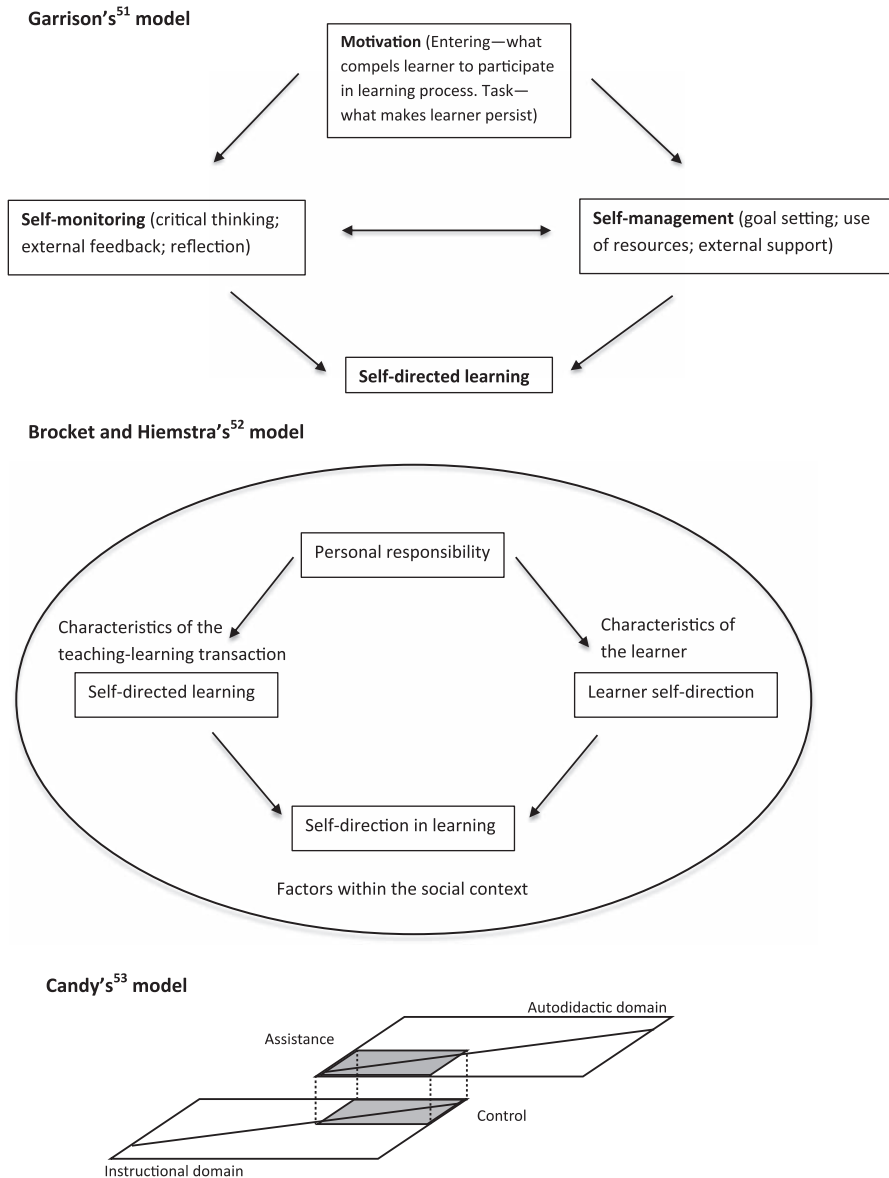
Garrison's[51] model

Brocket and Hiemstra's[52] model

Candy's[53] model

Figure 2 Three models of self-directed learning (SDL).[51–53] See the text for a discussion of these models. Used with permission.

- Interest stimulator (arranging for resources that maintain student interest in the subject, e.g., games, discussions; guest presentations)

- Positive attitude generator (through positive reinforcement; prompt, useful feedback)

- Creative and critical thinking stimulator (through study groups; journal writing; logs; simulation; role-play)

- Evaluation stimulator (learner evaluation and promotion of self-evaluation)

Conclusions

Given that SDL is closely linked to lifelong learning, a paradigm shift is required in the learning approaches of institutions and organizations. Promoting SDL in one or two courses by a few individual instructors is insufficient. Our medical school is currently undergoing curriculum reform. In the light of these findings, we hope to actively incorporate strategies to facilitate SDL throughout the curriculum. Comparison with schools using a different curricular approach may bring to light the impact of curriculum on fostering SDL.

A number of questions still remain unanswered. Does SDL readiness change after undergraduate training and as students become residents and practitioners? If it does, apart from age, what are the other factors that bring about these changes? Given the importance of SDL in medicine, how can we promote SDL among health professionals?

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Appendix 1

Semistructured Questions Used in the Student Focus Group*

1. How would you define self-directed learning (SDL)?

2. Given that SDL is learning where the individual takes the initiative and the responsibility for what occurs, individuals select, manage, and assess their own learning activities, which can be pursued at any time, in any place, through any means, at any age. What activities in the current curriculum encourage such learning?

3. In your opinion, what are the factors that encourage SDL in learners?

4. In your opinion, what are the factors that deter SDL in learners?

5. How can the current curriculum be changed to facilitate SDL among students in first year, second year, and lifelong?

6. If we told you that our findings show that SDL readiness decreases by the end of the first year, what do you think are the possible reasons for this change?

7. Before we finish, is there anything else you would like to add about self-directed learning?

*Student volunteers from the first and second years of their medical education were recruited via e-mail from each of five cohorts (2006–2010) to participate in a focus group. This group used the semistructured questions shown in this Appendix. The group consisted of five students. This focus group was formed to gain a better understanding of what facilitates and deters self-directed learning.