

## Computer Science students, Learning Styles and readiness for Self-Directed Learning

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### Abstract

The aim of this paper is to report on the learning styles and self-directed learning (SDL) readiness of fourth year Computer Science students. Some of the questions investigated in this paper are: Are different learning styles present in fourth-year Computer Science students, and what are these? Are there a connection between learning styles and SDL readiness? Are fourth-year Computer Science students ready for SDL? How does learning styles and self-directed learning readiness impact on the teaching and learning of these students? The paper begins with a literature study on learning styles and SDL readiness. Mixed methods were used to analyze data. Different learning styles were present, as well as different levels of SDL-readiness. Most of the students were visual learners, with auditory learners the second biggest group. SDL-readiness varied from very high to low-to-medium. All of these have to be taken into account when deciding on teaching methods.

**Keywords:** Learning styles, self-directed learning, mixed methods

### 1.1 INTRODUCTION

The aim of this paper is to report on the learning styles and self-directed learning (SDL) readiness of fourth year Computer Science students. In order to adequately teach students, lecturers have to try to accommodate the different learning styles present in one group.

The National Qualification Framework (NQF) of the South African Qualification Authority (SAQA) puts 4<sup>th</sup> year studies on level 7. In their description of level 7 under problem solving the skills required by the learner include:

*“Management of learning, in respect of which a learner is able to demonstrate an ability to identify, evaluate and address his or her learning needs in a self-directed manner, and to facilitate collaborative learning processes.”*

In this respect it is the responsibility of educators to equip learners with SDL skills. This can only be done effectively if educators understand their learners’ SDL readiness. Furthermore one needs to develop their SDL skills in order to prepare learners as life-long learners (very important in the changing world of IT).

Some of the questions investigated by this paper are: Are different learning styles present in fourth-year Computer Science students, and what are these? Are fourth-year Computer Science students ready for SDL? How does this impact on the teaching and learning of these students?

The paper begins with a literature study on learning styles and on self-directed learning. The research methodology is discussed, followed by results and conclusions.

## **1.2 LEARNING STYLES**

The term learning style refers to different approaches that learners follow to process complicated learning material (Ansalone & Ming, 2006:5; Chisholm, 1996:2; Wang, *et al.*, 2006:332). Most researchers agree that teaching and learning according to a student's learning style maximize learning potential. Lynch & Szorenyi (2005:17) recommended that more attention be given to changing the content and the way of teaching of computer related subjects, taking into account the different learning styles.

Learning styles can be categorized in different ways. There are, for example, visual learners (who learn better with pictures and graphical presentations) versus verbal learners (who prefer textual descriptions) and sequential learners versus global learners (Ansalone & Ming, 2006:5; Chisholm, 1996:2; Wang, *et al.*, 2006:332). According to Kolb (1984) the learning style of an individual can be determined by testing which one of four methods of learning processes is preferred by the person. These four methods are concrete experience, reflective observation, abstract conceptualisation and active experimentation. Concrete experience follows an intuitive approach rather than a scientific one. Reflective observation emphasises understanding rather than practical application and reflection rather than action. Abstract conceptualisation emphasises ideas rather than feelings. Active experimentation emphasises practical applications rather than understanding and action rather than observation.

The learning style questionnaire used in this study focuses on 3 learning styles, namely auditory, visual and tactile (LearningRx, 2012).

A student with an auditory learning style learns best when information is delivered in auditory formats such as lectures, discussions, oral readings, audio recordings, or podcasts. Auditory learners do well in classroom settings where professor lectures and student discussions are the norm. These students also do well with taped courses and group study situations, and may wish to use tapes to tape lectures to help fill in gaps in notes.

A student with a visual learning style learns best when information is presented in visual formats such as books, articles, web pages, images, videos, or diagrams. Visual learners do well with class handouts, power point presentations, movies, and chalkboards. These students take detailed notes, highlight their texts, and use flow charts for study aids.

A student with a tactile learning style learns best when information is conveyed in "hands-on" settings such as trade positions, labs, workshops, or participatory classes. Tactile learners respond well to touching and creating things in areas such as art and science. These students want to hold and manipulate the subject matter, rather than merely viewing an image of it. Taking and keeping lecture notes are very important to these learners.

### **1.3 SELF-DIRECTED LEARNING**

#### **1.3.1 Defining self-directed learning**

Few people have ever defined self-directed learning with precision (Grow, 1991:128). Different terms are used interchangeably with self-directed learning, for example individualized instruction, prescriptive learning, contract learning and a dozen others (Piskurich, 1993:1). One possible definition is that self-directed learning takes place when the learners take control and accept the freedom to learn what he or she views as important (Fisher et al., 2001:516). Another definition (Knowles, 1995) is that self-directed learning is a process in which learners take the initiative for analysis and diagnosis of their learning needs, formulation of personally relevant learning goals, identification of how to achieve them, and reflection on their achievement. For the purpose of this research self-directed learning will be defined as learning where the learners take control of their own learning, with the guidance of a facilitator, including the analysis of learning needs, formulation of goals and decisions on how to achieve these goals.

#### **1.3.2 The importance of self-directed learning**

According to Grow (1991:127) the goal of the educational process is to produce self-directed, lifelong learners. Knowles (1975:10) believes that self-directed learning is the best way to learn. Knowles (1975:110) states that he doesn't *'think it is healthy – or even humane – for a person to be kept permanently dependent upon a system or upon another person'*. In the right situation self-directed learning can be more efficient and effective than any other instructional design (Piskurich, 1993:2). Some of the advantages are that self-directed learning makes it easier to deal with individual differences, and students can work at their own pace (Piskurich, 1993:15, 177).

#### **1.3.3 The problem with self-directed learning**

The ability to be self-directed is situational. One may be self-directed in one subject, but a dependant learner in another subject. Self-direction is also partly a personality trait, and the degree of control the learner is willing to take depends on their attitude, abilities and personality characteristics. (Grow, 1991:127). Self-directed learning is also unfamiliar to most students (Piskurich, 1993:19). Some theorists have stated that self-directed learning is a natural way for people to learn. This may be true, but by the time they have made it through the school system; few people are comfortable with true self-directed learning. If you spend 12 or more years being told what to do, how and when, it is disconcerting to be told that you are on your own (Piskurich, 1993:20, 175). Many students entering into a new situation feel the need for a structured plan and teachers who are in charge, and they become anxious when this is absent (Knowles, 1995:37).

Students who are dependant learners are (mostly) resistant to be self-directed learners; they want to be taught (Knowles, 1975:33). Teachers also find it difficult to change from being a teacher to being a facilitator of learning, to move from being a requirement to being just one among many choices in how to learn (Knowles, 1997:33, Grow, 1991:142).

### **1.3.4 The stages of self-directed learning**

Grow (1991) developed the Staged Self-Directed Learning (SSDL) model. According to this model, there are 4 stages to self-directed learning:

- During stage 1 the student is a dependant learner who has to be taught by lectures, drilling and coaching. These students respond best to a clearly-organized, rigorous approach, and clear-cut objectives.
- The stage 2 learner is interested and can be taught by inspired lectures, guided discussion and goal-setting. These students respond best to motivational lectures.
- During stage 3 the students see themselves as participants in their own education. They are ready to explore, as long as they have a good guide. The teacher is a facilitator, and the student can be taught by discussions, seminars and group projects. Teachers and students share in decision-making. The teacher offers tools, methods and techniques.
- In the final stage, stage 4, the student is self-directed, the teacher is a consultant, and the teacher uses internships, dissertations and study groups to teach. Self-directed students set their own goals and standards. They exercise skills in time management, goal-setting, self-evaluation and use of resources.

### **1.3.5 Preparing students to become more self-directed**

The good news concerning self-directed learning is that it can be learned, and certain aspects of self-direction can be transferred to new situations (Grow, 1991:127).

It is very important that teaching is matched to the self-directed learning readiness of the students. What is 'good teaching' for a student in one stage of development may not be 'good teaching' for another student in another stage of development. Good teaching does two things: it matches the student's stage of self-direction, and it empowers the student to progress towards greater self-direction (Grow, 1991:140).

When the teaching style is not matched to the student's degree of self-direction, problems arise. When self-directed students are paired with teachers who are used to teaching dependant students the students will resent the teacher and rebel or retreat into boredom. When dependant students are paired with a teacher expecting them to be self-directed, the students are not equipped to handle this. They lack the necessary skills and will feel angry and frustrated (Grow, 1991:139-141).

The students can be prepared for the next stages by gradually giving them more freedom and responsibilities. During stage 2 it is important to begin training students in basic skills such as goal setting, as part of preparing the students to becoming more self-directed. Students need to, at this stage, recognize their different personality types, life-goals and styles of learning. During stage 3 the students will benefit from learning more about how they learn, such as making conscious use of learning strategies (Grow, 1991:139-141).

Students can, during one course, be moved gradually from dependant learners to self-directed learners. The course can begin with lectures, move to directed discussion, then less-directed discussion and finally to student-directed discussion. The teacher's role

changes from expert, to guide, to facilitating expert, to consultant. Even a single class meeting could be organized to move from dependency to self-directed learning (Grow, 1991:144).

To lessen anxiety, it is important to explain to the students that they will still be working within a structure, but it is not a content structure as they are used to, it is a process structure. They should also be assured that it is understood that they are not used to taking this much responsibility for their learning, and that they will be helped with this (Knowles, 1975:37).

Students can be given articles or books to read on self-directed learning, or they can go to workshops on self-directed learning (Knowles, 1975:40). The first meeting can begin with a comparison and discussion of self-directed learning and teacher-directed learning (Knowles, 1975:46). The students have to be sold on the advantages of self-directed learning (Piskurich, 1993:177).

#### 1.4 RESEARCH METHODOLOGY

The study was done on a group of students in a Data warehouse module at the Potchefstroom campus of the North-West University. The group consisted of 23 fourth year students, of which 19 completed the questionnaires. Students completed two questionnaires on SDL readiness (one with questions to be answered on a scale of 1 to 5, and the other one with open questions), as well as a questionnaire determining the learning style of the student. Mixed methods were used to analyze the data.

#### 1.5 RESULTS

##### 1.5.1 Quantitative results

Four different learning styles or combinations of learning styles were present (table 1). Most of the students were visual learners (47%), with auditory learners the second biggest group (37%), followed by combinations of visual, auditory and tactile. None of the students had a tactile learning style, which may be surprising considering this is Computer Science students (surprising as a tactile learning style means information is conveyed in hands-on settings such as trade positions, labs and workshops).

As can be seen from the data in table 1 SDL-readiness varied between very high (10.5% of all the learners who were part of the study), high (37%), medium to high (21%), medium (21%) and low to medium (10.5%). Of the 2 students with very high SDL-readiness, as well as the 2 students with low to medium readiness, three were auditory learners and one auditory visual.

**Table 1 Learning styles and SDL-readiness**

	Gender	Learning Style	SDL-readiness
1	F	Visual	Medium (3)
2	F	Visual Tactile	Medium to High (3.5)
3	F	Visual	High (4)

	Gender	Learning Style	SDL-readiness
4	F	Visual	Medium to High (3.7)
5	M	Visual Tactile	High (4)
6	M	Auditory	Very high (4.5)
7	M	Auditory	Low to medium (2.5)
8	M	Visual	High (4)
9	M	Visual	High (4)
10	M	Auditory	Very high (4.5)
11	M	Visual	High (4)
12	M	Visual	Medium to High (3.5)
13	M	Auditory Visual	Low to medium (2.5)
14	M	Auditory	Medium to High (3.5)
15	M	Visual	Medium (3)
16	M	Auditory	Medium (3)
17	M	Visual	High (4)
18	M	Auditory	High (4)
19	M	Auditory	Medium

### 1.5.2 Qualitative results

Content analysis was done on the answers to the open questions.

**Question 1:** *How do you view the role of the lecturer in post graduate modules?*

The answers to this question could be coded with the use of two codes, as can be seen in table 2 column 7. The students felt that a lecturer should teach and explain (code: teach), or that lecturers were only there to guide the students, mentor or facilitate (code: guide). Most of the students (58%) felt that, on post graduate level, the role of the lecturer is that of guide, but some (32%) still expected to be taught.

As can be seen in table 2, there is only one case where a student with high or very high SDL-readiness indicated that he or she expect a lecturer on post-graduate level to teach. From these answers it can be seen that students with lower SDL-readiness expected more guidance from the lecturer, where students with higher SDL-readiness saw the lecturer more as a guide or mentor.

**Table 2 Other factors**

	Gender	SDL-readiness	Structure	Time-management	Group / Alone	Lecturer
1	F	Medium (3)	Yes	Very good	Alone	Guide
2	F	Medium to High (3.5)	Yes	Medium	Group	Teach
3	F	High (4)	Yes	Very good	Group	Teach
4	F	Medium to High (3.7)	Yes	Very good	Alone	Guide

	Gender	SDL-readiness	Structure	Time-management	Group / Alone	Lecturer
5	M	High (4)	Sometimes	Medium	Group	Guide
6	M	Very high (4.5)	Yes	Very good	Alone	Guide
7	M	Low to medium (2.5)	Yes	Medium	Alone	Teach
8	M	High (4)	Sometimes	Medium	Group	Guide
9	M	High (4)	Yes	Very good	Alone	Guide
10	M	Very high (4.5)	Sometimes	Very good	Alone	Guide
11	M	High (4)	No	Very good	Alone	Guide
12	M	Medium to High (3.5)	Yes	Very good	Groups	Guide
13	M	Low to medium (2.5)	Yes	Low	Alone	Teach
14	M	Medium to High (3.5)	Yes	Low	Group	Guide
15	M	Medium (3)	Yes	Medium	Alone	Teach
16	M	Medium (3)	Yes	Very good	Alone	Guide
17	M	High (4)	Sometimes	Very good	Alone	Guide
18	M	High (4)	Yes	Medium	Both	Answer unclear
19	M	Medium	Yes	Medium	Alone	Teach

**Question 2:** Write a paragraph on your time management skills.

The answers to this question was coded using three codes, as can be seen in table 2, column 5 (Time-management). The answers indicated that students rated their time-management skills as very good, medium or low. Only 53% of the students felt that their time-management skills were very good. Some students (37%) felt that there time-management skills were medium (not bad, but could improve), and 2 students (10.5%) felt that their time-management skills were low.

Both students with very high SDL-readiness rated their time-management skills as very good. Only two students rated their time-management skills as low, and none of these students had high SDL-readiness.

**Question 3:** Are you somebody who likes rules / structure in your life?

The answers to this question were coded using three codes (Yes, No or Sometimes). As shown by the data in table 2 (column 5) most of the students (74%) preferred structure and rules. The 5 students who did not indicate that they prefer structure and rules were all students with very high or high SDL-readiness, meaning that 5 out of 9 students with a high or very high SDL-readiness did not prefer rules and structure, and all of the students with SDL-readiness lower than high preferred rules and structure.

**Question 4:** Do you prefer to work alone rather than in a group?

The answers to this question were coded using three codes showing the students' preference (Alone, Group or Both). Most of the learners (63%) preferred working alone (as opposed to working in a group).

### 1.5.3 Examples of answers

There were interesting correlations between the answers to the open questions and the SDL-readiness of the students. Some examples follow.

**Question 1:** *How do you view the role of the lecturer in post graduate modules?*

One of the students with low to medium SDL-readiness answered as follows: *"To tell you exactly what they expect of you. They should be there to help"*.

A student with medium SDL-readiness answered: *"I believe it is the lecturer's duty to at least teach and help the students understand the basic requirements for the module"*.

Another answer from a student with medium SDL-readiness was: *"They are only there to guide us, although I feel I want to be lectured. I can better understand something if it is explained to me"*. The learning style of this student is, as this answer suggests, auditory.

Answers from students with high SDL-readiness included:

*"More as a guidance role and less of an instructor role"*

*"Only as guides, gatekeepers of sorts. People who keep a general eye over the progress of a person's studies"*

*"That of a mentor and counsellor in terms of what is important"*.

**Question 2:** *Write a paragraph on your time management skills.*

One of the students with low to medium SDL-readiness answered as follows: *"I don't have great time management skills. I struggle sometimes to see how long some things will take"*.

Answers from students with high SDL-readiness:

*"In general I finish well within time and start working on projects and the likes well in advance. In regards to overall time-management I feel that I cope well, seeing as I study full-time, do freelance work, waiter and I have time for a social life"*

*"My time management is excellent. I have a unique ability to get a huge load of work done in a little amount of time. I am still able to apply the necessary degree of quality that would leave me confident and proud of my work completed"*.

From these answers it could be seen that students with lower SDL-readiness experienced more problems with time-management, while students with higher SDL-readiness mostly felt that their time-management skills are very good. There were, however, some students with high SDL-readiness who had doubts about their time management-skills:

*"My time management is fairly good although it can improve"*

*"Time management is not one of my stronger skills. I often finish early and sometimes late"*.

**Question 3:** *Are you somebody who likes rules / structure in your life?*

As mentioned earlier only five students did not prefer rules and structure. The SDL-

readiness of all of these students was high. Answers included:

*"The saying goes that rules were made to be broken. In my opinion rules and structures need to be ignored sometimes in order to reap the fullness of life"*

*"Yes and no. Rules can prevent a person from creating / imagining something new. It binds them to a box from which they cannot escape".*

One of the students with low to medium SDL-readiness answered: *"I like rules because without it things would be disordered. I like it if there is a set of rules to follow when I have to do something".*

Other interesting answers were:

*"A structure gives you boundaries you cannot cross or a directed path. It is easier to follow rules"*

*"Something is right or wrong. I seldom find neutral ground"*

*"I prefer structure. I prefer assignments with clear end-goals, as more open projects tend to confuse me".*

## **1.6 CONCLUSION**

Four different learning styles or combinations of learning styles were present. Most of the students were visual learners (47%), with auditory learners the second biggest group (37%), followed by combinations of visual, auditory and tactile. None of the students had a tactile learning style, which may be surprising considering this is Computer Science students (surprising as a tactile learning style means information is conveyed in hands-on settings such as trade positions, labs and workshops).

SDL-readiness varied between very high (10.5% of the students who participated in the study), high (37%), medium to high (21%), medium (21%) and low to medium (10.5%).

Most of the learners (63%) preferred working alone (as opposed to working in group), and most of the students (74%) preferred structure and rules. The 5 students who did not indicate that they prefer structure and rules were all students with a high SDL-readiness, meaning that 5 out of 9 students with a high or very high SDL-readiness did not prefer rules and structure.

Only 53% of the students felt that their time-management skills were very good.

From the answers to the open questions it could be seen that students with lower SDL-readiness expect more guidance from the lecturer, where students with higher SDL-readiness see the lecturer more as a guide or mentor. Students with lower SDL-readiness experience more problems with time-management, while students with higher SDL-readiness mostly feel that their time-management skills are very good. There were, however, some students with high SDL-readiness who had doubts about their time management-skills. Students with lower SDL-readiness are less curious and less likely to look for answers by themselves than students with higher SDL-readiness. This means different learning styles were present, as well as different levels of SDL-readiness. Students

also had different preferences as far as working in groups and working within a structured environment. Even though these are fourth year students only half of them were satisfied with their own time-management skills. All of these factors have to be taken into account when deciding on teaching methods. Teachers will have to vary teaching methods to accommodate these differences!

These are fourth-year students, and it is troublesome that the SDL-readiness of only some students are rated very high (10%) and high (37%). Lecturers will have to consider ways to help these students to move to a high level of SDL-readiness.

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