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THE DEVELOPMENT OF THE 'SELF-DIRECTED LEARNING READINESS SCALE IN BIOLOGY' (SDLRSbio) FOR PRE-UNIVERSITY BIOLOGY STUDENTS

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Abstract

In past research, the measurement of students' SDL readiness focused on self-motivation, self-management, and self-monitoring. These measurements were found to be too general to conclude one as a self-directed learner. Self-directedness should be specific for each subject area. This paper will discuss the pilot study of a larger research, where the SDLRSbio was developed using the Delphi technique. Specific biology laboratory skills readiness, experimental skills readiness, and data analysis and interpretation skills readiness were embedded in the SDLRSbio to ensure specificity in measuring biology students' SDL readiness. The SDLRSbio developed consisted of 46 items in a 5 point Likert-scale. This scale was pilot tested with 30 students in Kuala Lumpur. The total scores were superimposed on a readiness continuum to reflect students' SDL readiness. The Cronbach-alpha reading for the 46 items was 0.869. Results showed that, 73% of the biology students in the pilot study were moderately ready for SDL. 17% was less ready for SDL, and 10% was ready for SDL. This result has implications for planning and developing curricula of biology related fields.

Keywords: Self-directed Learning Readiness; Biology; Pre-University

Introduction

Self-directed learning (SDL) was introduced in adult learning in the 1970s. The notion of SDL is that learners learn according to their needs. SDL is often referred as "a process in which an individual takes the initiative, with or without the help of others, in diagnosing their learning needs, formulating and implementing appropriate learning strategies and evaluating learning outcomes" (Knowles, 1975a). SDL flourished in the field of medicine when Problem-Based Learning (PBL) was introduced in the 1980s. Since then SDL has been adopted by many other disciplines due to the effectiveness of SDL in helping students to pursue tertiary education and stay competent in their career life for the future (Horng, 2011; Noor Azina, 2011; Williamson, 2007).Similarly in Malaysia, recently the education development is

moving in the direction to ensure the education is relevant and functional with an efficient delivery systems (Hussein Ahmad, 2012). Consequently many higher education institutions converted their curricula to SDL, this happened especially in biology related fields like medicine, nursing and biosciences.

Based upon the literature review, it was interpreted readiness as the capabilities of an individual in achieving defined learning objectives. The premise is that, being self-directed in learning one must possess the specific skills and knowledge for the subject matter. The better the mastery of these specific skills and knowledge, the higher the capability of achieving the learning goals. Different subjects will have different skills and knowledge needed. Hence, for students to be self-directed in biology related fields, students must possess the biology skills and knowledge in order to be self-directed in the related fields. Therefore, a scale which measures the Biology students' SDL readiness is needed. This scale will measure not only the general skills and knowledge for SDL, but specific skills and knowledge for students to engage in SDL for Biology.

Much of the past research has found students entering tertiary education without being readied for SDL (Belzer, Millar, & Shoemake, 2003; Chakravarthi & Haleagajara, 2010; Van Den Hurk, Dolmans, Wolfhagen, & Van Der Vleuten, 2001). Consequently many have rejected SDL because of the lack of the skills among students to identify the depth and breadth of the study during their learning process (Ozan, Karademir, Gursel, Taskiran, & Musal, 2005). The students also lack confidence in the learning objective that they put forward themselves (Pepper, 2010). Scales have been developed by the past researchers to measure the readiness of students' for SDL. Table 1 shows the comparison of the scales developed thus far. The current research will add the biology skills measurement as a scale. This is because, according to Bloom's Taxonomy, skills and knowledge for any particular subject need to be specific. Hence, the specific skills and knowledge for biology need to be measured for better understanding of the SDL readiness for Biology. The previous scales measure skills which are general.

These developed scales focused at measuring the readiness of students' for SDL at the undergraduate level. However, it would be more pertinent to investigate the unpreparedness of undergraduate students before entering tertiary education (Dynan, Cate, & Rhee, 2008) in addition to after they have entered first year of study. By measuring pre-university students' readiness for SDL, there is a possibility that this will ensure the success of the students' performance at the tertiary education (Ozan et al., 2005). With better understanding of students' readiness at the pre-university level, perhaps curriculum designers could better refine the current curriculum. Indirectly it will also help students in applying their skills and knowledge for SDL at the tertiary level. Therefore, the paper will discuss the part of the larger research which aimed to develop a scale to measure and profile Malaysian pre-university biology students' readiness for SDL. The Delphi technique was used in the development of the scale.

Table 1
Comparison of past developed scales with the proposed SDLRSbio and SDLeRSbio

Skills	Research Constructs				
	Swapna Naskar Williamson, 2007	**Murray Fisher, 2001**	**Oddi, 1986**	**Guglielmino, 1977**	**Current Research**
Self-management	Learning Strategies Awareness	Self-management	Ability to self regulating	Future orientation Openness to learning opportunities	Biology learning skills readiness
Self-Motivation	Learning Activities Interpersonal skills	Desire for learning	Learner motivation/ self efficacy/ autonomy Learning with others	Self concept as an effective learner Initiative and dependence in leaning A love to learn	Emotional Readiness in Biology
Self monitoring	Evaluation	Self control	Reading avidity	Informed acceptance of responsibility for one's own learning Creativity Ability to use basic study and problem solving skills	Biology cognitive readiness
Biology Specific Skills	-	-	-	-	Laboratory skills Data Collection/ reading instrument Techniques Use of instrument

Methodology

Development of SDLRSbio

In the existing developed scales, readiness for SDL is measured in self-evaluations, self-motivation, and self-monitoring abilities of learning. According to Brookfield (1985a), and Brockett (1985), these skills are basic skills of learning. They may not

reflect the real readiness for SDL especially in a specific subject. These skills are too common, general, and can be applied for different disciplines (Hoban, Lawson, Mazmanian, Best, & Seibel, 2005). In other words, for one to be self-directed in learning biology, one should be ready in the skills and knowledge specific to biology. Hence, specific skills and knowledge for biology were included in the development of SDLRSbio.

Selected constructs of the SDLRSbio were predetermined from past research. According to the literature review, the constructs included in SDLRSbio were general cognitive readiness, learning skills readiness, and emotional readiness. To make the scale specifically measuring readiness for SDL in Biology lessons, constructs like "laboratory skills readiness", "experimental design skills readiness", and "data analysis and interpretation skills" were added. Under the laboratory skills readiness, there were 3 sub-constructs. They were "use of instruments", "techniques", "data collection/reading instruments" These predetermined constructs with the 58 predetermined items were then sent to a specially selected panel of members for content and language validation.

First round Delphi Technique

In order to conduct the first round of Delphi technique, a panel consisting of lecturers from medicine, education, teacher training college, and school teachers was formed. The selected panel members had at least 3 years experience in teaching biology related fields. A total of 8 experts were chosen as the panel members. Consent were obtained from the panel prior to conducting the Delphi rounds. Each member of the panel assessed and commented on the scale's constructs and items independently. Their responses were collected by the researchers for analysis and amendments.

After the first Delphi round, all 6 pre-determined constructs were accepted by the experts. However, some of the constructs were amended to focus in the study of biology. For example "Learning Skills readiness" was changed to "Biology Learning Skills Readiness". From the first round checking, experts also suggested changing the language used in the scale to active voice statements instead of questions. Additionally, the panel suggested that the items should be related to the biology context to make it more appropriate in measuring the readiness for SDL in biology. Hence, changes were made, for example, "How often do you critique on others' ideas?" to "I am able to give comments on other's ideas about biology concepts".

Experts also suggested re-arranging the items. Hence, the items were rearranged according to the experts' suggestions, in order to suit the constructs better. In the first Delphi round, 8 items were eliminated, and 11 items were amended. At the end, a total of 46 items were compiled.

After amending the scales according to the comments and suggestions of the experts, the scale was sent for a second Delphi round.

Second round Delphi Technique

The second Delphi round was conducted with the same panel of experts. From the second Delphi round, the experts commented that some items were referred not

suitable for Malaysian pre-university biology context. Thus changes were made to items 23, 25, and 26 to ensure that the items could measure laboratory skills included in Malaysian pre-university's syllabus. Furthermore, in this second round of checking, the experts advised that the relation of Bloom's taxonomy to identify the level of knowledge and skills in the constructs need to be added. This adaptation of Bloom's taxonomy to the scale is shown in Table 2.

Table 2
Categories of constructs in Bloom's Taxonomy in SDLRSbio

Knowledge Domains	**Constructs / (sub-constructs)**
Factual knowledge	-
Conceptual knowledge	Biology cognitive readiness
Procedural knowledge	Biology learning skills readiness Laboratory skills (Use of instrument, Laboratory techniques, Data collection or reading instrument)
Metacognitive knowledge	Emotional readiness in Biology Experimental design skills Data analysis and interpretation skills

After the second Delphi round, the scale was finalised for a pilot study. A third round of Delphi was not made at this point as all of the items in the scale were accepted by the panel. However, if time allows in the future, a third round Delphi will be conducted to collect statistical measurement for the items. The summary of the two Delphi rounds is shown in Table 3.

Table 3
Summary of Delphi rounds results

Round	Total Constructs	Constructs retained	Total items	Items retained	Items amended
1	6	6	58	35	11
2	6	6	46	43	3

The SDLRSbio before the pilot study had 46 items in a 5 point Likert scale. Students will put their score accordingly from 1 (lowest) to 5 (highest). The lowest total score is 46, and the highest score is 230. Therefore, the middle score is 138. Students' total scores were plotted on a readiness continuum to profile their readiness for SDL.

Pilot Test

In order to ensure the accessibility to the samples in a short period of time, nonprobabilistic sampling was used in the pilot test (Creswell & Clark, 2011). The pilot test involved 30 pre-university biology students from a local government school at Kuala Lumpur. Verbal consents were obtained from the students prior to administering the SDLRSbio. The researcher was present during the administering of the scale. Students were encouraged to raise questions should there be any.

Theoretical Framework of the Development of SDLRSbio

In Bloom's Taxonomy SDL readiness is reflected by higher order cognitive and knowledge development (Dynan et al., 2008). In other words, learners need to be at a higher level in both the knowledge and cognitive domains in order to be readied for SDL. This involves metacognition to help integrate learning to authentic problem solving (Hannafin, Hannafin, & Gabbitas, 2009). The development of Self-directedness require deep approaches to learning (Kek & Huijser, 2011), thus, one's metacognition level is highly needed to be readied for SDL. Bloom's Taxonomy is used in the development of SDLRSbio for better understanding of the knowledge and cognitive development of students. The categories of the skills measured in SDLRSbio according to Bloom's Taxonomy are shown in Table 2.

Results

The pilot test of 30 students on the SDLRSbio yielded a reading of 0.869 for Cronbach's Alpha. The Cronbach's alpha readings for each constructs are shown in table 4. The rating suggested by Landis and Koch (1977) was used for result interpretation. An agreement level of 0.0-0.2 was considered poor, 0.2-0.4 fair, 0.4-0.6 moderate, 0.6-0.8 substantial, and from 0.8 to <1.0 almost perfect.

Table 4
Statistics of Reliability

	Constructs	Cronbach's Alpha	N of Items
1	Biology Cognitive Readiness	.562	7
2	Biology Learning Skills Readiness	.624	7
3	Emotional Readiness in Biology	.609	7
4	Laboratory Skills	.723	15
5	Experimental Design Skills	.649	5
6	Data Analysis and Interpretation Skills	.694	5
	Overall	.869	46

The students' total pilot test scores from the SDLRSbio were plotted as a readiness continuum. The result is shown in Figure 1. Results showed that each and every individual student's readiness for SDL varies.

Based on the score of the scale, a continuum of 4 regions was planned. This was done to represent the readiness of STPM biology students more precisely. The four regions were verified by a science education expert. The first region ranged from a score of 46 – 69 (0 - 25%) representing individuals who are not ready for SDL in biology. The second region ranged from a score of 70 – 138 (26% - 50%) for individuals who are less readied for SDL. The third region ranged from a score of 139 - 207 (51%-75%) representing individuals with a moderate readiness for SDL in biology. And the last region ranged from a score of 208 – 230 (75% - 100%), representing individuals who were readied for SDL in biology.

The continuum showed that 73% of the Malaysian pre-university biology students involved in the pilot study were moderately readied for SDL. They scored

marks between 139 to 184. Meanwhile, 17% of the students were found less readied for SDL. They scored marks of less than 138, which is below 50% of the total scores. On the other hand, 10% of the students scored above 185, which is above 75% of the total scores, and were found to be readied for SDL. The lowest score obtained was 130, and the highest score was 202 among the 30 students.

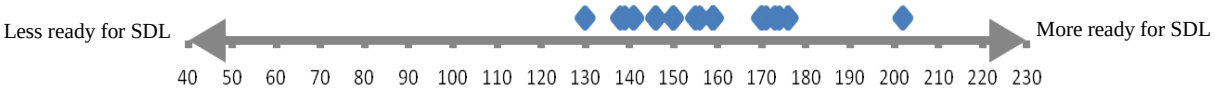

Figure 1. Malaysian pre-university biology students' SDL readiness continuum

Discussion

The developed SDLRSbio includes the specific skills and knowledge needed for SDL in biology. The scale is limited in measuring the SDL readiness of students in biology related field of studies. It is not suitable to be used for other disciplines, unless necessary adaptations are made. The understanding of pre-university biology students' readiness for SDL can possibly assist in planning and designing the tertiary education which is moving towards including SDL in the curriculum. In order to ensure the success of the tertiary education, especially in biological related fields, this scale provides a better understanding of students' readiness prior to entering to the tertiary education.

The pilot test results showed that each student had their own readiness level. Similarly, Hendry and Ginns (2009) showed in their study that, each and every learner will have their level of readiness for SDL. Tertiary education should design their curriculum to suit the students' level of readiness. The curriculum should provide sufficient time for students to adjust themselves for SDL in practice. Bradley, Oterholt, Nordheim, and Bjorndal (2005) said that students need time to familiarise themselves for SDL. Therefore readiness for SDL needs to be enhanced along the journey of learning. A proper planned and designed curriculum which derived based on the level of students' readiness for SDL is needed to ensure the success of the tertiary education. However, we do not expect to have a curriculum which suits each and every student. It is the duty of the teacher to identify the readiness and to develop the potential of the students for SDL in a more precise manner.

The results also indicated that Malaysian pre-university biology students are moderately readied for SDL. In fact past research found that undergraduate students were as yet to be ready for SDL. This indicated that a gap occurred between the transferring of skills and knowledge from secondary level to tertiary level. This gap has prohibited students from transferring their learned skills and knowledge for SDL to a higher level. Hence, a thorough understanding of the hindering factors for SDL should be carried out.

In their research, Finucane, Shannon, and McGrath (2009) and Pepper (2010), suggested that the teacher is the crucial factor in ensuring the success of a curriculum. Hence, teachers should have a better understanding of students' readiness level in order to effectively conduct lessons in SDL. Therefore, the SDLRSbio is a tool for the teacher to assess the readiness of students for SDL in

biology related fields. This will help teachers to strategize their lessons in order to help students in mastering the skills and knowledge needed

The pilot test of this study only collected data from 30 students of one of the pre-university programmes in Malaysia. It can be refined by administering the scale to more pre-university programmes in the country. By then it will probably provide a more complete profile of Malaysian pre-university biology students' readiness for SDL.

Conclusion

The development of SDLRSbio aims to measure and profile the Malaysian pre-university biology students' readiness for SDL. The scale is specific for the use of biology related fields. Necessary adaptations are needed for the use in other disciplines. With the profile of pre-university biology students' readiness for SDL, education planners and curriculum developers can redesign or rethink of the current pre-university biology curriculum. The curriculum and lessons designed should suit the level of readiness of the students. Having better understanding of the readiness of students, we can provide lessons which suited their current potential, and enhance their current skills and knowledge to a better level. Only when teachers understand the level of students' readiness, will they be able to help in developing the readiness level among the students.

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