CONNECTING LEARNING STYLES AND COGNITIVE DIMENSION IN BUILDING CONSTRUCTION EDUCATION

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ABSTRACT

Learning styles are not a new issue in education and much research has been conducted over past two decades. In the past, psychologists were interested in the distinction between individuals and created models based on personalities. Individual learning preferences and learning styles have been characterized in several different ways according a variety of theoretical models. In Vocational Education, learners are different characteristics from other type of education. Their learning orientation is more on job focused and they prefer to learn by doing than by attending lectures, writing or reading. However, the cognitive dimension is still need to measure their ability in their learning especially at school level. This article focused on discussion about the research finding on investigating relationship between learning styles and cognitive dimension in Vocational Education at school level. The model of Felder-Silverman Learning Styles (FSLS) and Cognitive Dimension (CD) in Building Construction Subject (BCS) in Vocational Schools are highlighted in this discussion. FSLS contained four dimension of learning styles; processing, perception, input and understanding while the cognitive dimension focused on cognitive level in Taxonomy Bloom and Anderson & Krathwohl Taxonomy. The analysis based on relationship between each dimension of FSLS and students' achievement derived from cognitive level in BCS. The detail explanation in this article in dimension of learning styles with students' preferences on how they learned BCS rooted in knowledge, skills and problem solving used taxonomies. In summary, the discussion identified which type of vocational students tend to be and how to accommodate learning styles with students' cognitive abilities. The link of learning styles and cognitive illustrated in this paper could act as a guideline teachers to facilitate students to learn more effectively.

Field of Research: *Learning Styles, Cognitive Dimension, Vocational Education, Knowledge, Skills, Problem Solving*

1.0 Introduction

Student learning is often taken for granted. Students are assumed academically capable of understanding lessons and assignments. The majority of them do pass, but for those who fail, the blame falls on the academic standards or teaching methods. Little consideration is given to the ways that students learn and the students' learning styles. Ideally, the way teachers teach should match the way

students learn, as well as how they prefer to learn. Teachers must adapt their teaching approaches to suit the ways students learn and their learning styles.

The elements of learning styles (LS) appeared in the research literature as early as 1892 (Fatt, 2000). The term "learning styles" was probably first used by Thelen (Madeline et. al, 2003) who discovered group dynamics at work. LS may also be defined as the tendency to adopt a particular strategy of learning. Teachers, then, should have the ability to understand how students learn. According to Felder (1993), students and teachers may prefer one learning style in one subject but generally prefer one style for most subjects that they learn or teach. Therefore, teachers may use this information from Felder (1993) to make sure they utilize all different learning styles, and students can use this information by realizing how they like to receive information.

Schools, institutions, colleges, and universities should adopt a theory of learning based on the classroom approach. Various learning theories exist, and caution should be exercised during selection. The learning theories should suit the subjects' needs, such as cognitive, behaviorism, and constructivism theories. The quality of teaching is measured by how effectively the learning approach the teacher selected functions to achieve the learning objectives in a particular subject. However, considering teachers usually do not know which approach will be the most effective, the measurement of a teacher's success is left to the students (Benke and Hermanson, 1988). The relationship between the teaching approach used and what the students learned, can be seen as a process where a teacher's beliefs will influence their teaching strategies, which will in turn influence student learning styles. A student's learning style represents the type of learner they become. Several inventories that can identify what type of learner a student may be have been published. In a classroom where only one approach to learning is encouraged by a teacher, some students may possibly work and learn less effectively than others (Alan, 2009). For this reason, an awareness of learning styles is important for teachers.

Students in vocational education (VE) are exposed to an educational system that is oriented more towards getting a job, and their learning styles are different from students in academic fields. Thus, VE is possibly an educational pursuit oriented to provide the necessary knowledge and skills to perform a particular job, occupation, or professional activity in the labor market (International Labour Organization, 1995). VE is also connected to technology transfer, innovation, and development. In vocational teaching, as in many knowledge areas, identifying and understanding learner differences to adapt the institute's needs to best suit the learning conditions and aptitudes of the students is important. The need to adapt teaching strategies to student learning styles and preferences is a reality in the classroom, which can be observed in real situations or in virtual approaches. However, these findings do not suggest that individual methods should be created for each student in a classroom. The best form of interaction for each of them should be identified by building groups of learners with common characteristics (Luciana et al., 2008).

2.0 FELDER AND SILVERMAN LEARNING STYLES MODEL

The Felder-Silverman Learning Styles Model (FSLSM) was developed by Richard Felder and Linda Silverman and was first published in 1988 (Felder and Silverman, 1988). The model was developed to address learning differences within engineering education. The FSLSM was developed from an information processing learning theory perspective whereby the authors viewed learning in a structured

educational system as two-step process that involved receiving and processing information. According to Felder and Silverman (1988), the reception step is where external and internal information becomes available to students and students select the information process and ignore the rest. The processing step is where students process information and move towards understanding.

The first dimension distinguishes between an active and a reflective way of processing information. Active learners learn best by working with the learning materials and by applying the material and trying things out. Furthermore, they tend to be more interested in communication with others and prefer to learn by working in groups where they can discuss the learned material. In contrast, reflective learners prefer to think about and reflect on the material. Regarding communication, they prefer to work alone or in small groups or with one good friend.

The second dimension covers sensing versus intuitive learning. Learners with a sensing learning style like to learn facts and concrete material. They like to solve problems with standard approaches and they tend to be patient with details. Furthermore, sensing learners are considered more realistic and sensible. They also tend to be more practical than intuitive learners and like to relate the learned material to the real world. In contrast, intuitive learners prefer abstract learning materials, such as theories and their underlying meanings. They like to discover possibilities and relationship and tend to be more innovative and creative than sensing learners. The third dimension is visual-verbal and it differentiates between learners who remember best what they have seen, such as picture, diagrams and flow-charts, and learners who understand textual representations regardless of whether it is written or spoken.

In the forth learning dimension, the learners are characterized according to their understanding. Sequential learners learn in small incremental steps and therefore have a linear learning process. They tend to follow logical stepwise paths in finding solutions. In contrast, global learners use holistic thinking process and learn in large leaps. They tend to absorb learning material almost randomly without seeing connections but after they have learned enough material, they suddenly get the whole picture. Then they are able to solve complex problems, find connections between different areas and put things together in novel ways but they have difficulty in explaining how they did it. Because the whole picture is important for global learners, they tend to be more interested in overviews and a broad knowledge whereas sequential learners are more interested in details. The emphasis in Felder's work is on preferred learning style, not ability. To measure the dimensions in FSLSM, Index of Learning Styles (ILS) was designed by Felder and Soloman.

ILS developed by Felder and Soloman (1997) is a 44-item questionnaire for identifying the learning style according to FSLSM. As mentioned earlier, each learner has a personal preference for each dimension. These preferences are expressed with values between +11 to -11 for each dimension. This range comes from the 11 questions that are posed for each dimension. When answering questions, for instance, with an active preference +1 is added to the value of the active/reflective dimension whereas an answer for a reflective preferences decrease the value by 1. Therefore, each question is answered either with a value +1 or -1. Each LS dimension has associated with it 11 forced-choice items each with either an option (a) or (b) match up to one or other category of the dimension. FSLSM shows that each learning style is described by different characteristics. Based on the description of FSLSM (Felder and Silverman, 1988) the questions in ILS were grouped according semantic similarities. Table 1 shows the semantic groups of learning styles with the questions construct in the groups as adapted from Sabine et.al (2007).

Table 1: Semantic Groups associated with ILS Questions

Style	Semantic group	ILS questions (answer a)	Style	Semantic group	ILS questions (answer b)
Active	Trying something out Social oriented	1,17,25,29 5,9,13,21,33,37,41	Reflective	Think about material Impersonal oriented	1,5,17,25,29 9,13,21,33,41,37
Sensing	Existing ways Concrete material Careful with details	2,30,34 6,10,14,18,26,38 22,42	Intuitive	New ways Abstract material Not careful with details	2,14,22,26,30,34 6,10,18,38 42
Visual	Pictures	3,7,11,15,19,23, 27,31,35,39,43	Verbal	Spoken words Written words Difficulty with visual style	3,7,15,19,27,35 3,7,11,23,31,39 43
Sequential	Detail oriented Sequential progress From parts to the whole	4,28,40 20,24,32,36,44 8,12,16	Global	Overall picture Non-sequential progress Relations/ connections	4,8,12,16,28,40 24,32 20,36,44

3.0 COGNITIVE DIMENSION IN VOCATIONAL EDUCATION

The cognitive learning in this study was covered by looking at the cognitive dimension, cognitive domain, cognitive level and cognitive mastery. The cognitive perspective involved the mental and information process that directly affect effective learning (Schneider and Stern, 2010). The first investigation of the cognitive perspective in this study was the examination of the cognitive dimension in BCS. A matrix was design to determine cognitive elements such as knowledge, skills and problem solving. The questionnaire item asked about student understanding and identified significant differences in the cognitive dimension. The results of this study showed that the students had significant difference in knowledge and skills but not in problem solving. In other words, students were competent when learning was based on knowledge and skills but less competent when it came to problem solving. The students agreed with the assessment of their learning abilities in knowledge and skills content but they were unsure about problem solving. The items for this study were constructed based on BCS specifications and used Bloom's Taxonomy of Educational Objectives, which has guided the pedagogical process for almost half century. Knowledge is the lowest level in the cognitive domain and it depends on the rote recall of previously learned material (Francisco, 2003). The results of this study showed that students agree they have knowledge of BCS. Anderson and Krathwohl (2001) defined the perception held by students who participated in this study as "factual knowledge," Factual knowledge refers to the basic elements students must know to be acquainted with a discipline or solve problems.

The results from this study also support Shulman's (1987) findings. Shulman categorized VET teacher knowledge into seven categories; pedagogical knowledge, curriculum knowledge, pedagogical content knowledge, knowledge of learners, knowledge of educational contexts and knowledge of educational ends. The teachers who participated in this study understood the required knowledge content and as a result, they were able to help their students master the knowledge element. Ruth (1992) claimed that vocational educators are concerned with instruction relevant to higher levels of cognition including conceptualizations, literature reviews, arguments and reports of activities. This is an important issue, and this study focused on the cognitive ability in each level of the BCS curriculum. To test skills at the cognitive level students were asked about how to manipulate ideas, exploring procedures, differentiate, make comparisons, create strategies, and come up with new ideas using various approaches. This study classified the BCS skills element, as defined in the taxonomy as application, analysis and evaluation, which is similar to Anderson and Krathwohl's cognitive dimension. The result showed that there were no significant differences between students in regards to their skill learning abilities.

Another issue examined in this study was the ability of BCS students to solve problems. The result showed that there was no significant difference between learning styles in terms of problem solving abilities. Any differences that were uncovered were likely due to each student relying on their individual resources (critical thinking skills, creativity) which will produce the different solutions. Widad et. al (2007) supports the findings of this study as he reported that engineering students showed no difference in problem solving skills between learner types based on Kolb's Learning Styles. Problem solving is at the taxonomy level of analyze and synthesis. Researcher concludes that problem solving is the highest level that students need to achieve. Therefore, in illustration method, researcher summarized the characteristic of each element in cognitive as presented in Figure 1 based on student's understanding towards their cognitive learning in BCS. The basic of cognitive dimension in this research are based on Bloom Taxonomy and revised taxonomy by Anderson & Krathwohl. To measure the cognitive dimension relate into vocational elements matrix between these factors was developed. The

elements concerned on knowledge, skills and problem solving in Building Construction subject for Vocational School. Figure 1 shows how the constructs of vocational elements merge with cognitive level in taxonomies. Knowledge is the basic element held by students acquainted with a discipline or able to solve problem. In this study, knowledge refers to student's awareness of what Building Construction is. Skill is defined as the work based and industry oriented activities which aim to provide the knowledge in performance of task or job. The application of skills in practical tasks requires using previously learned information to novel situation. The next element is problem solving, in vocational education problem solving is define as a way to relate classroom learning to real-life situation or problems. The problem solving approach of teaching incorporates problem solving activities but places the responsibility for learning on the student.

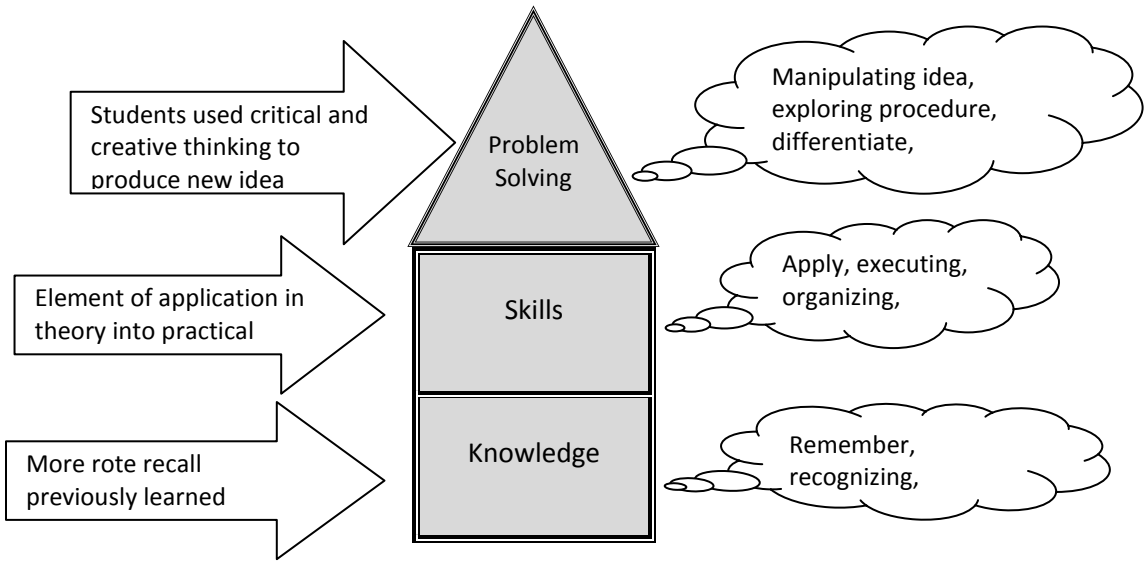

Figure 1: Connecting Vocational Elements and Cognitive Dimension

4.0 LEARNING STYLES AND COGNITIVE DIMENSION IN VOCATIONAL EDUCATION

Formal test, quizzes and inventories are all methods used to identify Learning Styles. A considerable number of research studies have been carried out using an inventory as a tool for investigating and exploring the application of learning style constructs to the school context (Richard and Stephen, 1998; Griggs, 1991; Jonassen and Grabowski, 1993). De Bello (1985) and Gianitti (1988), investigated the effectiveness of matching learning preferences to learning outcomes. Other researchers have looked at establishing a relationship between learning style and learning environment (Brennan, 1984; Clark-Thayer, 1987; Bruno, 1998).

Usually teachers do not formally test the LS of a class but they still want to know each individual's style in order to be able to understand how they are likely to function in learning situations. Research with vocational teachers by Smith and Dalton (2005) has indicated that teacher identification of styles among students has two major components. First, identifications are made through observation of students as they work with the content that teacher uses in class. These identifications are used in responsive and

interactive teaching and learning situations as developed in the 'onion ring' model developed by Curry (1983) that contained learning preferences, information processing styles and cognitive styles. Second, they identified that experienced VET teachers develop a fundamental understanding and response to student learning styles. VET teachers generally understand learning styles through experienced rather than understanding based on theory. Derived from experience, teachers enable identify different characteristics between individual and between groups as well as responding to those differences in teaching design and delivery. Through student activity, Smith and Dalton (2005) classified learning styles thorough two domains; first associated with student reaction to different media used to present content such as visual, hands-on, listening, print-based and second domain comprised student reaction to various learning context such as group learning, collaborative and independent learning.

This study used Index of Learning Styles by Felder and Soloman (1997), this index contained four types of learners had identified in Building Construction students. There are active, sensing, visual and sequential learners. The discussion made with these four types of learners and students cognitive abilities in terms of knowledge, skills and understanding. The statistical analysis was conducted to identify significant differences between learning styles and cognitive abilities between knowledge, skills and problem solving. Discussion in this article is concern on factors showed the differences in each type of learners. Research findings showed that Building Construction students are tending to be visual learner however there is few students are active, sensing and sequential learner. The dominant group is visual learner. This article is focused in visual learner and significant factors in vocational elements. The statistical from the whole research process reported that visual learners have significant differences with the ability in cognitive dimension in terms of skills and problem solving. Researcher findings enhance the understanding of vocational students' learning styles and Figure 2 shows that the most prevalent learning styles exhibited by Building Construction students was the visual type. The factors looked at were skills and problem solving. The circles representing other type of learners; active, sensing and sequential were placed inside the circle representing visual learners because the active, sensing and sequential learners tend to have strong visual traits.

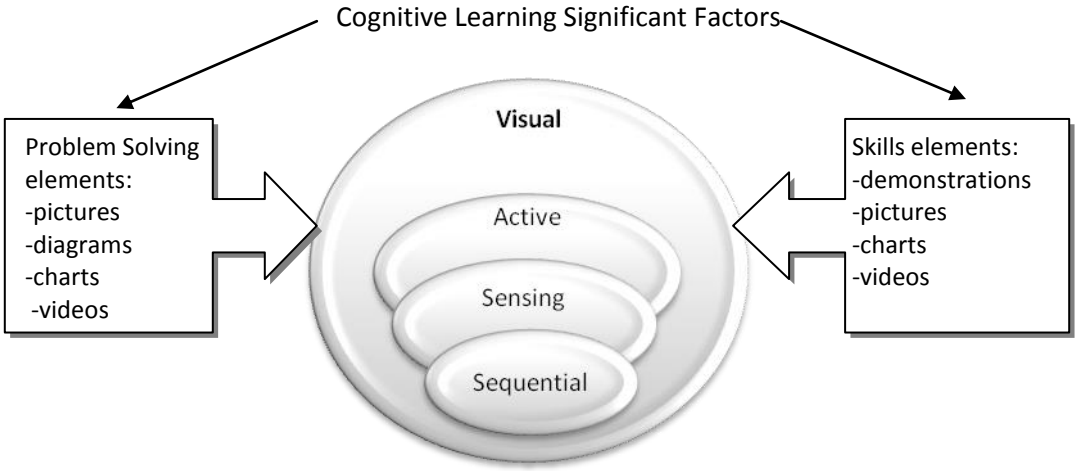

Figure 2: Learning Styles and Significant Factors

5.0 CONCLUSION

Understanding of learning styles and how to enhance student learning through learning styles is responsive strategies for potential approach in student learning. In vocational education students are commonly expressed the view that their teachers did take account of student learning characteristics in their teaching and provided experiences that were design to cater their learning (Smith and Dalton, 2005). In the context of greater student choice among different mode of learning, a special approach should be developed to their satisfaction and align with interest. This study has concluded that vocational students have their own characteristics and preferences in learning. They tend to be visual learners and capable of using the knowledge elements in cognitive learning. However, they struggle to master skills and problem solving abilities as evidenced by their marks from the questions in achievement test. The cognitive factors investigated based on students' academic achievement. Research find out most students in BCC are visual type and there have differences in skills and problem solving on cognitive learning. A visual characteristic applied in skills related to demonstrate with diagrams, pictures or charts to certain topic in BCS which skills is needed. As an example, students had complete the task in constructing brick wall, in order to understand either they enable to present the what they did in practical task in written presentation they might use the picture of brick wall to list down the complete procedure. A visual type also can assist student in the difficult part of problem solving. The problem solving usually need students produced some ideas to overcome the problem. Refer to the test given the land slide situation was given measure the how student solve the problem. Visual characteristic is very useful to help students write the procedure systematically. They can use the picture and video with their experienced to explain how. As a final conclusion, the researcher concluded the research overview that explained the procedure and analysis of research data and discussed the related literature.

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