

CONCEPTIONS OF LEARNING THROUGH LEARNING STYLES AND COGNITIVE DIMENSION IN VOCATIONAL EDUCATION

Mimi Mohaffyza Binti Mohamad and Yee Mei Heong

Faculty of Technical and Vocational Education
Universiti Tun Hussein Onn Malaysia
86400 Batu Pahat, Johor

mimi@uthm.edu.my, mhyee@uthm.edu.my

Tee Tze Kiong

Universiti Pendidikan Sultan Idris
Faculty of Technical and Vocational Education
Sultan Idris University of Education
35900 Tanjong Malim, Perak, Malaysia

tktee@fptv.upsi.edu.my

ABSTRACT

Individual learning preferences and learning styles have been defined in several different ways according to theoretical models. In the context of vocational education, students have different characteristics compared to their counterparts in other fields of education, since learning orientation is more on job focused. However, the cognitive dimension is still need to be measured especially for learners at school level. This article addresses the relationship between learning styles and cognitive dimension in vocational education at secondary school level. Based on the Felder-Silverman Learning Styles and Cognitive Dimension Model, the authors highlighted students' dimension of learning styles, students' preferences on learning preference, and the conceptual of knowledge, skills and problem solving construct according to taxonomy. It is concluded that the vocational students are more incline to be visual learner. This learning preference and learning styles will contribute to their engagement on the concept of learning in vocational education.

Keywords: *Felder-Silverman Learning Styles Model, Cognitive Dimension, Vocational Education, Knowledge, Skills, Problem Solving*

1 INTRODUCTION

Learning style is a component of wider concept of personality (Thomas and Amit, 2007). According to Kolb (1984), learning style is defined as the generalized differences in learning orientation based on the degree at which people emphasize the four modes of learning process. Whilst, Fleming (2001) defined learning style as an individual characteristic and preferred ways of gathering, organizing, and thinking about information. Moreover, Felder and Silverman (1988) stated that learning style as the strengths of the characteristics and preferences in the ways individuals take in and process information. However, a little consideration has been given to the ways on how students learn and learning styles (LS). Ideally, the way how teachers teach should match the way how 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 LS appeared in the research literature as early as in 1892 (Fatt, 2000). 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. Students and teachers may prefer one learning style in one subject but generally prefer one style for most subjects that they learn or teach (Felder, 1993). Therefore, teachers may use this information from Felder (1993) to ensure that they utilize all different learning styles, while students may use this information in order to know 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 are available in the current literature, but any decision to use one of them should undergo a very careful consideration. Learning theories should meet 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 aiming at getting a job. It is possible to say that VE are; (1) a component of educational activity oriented to provide the necessary knowledge and skills to perform a particular job post, an occupation or professional activity in the labor market. At the same time, its acts as a supplementary form other types of education by training people not only workers but also as citizens; (2) an activity connected with the process of technological transfer, innovation and development. Knowledge and skills should be transfer since it is the fundamental basis for the process of technological innovation and development. (Mohamad *et al.*, 2012). 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. Hence, this article focused on discussion about the research findings on investigating relationship between learning styles and cognitive dimension in vocational education at secondary school level. However, these findings do not suggest that individual methods should be created for each student in the classroom. The best form of interaction for each of them should be identified by grouping learners with common characteristics (Luciana *et al.*, 2008).

2 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 amongst engineering education. The FSLSM was developed based on the theory of information processing, whereby learning is viewed as two-step processes of structured system that involved receiving and information processing. According to Felder and Silverman (1988), the reception step is where internal and external information becomes available to students and students select the information process and ignore the rest. The information processing step is where students mentally process the information towards understanding it. The first dimension of information processing is to distinguish between active and reflective way of learning. Active learners learn best by working with learning materials, applying, and trying things out. Furthermore, they tend to be more interested in communication with others and prefer to learn by working in groups where students can discuss the learned material. In contrast, reflective learners prefer to think about and reflect on the materials. This groups of learners typically 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 fourth 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 FLSM, 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 FLSM. 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. FLSM shows that each learning style is described by different characteristics. Based on the description of FLSM (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 | 1,17,25,29 | Reflective | Think about material | 1,5,17,25,29 |
| | Social oriented | 5,9,13,21,33,37,41 | | Impersonal oriented | 9,13,21,33,41,37 |
| Sensing | Existing ways | 2,30,34 | Intuitive | New ways | 2,14,22,26,30,34 |
| | Concrete material | 6,10,14,18,26,38 | | Abstract material | 6,10,18,38 |
| | Careful with details | 22,42 | | Not careful with details | 42 |
| Visual | Pictures | 3,7,11,15,19,23,27,31,35,39,43 | Verbal | Spoken words | 3,7,15,19,27,35 |
| | | | | Written words | 3,7,11,23,31,39 |
| | | | | Difficulty with visual style | 43 |
| Sequential | Detail oriented | 4,28,40 | Global | Overall picture | 4,8,12,16,28,40 |
| | Sequential progress | 20,24,32,36,44 | | Non-sequential progress | 24,32 |
| | From parts to the whole | 8,12,16 | | Relations/connections | 20,36,44 |

3 CONCEPT OF COGNITIVE DIMENSION VOCATIONAL EDUCATION

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 vocational subject. A matrix was design to determine cognitive elements such as knowledge, skills and problem solving.

Table 2 shows the matrix of taxonomies and concept in vocational subject. Both taxonomies (Bloom & Anderson Krathwohl) constructed with the concept of learning in VE; knowledge, skills and problem solving is important part to measure students' cognitive abilities. This concept could be as framework to develop the items in achievement test on particular subject in VE.

Table 2: Matrix of Cognitive and Vocational Education Concept

| Anderson Kartwohl Cognitive Dimension | Bloom Taxonomy | | | | | |
|--|------------------|------------------|---------------|------------------------|------------------------|---------------|
| | Knowledge | Understand | Application | Analyze | Synthesis | Evaluation |
| Remember | <i>Knowledge</i> | <i>Knowledge</i> | | | | |
| Understand | <i>Knowledge</i> | <i>Knowledge</i> | | | | |
| Apply | | | <i>Skills</i> | | | |
| Analyze | | | <i>Skills</i> | <i>Problem Solving</i> | | |
| Evaluate | | | <i>Skills</i> | | | <i>Skills</i> |
| Create | | | | <i>Problem Solving</i> | <i>Problem Solving</i> | |

Figure 1 showed 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. 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.

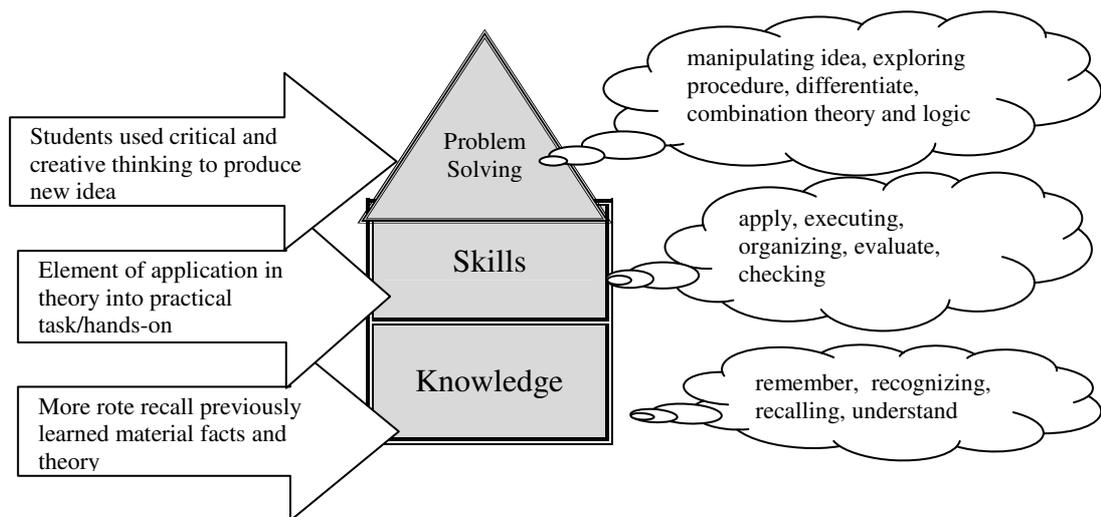


Figure 1: Connecting Vocational Elements and Cognitive Dimension

Problem solving need students have ability to think deeply to solve the situations or problem given. Their creative thinking will be tested based on what they learned and connect with previous experience. Creative thinking will make students move sideways to try different perceptions, different concepts and different points of entry (Mohamad *et. al*, 2011). Creative thinking has very much to do with perception to put forward different views. The different views are not derived each from the other but are independently produced. In this sense, creative thinking has to do with exploration just as perception.

4 LEARNING STYLES AND CONCEPT OF COGNITIVE DIMENSION IN VOCATIONAL EDUCATION

Formal test, quizzes and inventories are all methods which are 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 in the school context (Griggs, 1991; Jonassen and Grabowski, 1993; Richard and Stephen, 1998). Some authors have also investigated the effectiveness of matching learning preferences to learning outcomes (De Bello, 1985; Gianitti, 1988), while other researchers have contributed on establishing a relationship between learning style and learning environment (Brennan, 1984; Clark-Thayer, 1987).

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 VE teachers develop a fundamental understanding and

response to student learning styles. VE 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.

The study conducted by the authors previously had identified based on the FSLSM Index of Learning Styles revealed that vocational students favored in visual styles, followed by active, sensing and sequential styles. 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. This article is focused in visual learner and significant actors in vocational elements. Researcher summarizes the attributes of visual learners as shown in Figure 2.

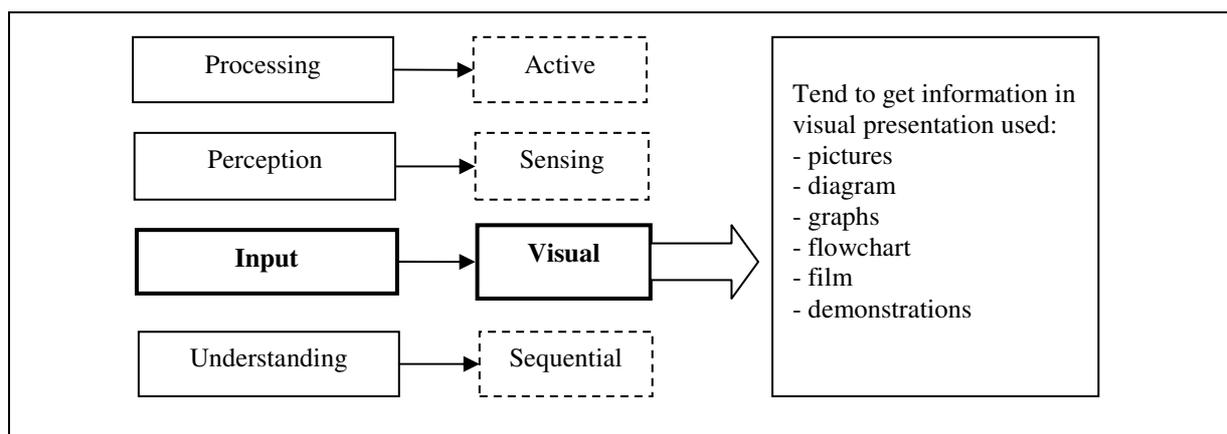


Figure 2: Vocational students characteristic and attributes

The importance of a clear understanding of LS, not in just a general way but in a very specific way so that teaching and learning strategies can be integrated, is supported by Peter and Jennifer (2005). In their discussion, they stated that teachers discovered that there were differences in the way that different groups of students learnt. One explanation was the possibility that the teacher grouped students based on their examination results and taught according to those examination results. They also agree that identifying students' learning styles can play an important role as an approach to plan teaching strategies even though they never used the LS inventories or model to measure their students. Learning styles has been founded as important and interesting. This considering that learning style will help teachers focus and realize about an individual difference (Hassan *et. al*, 2010). Hassan (2010) also

argued that students will learn better when using the preferences in which they are successful; students will be better learners when they can expand their preferences and students will better learn when teaching accommodates various preferences, more students will be successful.

When research find out that vocational students are tend to be visual learner, the investigation in terms of ability to cater concept of vocational learning was measured. The result shows students have significant differences in skills and problem solving but not in knowledge. It means, students have same ability to cater in knowledge concept, when comes to applying skills and problem solving each student have their own preferences. Thus, teacher should aware and it will help them how to accommodate learning styles and the concept of cognitive dimension in VE. Figure 3 presents the idea on how to connect visual criteria with skills and problem solving. Problem solving skills is a basic skill required by today’s learner .This is especially true as changes in the economic, organizational and technological forces have changed the nature of most workplaces. The ability to solve a complex or an ill-structured work problem in the kind of skill demanded at a high-level performance organization (Wan Mohamed *et. al*, 2010).

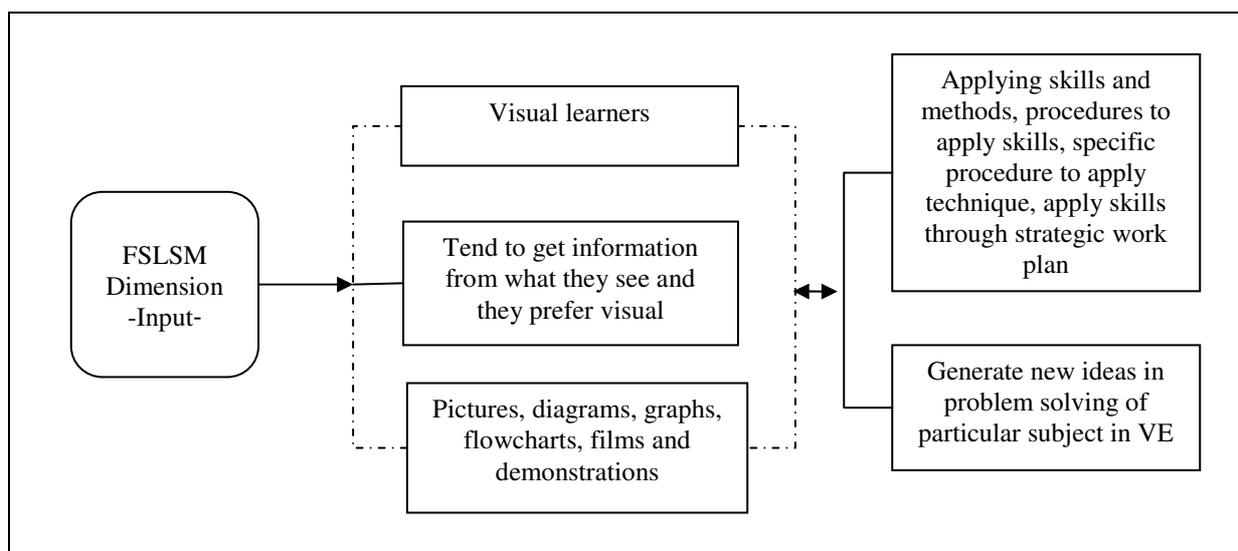


Figure 3: Connection between Visual Learner with Skills and Problem Solving

5 CONCLUSION

This study concludes that vocational students have their own characteristics and preferences in learning. Vocational students incline to be visual learners and capable of using the knowledge elements in cognitive learning, even though they are struggling to master the skills and problem solving abilities that are indicated by achievement test. Their ability as visual learners is applied in understanding diagrams, pictures, and charts, as well as certain topic in VE subject which involve skills. For instance, when students had completed the task

in constructing brick wall; they might use pictures of brick wall to explain the complete procedures as needed in the report. 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.

REFERENCES

- Alan, P. (2009). *Ways of Learning ; Learning Theories and Learning Styles in The Classroom 2nd Edition*. University of Warwick, UK: David Fulton Publishers
- Anderson, L. W and Krathwohl, D. R. (2001). *Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Educational Objectives*. Boston, MA: Allyn and Bacon
- Benke, Ralph L., Jr. and Hermanson, Roger H. (1988) "Measuring Quality Teaching - II." *Management Accounting*. 69(8), pp.40-41
- Brennan, P. (2003). *An Analysis of the Relationship among Hemispheric Preference and Analytic/Global Cognitive Style, Two Elements of Learning Style, Method of Instruction, Gender and Mathematics Achievement*. Doctoral Dissertation St John's University Jamaica. Dissertation Abstract International 45/11, 3271A
- Clark-Thayer, S. (1987). *The Relationship of the Knowledge of Student-Perceived Learning Style Preferences and Study Habits and Attitudes to Achievement of College Freshman in a Small Urban University*. Doctoral Dissertation St John's University Jamaica. Annotated Bibliography, 1991. New York: The Learning Styles Network
- Cury, L (1983). *An Organization of Learning Styles Theory and Constructs*. ERIC Document Retrieval Service.
- DeBello, T.C. (1985a). *A Critical Analysis of the Effect on Achievement and Attitudes of Administrative to Social Studies Instruction based on Eight Grade Student's Sociological Preferences for Learning Alone, With Teachers*. Doctoral Dissertation, St John University Jamaica. Annotated Bibliography, 1991. New York: The Learning Styles Network
- Fatt J.P.T, (2000). Understanding the learning styles of students: Implication for educators. *International Journal of Sociology and Social Policy*, 20 (11/12),pp 35-45
- Felder, R. M (1993). *Reaching the second tier- Learning and Teaching Styles in College Science Education*. *Journal of College Science Teaching*. 23 (5), pp 286-290
- Felder, R.M and Soloman B.A (1997), *Index of Learning Styles Questionnaire*. Retrieved 31 July 2010 from http://www.engr.ncsu.edu/learning_styles/ilsweb.html
- Felder,R. Silverman L.K.(1988). *Learning and teaching styles in engineering education*. *Journal in Engineering Education*, 78 (7),pp 674-681
- Fleming, N.D.(2001).*Teaching and Learning Styles : VARK Strategies*. Christchurch, New Zealand : N.D. Fleming

- Francisco J. (2003) *Transformative Dimensions of Adult Learning*. New York: Macmillan. Gianitti, M.C (1988). *An Experimental Investigation of The Relationship among The Learning Style Sociological Preferences of Middle School Students, their attitudes and achievement in social studies and selected instructional techniques*. Doctoral Dissertation St John's University Jamaica. Annotated Bibliography, 1991. New York: The Learning Styles Network
- Griggs, S.A (1991). *Learning Styles Counseling*. Ann Arbor, MI: ERIC Counseling and Personnel Services Clearinghouse, University of Michigan
- Hassan, R., Hashim, M.N, Hussein, A (2010), *How Do Learners Respond To CBL Material Based On Modality Learning Style?* Journal of Technical Education and Training, 2 (1), 21-30
- International Labour Organization. (1995). *Safety Health and Welfare on Construction Site*. Geneva: International Labour Office
- International Labour Organization. (2000). *Employment Paper*. Geneva: International Labour Office
- Jonassen, D.H and Grabowski, B.L (1993). *Handbook of Individual Differences, Learning and Instruction*. Hillsdale, NJ: Lawrence Erlbaum
- Luciana, A. M Zaina & Graca, B (2008). *Classification of Learning Profile Based on Categories Student Preferences*. 38th ASEE/IEEE Frontiers Education Conference. New York: Saratoga Springs
- Madeline E.E, Betty L.L and Rebecca L.O (2003). *A Brief Overview of Individual Differences in Second Language Learning*. System 31 (2003), pp 313-330. Elsevier Ltd Peter Smith and Jenifer Dalton (2005). *Getting Grip with Learning Styles*. Adelaide, Australia : NCVER
- Mohamad, M.M, Tee, T.K, Yee, M.H, Rajuddin, M.R (2012). *Vocational Pedagogy: A Dimension of Vocational Learning With Workplace Requirement*. Journal of Technical Education and Training, 4 (1), 23-30
- Mohamad, M.M, Tee, T.K, Yee, M.H, Rajuddin, M.R (2011). *Identifying Relationship Involving Learning Styles and Problem Solving Skills Among Vokasional Students*. Journal of Technical Education and Training, 3 (1), 37-45
- Richard, R. & Stephen, R. (1998). *Cognitive Styles and Learning Strategies; Understanding Style Differences in Learning Behaviour*. London: David Fulton Publishers
- Ruth G.Thomas (1992). *Cognitive Theory-Based Teaching and Learning in Vocational Education*. University of Minnesota; Thesis Dissertation
- Sabine, G., Silvia, R.V., Tommaso, L. (2007). *In-depth analysis of Felder-Silverman learning styles dimensions*. Journal of Research on Technology in Education, 40(1), pp 79-93
- Schneider, M., and Stern, E. (2010). *The Cognitive Perspective on Learning: Ten Cornerstone Findings*. Int. Organisation for Economic Co-Operation and Development (OECD) (ed). Paris: OECD
- Shulman, L (1987). *Knowledge and teaching: Foundations of the New Reform*. Havard Educational Review
- Thomas F.H., Amit, J.S., (2007). *Using learning styles instruments to enhance student learning*. Journal of Innovative Education, 5(1), pp 249-252
- Widad, Rio Sumarni and Lee, M. F (2007). *The Relationship between Personality Type, Learning Styles and Problem Solving Approach in Technical and Vocational Education Students*. Journal of Social Science and Humanities. 15 (1), pp 1-8: Universiti Putra Malaysia