LEARNING STYLES AND ACADEMIC ACHIEVEMENT AMONG BUILDING CONSTRUCTION STUDENTS

MIMI MOHAFFYZA BINTI MOHAMAD

A thesis submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy (Technical and Vocational Education)

Faculty of Education
Universiti Teknologi Malaysia

JANUARY 2013
ABSTRACT

This study is conducted to identify how learning styles (LS) influence the students’ academic achievement based on cognitive mastery and vocational elements in Building Construction Subject (BCS) involving the students and teachers of Building Construction Course (BCC) from three secondary vocational schools in Johor. Descriptive case study was applied with quantitative and semi-structured interview as supporting components in this study. The quantitative data were gathered based on Felder and Silverman Learning Styles Model (FSLSM), Felder-Soloman Index of Learning Styles (ILS) and vocational cognitive elements which consist of the aspects of knowledge, skills and problem solving were taken into account in constructing the question items. Purposive sampling was used to select the schools and stratified sampling procedure was applied in the selection of 128 students as research respondents. Purposive sampling was also chosen to select teachers as respondents for interview. The quantitative data was analyzed in descriptive and inferential statistic involving parametric test; Chi Square and Multivariate Analysis of Variance (MANOVA). Kruskal-Wallis was used for non-parametric test for this study. The content analysis for interview was managed to analyze the narrative text from interview record. The study discovered that students in BCC tend to be visual learners. Visual learners represent the input dimension of FSLSM and the result showed there are significant differences between input dimension with skills and problem solving but not with knowledge. The discussions with teachers revealed that most teachers accommodate students learning styles with cognitive mastery by using visual approach to increase students’ academic achievement. Research findings suggested a few framework of learning styles with vocational elements in BCS and concluded the need for a framework based on the dominant students’ learning style through the cognitive mastery and vocational elements. In conclusion, the research proposed that the Cognitive Learning Styles Framework (C-LSF) could act as a guideline for teachers to facilitate students to learn more effectively and to boost the academic achievement in Building Construction Subject.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>CHAPTER</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DECLARATION</td>
<td>ii</td>
<td></td>
</tr>
<tr>
<td>DEDICATION</td>
<td>iii</td>
<td></td>
</tr>
<tr>
<td>ACKNOWLEDMENT</td>
<td>iv</td>
<td></td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>v</td>
<td></td>
</tr>
<tr>
<td>ABSTRAK</td>
<td>vi</td>
<td></td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>vii</td>
<td></td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>xi</td>
<td></td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>xiv</td>
<td></td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xvi</td>
<td></td>
</tr>
<tr>
<td>LIST OF APPENDICES</td>
<td>xvii</td>
<td></td>
</tr>
</tbody>
</table>

1 | INTRODUCTION | 1 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>Background of Problem</td>
<td>3</td>
</tr>
<tr>
<td>1.2.1</td>
<td>Identifying Learning Styles</td>
<td>5</td>
</tr>
<tr>
<td>1.2.2</td>
<td>Student Learning</td>
<td>11</td>
</tr>
<tr>
<td>1.3</td>
<td>Statement of Problem</td>
<td>17</td>
</tr>
<tr>
<td>1.4</td>
<td>Research Objectives</td>
<td>18</td>
</tr>
</tbody>
</table>
# LITERATURE REVIEW

## 2.1 Introduction

## 2.2 Learning Styles (LS)
- 2.2.1 Identifying Learning Styles
- 2.2.2 LS Models and Theories
- 2.2.3 Felder and Silverman Learning Styles Model (FSLSM)

## 2.3 Comparison between Learning Styles Model

## 2.4 Learning Styles in Vocational Education

## 2.5 Cognitive Perspectives

## 2.6 Cognitive Domain of Bloom’s Taxonomy Educational Objectives

## 2.7 Revision of Bloom’s Taxonomy- Anderson & Krathwohl Taxonomy

## 2.8 Cognitive Learning in Vocational Education

## 2.9 Vocational Elements in BCS

## 2.10 Vocational Education

## 2.11 Chapter Summary
### 3 RESEARCH METHODS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Introduction</td>
<td>93</td>
</tr>
<tr>
<td>3.2</td>
<td>Research Design and Procedure</td>
<td>93</td>
</tr>
<tr>
<td>3.3</td>
<td>Research Respondents</td>
<td>99</td>
</tr>
<tr>
<td>3.4</td>
<td>Research Instruments</td>
<td>101</td>
</tr>
<tr>
<td>3.4.1</td>
<td>Felder Soloman Learning Styles Index (ILS)</td>
<td>101</td>
</tr>
<tr>
<td>3.4.2</td>
<td>Set of Questionnaires for Students’ Perception in Cognitive Learning (SPCL)</td>
<td>104</td>
</tr>
<tr>
<td>3.4.3</td>
<td>Cognitive Mastery Achievement Test (CMAT)</td>
<td>107</td>
</tr>
<tr>
<td>3.4.4</td>
<td>Semi structured Interview</td>
<td>111</td>
</tr>
<tr>
<td>3.5</td>
<td>Reliability and Validity</td>
<td>113</td>
</tr>
<tr>
<td>3.5.1</td>
<td>Pilot Study</td>
<td>114</td>
</tr>
<tr>
<td>3.6</td>
<td>Methods of Data Analysis</td>
<td>127</td>
</tr>
<tr>
<td>3.6.1</td>
<td>Quantitative Data Analysis</td>
<td>127</td>
</tr>
<tr>
<td>3.6.2</td>
<td>Qualitative Data Analysis</td>
<td>128</td>
</tr>
<tr>
<td>3.7</td>
<td>Chapter Summary</td>
<td>130</td>
</tr>
</tbody>
</table>

### 4 DATA ANALYSIS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Introduction</td>
<td>131</td>
</tr>
<tr>
<td>4.2</td>
<td>Analysis of Research Question (i)</td>
<td>132</td>
</tr>
<tr>
<td>4.3</td>
<td>Analysis of Research Question (ii)</td>
<td>143</td>
</tr>
<tr>
<td>4.4</td>
<td>Analysis of Research Question (iii)</td>
<td>134</td>
</tr>
<tr>
<td>4.5</td>
<td>Analysis of Research Question (iv)</td>
<td>138</td>
</tr>
<tr>
<td>4.6</td>
<td>Analysis of Research Question (v)</td>
<td>141</td>
</tr>
<tr>
<td>4.7</td>
<td>Analysis of Research Question (vi)</td>
<td>144</td>
</tr>
</tbody>
</table>
5 DISCUSSION, RECOMMENDATION AND CONCLUSION 164
  5.1 Introduction 164
  5.2 Research Overview 164
  5.3 Research Discussion 168
    5.3.1 Learning Styles (LS) 168
    5.3.2 Cognitive Learning 174
  5.4 Recommendations 186
    5.4.1 Teachers 187
    5.4.2 Students 188
    5.4.3 Curriculum Designer 190
  5.5 Cognitive Learning Styles Framework (C-LSF) 191
  5.5 Recommendations for Future Research 195
  5.6 Conclusion 196

REFERENCES 197

Appendices A-J 212-279
<table>
<thead>
<tr>
<th>TABLE NO.</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Result Analysis of Sijil Pelajaran Malaysia in Building Construction Technology 2006-2009</td>
<td>12</td>
</tr>
<tr>
<td>1.2</td>
<td>Analysis of Students Achievement in Building Construction Modules</td>
<td>13</td>
</tr>
<tr>
<td>1.3</td>
<td>Types of Learners and Creative Thinking</td>
<td>15</td>
</tr>
<tr>
<td>1.4</td>
<td>Teachers Strategies for Student Performance</td>
<td>15</td>
</tr>
<tr>
<td>2.1</td>
<td>Families of Learning Styles</td>
<td>44</td>
</tr>
<tr>
<td>2.2</td>
<td>Dunn and Dunn’s Model and Instruments of Learning Style</td>
<td>45</td>
</tr>
<tr>
<td>2.3</td>
<td>Myers-Briggs Type of Indicator (MBTI)</td>
<td>47</td>
</tr>
<tr>
<td>2.4</td>
<td>Entwistle’s Approaches and Study Skills Inventory for Students</td>
<td>48</td>
</tr>
<tr>
<td>2.5</td>
<td>Honey and Mumford LSQ</td>
<td>49</td>
</tr>
<tr>
<td>2.6</td>
<td>Kolb’s Experiential Learning Model</td>
<td>51</td>
</tr>
<tr>
<td>2.7</td>
<td>Vermunt’s Inventory of Learning Styles</td>
<td>52</td>
</tr>
<tr>
<td>2.8</td>
<td>Semantic Groups associated with the ILS Questions</td>
<td>57</td>
</tr>
<tr>
<td>2.9</td>
<td>Test-Retest Correlation Coefficients</td>
<td>58</td>
</tr>
<tr>
<td>2.10</td>
<td>Cronbach Alpha Coefficients</td>
<td>58</td>
</tr>
<tr>
<td>2.11</td>
<td>ANOVA Results for Time Comparison</td>
<td>59</td>
</tr>
<tr>
<td>2.12</td>
<td>Learning Styles Model</td>
<td>61</td>
</tr>
<tr>
<td>2.13</td>
<td>General Education versus Vocational Education</td>
<td>62</td>
</tr>
<tr>
<td>2.14</td>
<td>Bloom’s Taxonomy Educational Objectives</td>
<td>73</td>
</tr>
<tr>
<td>2.15</td>
<td>The Knowledge Dimension</td>
<td>75</td>
</tr>
<tr>
<td>2.16</td>
<td>The Cognitive Process Dimension</td>
<td>77</td>
</tr>
<tr>
<td>2.17</td>
<td>Cognitive Learning Characteristics</td>
<td>80</td>
</tr>
<tr>
<td>2.18</td>
<td>Cognitive Level in Construction Material Module</td>
<td>82</td>
</tr>
<tr>
<td>2.19</td>
<td>Cognitive Level in Construction Technology Module</td>
<td>83</td>
</tr>
<tr>
<td>2.20</td>
<td>Knowledge Bases</td>
<td>85</td>
</tr>
<tr>
<td>3.1</td>
<td>Research Respondents</td>
<td>99</td>
</tr>
<tr>
<td>3.2</td>
<td>Selecting Research Respondents</td>
<td>100</td>
</tr>
<tr>
<td>3.3</td>
<td>Semantic Groups associated with ILS Questions</td>
<td>104</td>
</tr>
</tbody>
</table>
3.4 Matrix Bloom Taxonomy 105
3.5 Items Construct 106
3.6 CMAT Items Construct 108
3.7 Construction Material Subject Specification 109
3.8 Construction Technology Subject Specification 110
3.9 Table of Specification for BCS CMAT 111
3.10 Interview Protocol 112
3.11 Rating Scale Instrument Quality Criteria 113
3.12 ILS Person Reliability 115
3.13 ILS Items Reliability 115
3.14 ILS Processing Dimension 116
3.15 ILS Perception Dimension 116
3.16 ILS Input Dimension 117
3.17 ILS Understanding Dimension 117
3.18 SPCL Items in Questionnaires 118
3.19 Person Measure of SPCL 118
3.20 Item Measure of SUCL 119
3.21 Knowledge Construct 119
3.22 Skills Construct 120
3.23 Problem Solving Construct 120
3.24 Percent-Agreement Items of SPCL 122
3.25 Person Measure CMAT 123
3.26 Item Measure CMAT 123
3.27 Knowledge Construct 124
3.28 Skills Construct 124
3.29 Problem Solving Construct 125
3.30 Percent-Agreement Items of CMAT 126
3.31 Methods of Quantitative Data Analysis 127
3.32 Methods of Qualitative Data Analysis 129
4.1 Descriptive Statistics of ILS 133
4.2 Categories of Learners 142
4.3 Semantic Group with ILS Questions 134
4.4 Chi Square Types of Learners 135
4.5 Kruskal-Wallis Test Statistics 136
4.6 Marks Distribution in Achievement Test 139
4.7 School Grade System 139
4.8 Students’ Grade 140
4.9 Grading Criteria 141
4.10 Multivariate Test on Processing Dimension 142
4.11 Tests of Between-Subjects Effects Processing-Cognitive Learning 143
4.12 Analysis Processing Dimension Across-Cognitive Learning 143
4.13 Multivariate Tests on Perception Dimension 145
4.14 Tests of Between-Subjects Effects Perception-Cognitive Learning 146
4.15 Analysis Perception Dimension Across-Cognitive Learning 146
4.16 Multivariate Tests on Input Dimension 148
4.17 Tests of Between-Subjects Effects Input- Cognitive Learning 149
4.18 Analysis Input Dimension Across-Cognitive Learning 149
4.19 Multivariate Tests on Understanding Dimension 151
4.20 Tests of Between-Subjects Effects Understanding-Cognitive Learning 151
4.21 Analysis Understanding Dimension Across-Cognitive Learning 152
4.22 Quantitative Finding Summary 153
### LIST OF FIGURES

<table>
<thead>
<tr>
<th>FIGURE NO</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>The role of teaching to adapt students learning</td>
<td>6</td>
</tr>
<tr>
<td>1.2</td>
<td>Students’ Learning Styles in Hands-on Course</td>
<td>7</td>
</tr>
<tr>
<td>1.3</td>
<td>Students’ Learning Styles in Mixed Course</td>
<td>8</td>
</tr>
<tr>
<td>1.4</td>
<td>Students’ Learning Styles in Paper-Based Course</td>
<td>8</td>
</tr>
<tr>
<td>1.5</td>
<td>Pre-Service Teachers in Engineering Education Learning Styles</td>
<td>9</td>
</tr>
<tr>
<td>1.6</td>
<td>Learning Styles among Major Subject</td>
<td>10</td>
</tr>
<tr>
<td>1.7</td>
<td>Research Conceptual Framework</td>
<td>25</td>
</tr>
<tr>
<td>2.1</td>
<td>Three Layer Onion Ring Model of LS by Curry 1993</td>
<td>45</td>
</tr>
<tr>
<td>2.2</td>
<td>Kolb’s Experiential Learning Model (ELM)</td>
<td>50</td>
</tr>
<tr>
<td>2.3</td>
<td>ILS Felder Soloman</td>
<td>56</td>
</tr>
<tr>
<td>2.4</td>
<td>Correlation between LS</td>
<td>60</td>
</tr>
<tr>
<td>2.5</td>
<td>Relationship of Cognitive, Affective and Psychomotor Domain</td>
<td>72</td>
</tr>
<tr>
<td>2.6</td>
<td>Learning Model and VET Students Preferences</td>
<td>81</td>
</tr>
<tr>
<td>2.7</td>
<td>Making Vocational Education Works</td>
<td>91</td>
</tr>
<tr>
<td>3.1</td>
<td>Stage 1 Research Procedure</td>
<td>96</td>
</tr>
<tr>
<td>3.2</td>
<td>Stage 2 Research Procedure</td>
<td>97</td>
</tr>
<tr>
<td>3.3</td>
<td>Stage 3 Research Procedure</td>
<td>98</td>
</tr>
<tr>
<td>3.4</td>
<td>ILS Felder-Soloman</td>
<td>102</td>
</tr>
<tr>
<td>3.5</td>
<td>A Visual Model of the Coding in Qualitative</td>
<td>129</td>
</tr>
<tr>
<td>4.1</td>
<td>Number of Respondents</td>
<td>132</td>
</tr>
<tr>
<td>4.2</td>
<td>Boxplot Graph of Knowledge Elements</td>
<td>136</td>
</tr>
<tr>
<td>4.3</td>
<td>Boxplot Graph of Skills Elements</td>
<td>137</td>
</tr>
<tr>
<td>4.4</td>
<td>Boxplot Graph of Problem Solving Elements</td>
<td>137</td>
</tr>
<tr>
<td>4.5</td>
<td>Distribution of Students’ Marks in Achievement Test</td>
<td>140</td>
</tr>
<tr>
<td>4.6</td>
<td>Summary of Qualitative</td>
<td>162</td>
</tr>
<tr>
<td>5.1</td>
<td>BCC students’ characteristic attributes</td>
<td>170</td>
</tr>
<tr>
<td>5.2</td>
<td>Cognitive Understanding in BCS</td>
<td>176</td>
</tr>
<tr>
<td>5.3</td>
<td>Connection between Active Learner and Problem Solving</td>
<td>180</td>
</tr>
<tr>
<td>5.4</td>
<td>Connection between Sensing Learner and Problem Solving</td>
<td>182</td>
</tr>
<tr>
<td>5.5</td>
<td>Connection between Visual Learner with Skills and Problem Solving</td>
<td>184</td>
</tr>
<tr>
<td>5.6</td>
<td>Connection between Sequential Learner with Knowledge and Skills</td>
<td>185</td>
</tr>
<tr>
<td>5.7</td>
<td>Learning Styles and Significant factors in C-LSF</td>
<td>186</td>
</tr>
<tr>
<td>5.8</td>
<td>Applying Visual Styles in Skills</td>
<td>187</td>
</tr>
<tr>
<td>5.9</td>
<td>Applying Visual Styles in Problem Solving</td>
<td>188</td>
</tr>
<tr>
<td>5.10</td>
<td>Cognitive Learning Styles Framework (C-LSF)</td>
<td>194</td>
</tr>
</tbody>
</table>
**LIST OF ABBREVIATIONS**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Abstract Conceptualization</td>
</tr>
<tr>
<td>AE</td>
<td>Active Experimentation</td>
</tr>
<tr>
<td>ASSIST</td>
<td>Approaches and Study Skills Inventory for Students</td>
</tr>
<tr>
<td>BC</td>
<td>Building Construction</td>
</tr>
<tr>
<td>BCC</td>
<td>Building Construction Course</td>
</tr>
<tr>
<td>BCI</td>
<td>Building Construction Industry</td>
</tr>
<tr>
<td>BCS</td>
<td>Building Construction Subject</td>
</tr>
<tr>
<td>CDC</td>
<td>Curriculum Development Center</td>
</tr>
<tr>
<td>CE</td>
<td>Concrete Experience</td>
</tr>
<tr>
<td>C-LSF</td>
<td>Cognitive Learning Style Framework</td>
</tr>
<tr>
<td>CMAT</td>
<td>Cognitive Mastery Achievement Test</td>
</tr>
<tr>
<td>ELM</td>
<td>Experiential Learning Style Model</td>
</tr>
<tr>
<td>FSLSM</td>
<td>Felder Silverman Learning Style Model</td>
</tr>
<tr>
<td>ILS</td>
<td>Index of Learning Styles</td>
</tr>
<tr>
<td>LS</td>
<td>Learning Styles</td>
</tr>
<tr>
<td>LSQ</td>
<td>Learning Styles Questionnaires</td>
</tr>
<tr>
<td>MANOVA</td>
<td>Multivariate Analysis of Variance</td>
</tr>
<tr>
<td>MBTI</td>
<td>Myer-Briggs Type Indicator</td>
</tr>
<tr>
<td>MOE</td>
<td>Ministry of Education</td>
</tr>
<tr>
<td>PLSPQ</td>
<td>Perceptual Learning Styles Questionnaire</td>
</tr>
<tr>
<td>RO</td>
<td>Reflective Observation</td>
</tr>
<tr>
<td>SPM</td>
<td>Sijil Pelajaran Malaysia</td>
</tr>
<tr>
<td>TVE</td>
<td>Technical Vocational Education</td>
</tr>
<tr>
<td>TVED</td>
<td>Technical and Vocational Education Division</td>
</tr>
<tr>
<td>VAKT</td>
<td>Visual, Auditory, Kinesthetic and Tactile</td>
</tr>
<tr>
<td>VE</td>
<td>Vocational Education</td>
</tr>
</tbody>
</table>
# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>APPENDIX</th>
<th>TITLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Felder-Soloman Index of Learning Styles</td>
<td>212</td>
</tr>
<tr>
<td>B</td>
<td>Inventori Gaya Pembelajaran</td>
<td>218</td>
</tr>
<tr>
<td>C</td>
<td>Student Perception of Cognitive Learning</td>
<td>226</td>
</tr>
<tr>
<td>D</td>
<td>Cognitive Mastery Achievement Test</td>
<td>231</td>
</tr>
<tr>
<td>E</td>
<td>Interview Protocol</td>
<td>248</td>
</tr>
<tr>
<td>F</td>
<td>Interview Transcription</td>
<td>249</td>
</tr>
<tr>
<td>G</td>
<td>Letter of Approval (Ministry of Education)</td>
<td>265</td>
</tr>
<tr>
<td>H</td>
<td>Permission using ILS- Dr. Richard M Felder</td>
<td>267</td>
</tr>
<tr>
<td>H</td>
<td>Translation Approval</td>
<td>268</td>
</tr>
<tr>
<td>I</td>
<td>Content Validity Approval</td>
<td>272</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Introduction

Every year, the Malaysian Government spends a great deal of money on the improvement of the quality of education. Education is an expensive investment in the future of students, and much emphasis is placed on the curriculum and values of education to enable the students to meet the needs of the industry. Teaching and learning is the root of all advancement in all levels of education, namely, primary, secondary, college, and university. The difference between the levels is the level of difficulty that students face. The Taxonomy of Educational Objectives by Bloom (1956) classified learning into three major areas; cognitive, affective, and psychomotor.

The cognitive domain and level stated in educational settings help teachers understand and implement what they need to achieve in their teaching objectives. The structure of Bloom’s Taxonomy contains knowledge, comprehension, application, analysis, synthesis, and evaluation. Anderson and Karthwolh (2001) revised Bloom’s Taxonomy and changed the original number of categories by introducing the Four-Knowledge Dimension of Taxonomy: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge. Splitter (1995), Caviglioli et al. (2004), and Tee et al. (2009), suggested that all educators should provide students with multiple skills and for teachers to cater their learning abilities with various teaching methods. Teachers, however, cannot assume that students will easily understand the learning content when they only sit in class.
and follow instructions. An awareness of the interaction between students, teachers, and teaching materials must also be present.

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 cognitivism, 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).

1.2 Background of the Problem

The cognitive processes that contribute to student learning require that the student have the ability to manipulate information and ideas to solve problems and produce new knowledge. Many features of current cognitive theories on teaching and learning reflect earlier models of teaching such as Bruner’s, Taba’s, and various group-based and student-centered teaching models (Ruth, 1992). In VE, the importance of the cognitive process is based on a few factors, namely, the cognitive abilities needed in the current work environment, the ability to adapt to changing VE
requirements in a global context, and the demands of cognitive development (Tee et al., 2009). In their cognitive research, Johnson and Thomas (1992) summarized that learning does not automatically change and that understanding the learning content is difficult. Cognitive processes are not encouraged by passive learning.

VE students have their own learning preferences, considering they rely less on their cognitive abilities and more on their psychomotor talents, including physical movement, coordination, and use of motor skills (Bloom, 1956). They need to increase their cognitive abilities with a suitable approach so that they can be creative and innovative workers in order to do well in their work situation. The suitable approach in this case is perhaps the identification of the students’ learning styles that equal to VE characteristics to produce suggestions on overcoming the problems. Bloom (1989) also states that the ability of students to learn basic principles and their ability to apply knowledge or explained what they learned.

A student’s learning is influenced by a few factors. The basic issues of student learning as explored by Muhammed et al. (2008) include home background, learning environment, and government policies. Martins et al. (2007) stated that family background factors determined academic performance, and Azizi et al. (2003) claimed that learning styles influenced a student’s academic performance. Francis and Segun (2008) concluded that the school environment and teacher-related factors were the dominant factors influencing achievements, especially if the student was highly self-motivated. Learning in VE is defined as the transition from using basic problem-solving strategies towards using expert problem-solving strategies (Ruth, 1992). Learners in VE must observe and experience the required cognitive processes to learn them and know how, where, and when to use them. One of the factors debated over the last few decades was the relationship between student achievement and learning styles. Proponents of learning styles maintain that adapting classroom teaching methods to suit students’ preferred styles of learning improves the educative process (Felder, 1993). However, opponents of learning style theories maintain that little empirical evidence is available to support this proposition LS involved strategies that students tend to apply to a given teaching situation. Each individual can fit into different styles that can result in students adopting attitudes and behaviors that are repeated in different situations.
1.2.1 Identifying Learning Styles

Learning styles can be classified into various categories, for example, sensory, auditory, visual, and tactile. Dunn and Dunn (1992) reported that learning styles is an individual reaction to several environmental, emotional, psychological, and sociological factors. In vocational schools, the VE students have their own characteristics, according to Brennan (2003). They are verbal learners who watch and see rather than read and listen. They are hands-on and learn by doing and practicing. They learn in groups and are dependent learners who need instructor guidance for clear understanding. Considering that the characteristics of students in VE are more hands-on, and that they learn by doing, an understanding of this type of LS will help teachers provide a teaching delivery method that matches their students’ needs.

“Students’ needs” is a term described by Posner et.al (1992) as a description of how students deal with curricular tasks by employing relevant learning structures. The goal in teaching VE students is to gain experience and to apply existing knowledge to new situations. The role of the teacher is to create learning environments for students handling the presented tasks. Figure 1.1 shows how a VE student’s learning ability is influenced by various factors (John, 1995).
VE encompasses a wide range of courses or skills that help students prepare to enter an occupational-based employment or workplace (International Labour Organization, 2000). The concept behind VE is to bridge theory and practical components, such as lab- and workshop-oriented knowledge to workplace knowledge, with specific skills. As a result, vocational students have their own LS. In her research on learning strategies among vocational students, Briggs (2000) concluded that vocational students benefited from three types of courses, namely, “hands-on courses,” “mixed-courses,” and “paper-based courses.” She also classified the analysis of LS into visual, auditory, and kinesthetic (VAK) to create a basis for innovation in teaching and learning strategies.

A visual style relies on seeing and reading, auditory depends on listening and speaking, and a kinesthetic style focuses on touching and doing. Figure 1.2 shows the use of LS in hands-on courses. Hands-on courses refer to hairdressing, plumbing, professional craft catering, and painting. This group showed that their preference was for visual strategies. The figure illustrated three categories of students’ score as
indicating strong, medium, and weak use of visual, auditory, and kinesthetic learning style strategies. The results show that the students most preferred visual learning strategies. The results show that the highest number of students scored in visual strategies. This means that the students scored strongly in a range of visual strategies. Meanwhile, 20 students strongly used auditory learning strategies, and only 18 students strongly applied the kinesthetic approach to learning.

Figure 1.2: Students’ Learning Styles in Hands-on Courses

Briggs (2000) used the same method of using learning strategies for “mixed” courses. Mixed courses refer to courses that involve a mixture of paper-based and hands-on materials. Mixed courses represent the course related to engineering education and performing arts. The result showed that this group preferred visual strategies the most and kinesthetic strategies the least. Figure 1.3 shows that the students preferred visual learning styles (17 students) over both auditory (12 students) and kinesthetic styles (3 students).
Figure 1.3: Students’ Learning Styles in Mixed Courses

Figure 1.4 shows the profiles of LS for students in a paper-based course. The students investigated were involved in business, public service, and health science courses. The results showed a strong use of visual strategies among students in “paper-based” courses. Forty-five students preferred visual study approaches, 20 who preferred auditory, and 19 students who preferred kinesthetic. Generalizing course groups is difficult, even when they are aggregated. However, students in paper-based courses appeared to choose visual and auditory strategies more than students did in hands-on courses.

Figure 1.4: Students’ Learning Styles in Paper-Based Courses

The concept of LS is understood by VE teachers as a legitimate way of expressing individual differences in the way their students learn. However, the
fundamental concept of LS is and understanding of the characteristics and dimensions of various learning strategies. Research conducted by Peter (2003) indicated that understanding students’ LS and preferences is very important for teachers. Peter also suggested an LS model among VE practitioners. A survey conducted by Muhammad et al. (2010) involved 48 pre-service Engineering teachers with a major in mechanical, electrical, or civil engineering to identify their learning styles. This study was designed to prepare students to become future teachers when they completed their degrees in Technical and Vocational Education. The pre-service teachers were students attending schools during their practicum. They taught engineering subjects containing both task theory and hands-on components. The characteristics of engineering education are similar to VE, meaning that the results could be used to represent how the pre-service teachers accommodated various learning styles and learning preferences. As future teachers, they needed to equip themselves with strong skills in behavioral, cognitive, and constructivist basics so that they will be able to accommodate students’ learning styles.

The study used Perceptual Learning Styles Questionnaires (PLSPQ) distributed to 48 students, 20 males and 28 females. The results are illustrated in Figure 1.5, which shows that male students preferred visual (33%) and kinesthetic (36%) learning, whereas female students were more likely to be auditory learners (43%). Both female (63%) and male students (58%) liked to learn in groups.

![Figure 1.5: Pre-Service Teachers in Engineering Education Learning Styles](Source: Muhammad, et.al, 2010)
Figure 1.6 presents the results from the study based on the students’ major. The results show that 38% of mechanical engineering students were kinesthetic learners, whereas 34% of them were visual learners. Electrical engineering students prefer auditory learning styles (36%) while civil engineering students scored the highest for kinesthetic learning style (42%).

Figure 1.6: Learning Styles among Major Subject

Auditory learners learn better in a lecture class and by listening to someone. Many students also like to learn by doing exercises and drills in class. This is one of the characteristics of a kinesthetic learner. Tactile learners are the rarest of the other learning preferences. However, most students were undecided regarding tactile learning styles. The dominant learning style of engineering pre-service teachers was visual, and these teachers were comfortable with pictures, images, and graphs while studying and retaining information. Muhammad et Al. (2010) also showed that, in terms of visual learning, the majority of students agreed that when learning a new skill, they would rather watch someone demonstrate the skill than listen to someone talk about the skill.
CHAPTER 1

INTRODUCTION

1.1 Introduction

Every year, the Malaysian Government spends a great deal of money on the improvement of the quality of education. Education is an expensive investment in the future of students, and much emphasis is placed on the curriculum and values of education to enable the students to meet the needs of the industry. Teaching and learning is the root of all advancement in all levels of education, namely, primary, secondary, college, and university. The difference between the levels is the level of difficulty that students face. The Taxonomy of Educational Objectives by Bloom (1956) classified learning into three major areas; cognitive, affective, and psychomotor.

The cognitive domain and level stated in educational settings help teachers understand and implement what they need to achieve in their teaching objectives. The structure of Bloom’s Taxonomy contains knowledge, comprehension, application, analysis, synthesis, and evaluation. Anderson and Karthwolh (2001) revised Bloom’s Taxonomy and changed the original number of categories by introducing the Four-Knowledge Dimension of Taxonomy: factual knowledge, conceptual knowledge, procedural knowledge, and metacognitive knowledge. Splitter (1995), Caviglioli et al. (2004), and Tee et al. (2009), suggested that all educators should provide students with multiple skills and for teachers to cater their learning abilities with various teaching methods. Teachers, however, cannot assume that students will easily understand the learning content when they only sit in class and follow instructions. An
awareness of the interaction between students, teachers, and teaching materials must also be present.

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 cognitivism, 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).

1.2 Background of the Problem

The cognitive processes that contribute to student learning require that the student have the ability to manipulate information and ideas to solve problems and produce new knowledge. Many features of current cognitive theories on teaching and learning reflect earlier models of teaching such as Bruner’s, Taba’s, and various group-based and student-centered teaching models (Ruth, 1992). In VE, the importance of the cognitive process is based on a few factors, namely, the cognitive abilities needed in the current work environment, the ability to adapt to changing VE requirements in a global context, and the demands of cognitive development (Tee et al., 2009). In their cognitive research, Johnson and Thomas (1992) summarized that
learning does not automatically change and that understanding the learning content is difficult. Cognitive processes are not encouraged by passive learning.

VE students have their own learning preferences, considering they rely less on their cognitive abilities and more on their psychomotor talents, including physical movement, coordination, and use of motor skills (Bloom, 1956). They need to increase their cognitive abilities with a suitable approach so that they can be creative and innovative workers in order to do well in their work situation. The suitable approach in this case is perhaps the identification of the students’ learning styles that equal to VE characteristics to produce suggestions on overcoming the problems. Bloom (1989) also states that the ability of students to learn basic principles and their ability to apply knowledge or explained what they learned.

A student’s learning is influenced by a few factors. The basic issues of student learning as explored by Muhammed et al. (2008) include home background, learning environment, and government policies. Martins et al. (2007) stated that family background factors determined academic performance, and Azizi et al. (2003) claimed that learning styles influenced a student’s academic performance. Francis and Segun (2008) concluded that the school environment and teacher-related factors were the dominant factors influencing achievements, especially if the student was highly self-motivated. Learning in VE is defined as the transition from using basic problem-solving strategies towards using expert problem-solving strategies (Ruth, 1992). Learners in VE must observe and experience the required cognitive processes to learn them and know how, where, and when to use them. One of the factors debated over the last few decades was the relationship between student achievement and learning styles. Proponents of learning styles maintain that adapting classroom teaching methods to suit students’ preferred styles of learning improves the educative process (Felder, 1993). However, opponents of learning style theories maintain that little empirical evidence is available to support this proposition LS involved strategies that students tend to apply to a given teaching situation. Each individual can fit into different styles that can result in students adopting attitudes and behaviors that are repeated in different situations.
1.2.1 Identifying Learning Styles

Learning styles can be classified into various categories, for example, sensory, auditory, visual, and tactile. Dunn and Dunn (1992) reported that learning styles is an individual reaction to several environmental, emotional, psychological, and sociological factors. In vocational schools, the VE students have their own characteristics, according to Brennan (2003). They are verbal learners who watch and see rather than read and listen. They are hands-on and learn by doing and practicing. They learn in groups and are dependent learners who need instructor guidance for clear understanding. Considering that the characteristics of students in VE are more hands-on, and that they learn by doing, an understanding of this type of LS will help teachers provide a teaching delivery method that matches their students’ needs.

“Students’ needs” is a term described by Posner et.al (1992) as a description of how students deal with curricular tasks by employing relevant learning structures. The goal in teaching VE students is to gain experience and to apply existing knowledge to new situations. The role of the teacher is to create learning environments for students handling the presented tasks. Figure 1.1 shows how a VE student’s learning ability is influenced by various factors (John, 1995).
VE encompasses a wide range of courses or skills that help students prepare to enter an occupational-based employment or workplace (International Labour Organization, 2000). The concept behind VE is to bridge theory and practical components, such as lab- and workshop-oriented knowledge to workplace knowledge, with specific skills. As a result, vocational students have their own LS. In here research on learning strategies among vocational students, Briggs (2000) concluded that vocational students benefited from three types of courses, namely, “hands-on courses,” “mixed-courses,” and “paper-based courses.” She also classified the analysis of LS into visual, auditory, and kinesthetic (VAK) to create a basis for innovation in teaching and learning strategies.

A visual style relies on seeing and reading, auditory depends on listening and speaking, and a kinesthetic style focuses on touching and doing. Figure 1.2 shows the use of LS in hands-on courses. Hands-on courses refer to hairdressing, plumbing, professional craft catering, and painting. This group showed that their preference was for visual strategies. The figure illustrated three categories of students’ score as
indicating strong, medium, and weak use of visual, auditory, and kinesthetic learning style strategies. The results show that the students most preferred visual learning strategies. The results show that the highest number of students scored in visual strategies. This means that the students scored strongly in a range of visual strategies. Meanwhile, 20 students strongly used auditory learning strategies, and only 18 students strongly applied the kinesthetic approach to learning.

![Bar chart showing learning styles](Source: Briggs, 2000)

**Figure 1.2:** Students’ Learning Styles in Hands-on Courses

Briggs (2000) used the same method of using learning strategies for “mixed” courses. Mixed courses refer to courses that involve a mixture of paper-based and hands-on materials. Mixed courses represent the course related to engineering education and performing arts. The result showed that this group preferred visual strategies the most and kinesthetic strategies the least. Figure 1.3 shows that the students preferred visual learning styles (17 students) over both auditory (12 students) and kinesthetic styles (3 students).
Figure 1.3: Students’ Learning Styles in Mixed Courses

Figure 1.4 shows the profiles of LS for students in a paper-based course. The students investigated were involved in business, public service, and health science courses. The results showed a strong use of visual strategies among students in “paper-based” courses. Forty-five students preferred visual study approaches, 20 who preferred auditory, and 19 students who preferred kinesthetic. Generalizing course groups is difficult, even when they are aggregated. However, students in paper-based courses appeared to choose visual and auditory strategies more than students did in hands-on courses.

Figure 1.4: Students’ Learning Styles in Paper-Based Courses

The concept of LS is understood by VE teachers as a legitimate way of expressing individual differences in the way their students learn. However, the
fundamental concept of LS is an understanding of the characteristics and dimensions of various learning strategies. Research conducted by Peter (2003) indicated that understanding students’ LS and preferences is very important for teachers. Peter also suggested an LS model among VE practitioners. A survey conducted by Muhammad et al. (2010) involved 48 pre-service Engineering teachers with a major in mechanical, electrical, or civil engineering to identify their learning styles. This study was designed to prepare students to become future teachers when they completed their degrees in Technical and Vocational Education. The pre-service teachers were students attending schools during their practicum. They taught engineering subjects containing both task theory and hands-on components. The characteristics of engineering education are similar to VE, meaning that the results could be used to represent how the pre-service teachers accommodated various learning styles and learning preferences. As future teachers, they needed to equip themselves with strong skills in behavioral, cognitive, and constructivist basics so that they will be able to accommodate students’ learning styles.

The study used Perceptual Learning Styles Questionnaires (PLSPQ) distributed to 48 students, 20 males and 28 females. The results are illustrated in Figure 1.5, which shows that male students preferred visual (33%) and kinesthetic (36%) learning, whereas female students were more likely to be auditory learners (43%). Both female (63%) and male students (58%) liked to learn in groups.

![Figure 1.5: Pre-Service Teachers in Engineering Education Learning Styles](Source: Muhammad, et.al, 2010)
Figure 1.6 presents the results from the study based on the students’ major. The results show that 38% of mechanical engineering students were kinesthetic learners, whereas 34% of them were visual learners. Electrical engineering students prefer auditory learning styles (36%) while civil engineering students scored the highest for kinesthetic learning style (42%).

(Source: Muhammad, et.al, 2010)

Figure 1.6: Learning Styles among Major Subject

Auditory learners learn better in a lecture class and by listening to someone. Many students also like to learn by doing exercises and drills in class. This is one of the characteristics of a kinesthetic learner. Tactile learners are the rarest of the other learning preferences. However, most students were undecided regarding tactile learning styles. The dominant learning style of engineering pre-service teachers was visual, and these teachers were comfortable with pictures, images, and graphs while studying and retaining information. Muhammad et Al. (2010) also showed that, in terms of visual learning, the majority of students agreed that when learning a new skill, they would rather watch someone demonstrate the skill than listen to someone talk about the skill.

Richard and Stephen (1998) stated that two methods of assessing learning styles, self-reports and observed behavior, were used. Self-reports use the learning material preferred by the students. They will show whether a student’s awareness is in line with that individual’s actual performance.” Observed behavior requires the
teachers to give the students information in a variety of ways and observe what version the student picks. Both these methods contribute in assessing the learning style of the student. They are, however, not without their problems. One way of improving learning performance is to adapt the mode of each student’s style. Research is needed to find the most efficient ways of doing this (Richard and Stephen, 1998).

### 1.2.2 Student Learning

Meeting the students’ needs requires the teacher to identify several aspects about the students’ learning, such as the individual learner characteristics, learner characteristics within the wider community, learning processes within the learning environment, and learning process within the curriculum (Richard & Stephen, 1998; Jones & Charlton, 1998). In Malaysia, the focus is on the learning process within the curriculum. The school curriculum contains core subjects and elective subjects based on the students’ achievements and choices. The secondary school system consists of academic, technical, vocational, Islamic, and private schools. Every school in Malaysia has a different curriculum. In vocational schools, two curriculums are used: vocational courses and skill-based courses. Vocational courses are based on a major field, such as Building Construction, Electronics, Machine Shop Practice, Welding, and Office Technology Management, to name a few. The curriculum is divided into 45% academic subjects and 55% vocational subjects (Curriculum Department of Technical and Vocational, 2003). This study focused on Building Construction Subjects (BCS) to investigate the factors needed for students’ learning and students’ learning styles.

The main subjects in BCS are theory and practical work, thereby placing the field under the mixed-course category of learning. Students study the theory of BC then apply it during practical work. According to the Curriculum Department of Technical and Vocational (2003), BC is an important skill in the construction industry. Early exposure is important for students who have an interest in construction
and have chosen it as their career path. BC is one of the vocational subjects in that students can choose to learn more about the construction process. Students’ knowledge in both the theoretical and practical aspects is assessed. Some of the criteria evaluated in the main examination (Malaysian Examination Board 2003) were:

i) Knowledge and theory understanding

Experience while doing the practical work – skills

ii) Application a situation to another new situation

iii) Creativity and problem solving ability will produce new idea

The Malaysian Examination Board (2003) reported that students lack the ability to solve problems in Parts C and D. Based on the results analysis for “Sijil Pelajaran Malaysia” (SPM), the subject, BC Technology, showed the lowest level of achievement. Table 1.1 shows the results for three schools in Southern Zone Peninsular Malaysia. A large number of failures (9G) was shown over the years.

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>YEAR</th>
<th>GRED PERCENTAGE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1A</td>
</tr>
<tr>
<td>I</td>
<td>2006</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2009</td>
<td>0</td>
</tr>
<tr>
<td>II</td>
<td>2006</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2009</td>
<td>1</td>
</tr>
<tr>
<td>III</td>
<td>2006</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2008</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2009</td>
<td>0</td>
</tr>
</tbody>
</table>

(Source: Three Vocational Schools in Southern Zone, 2010)
An analysis of school-based assessment in BC Modules using the modular system shows that a few students were able to obtain good scores in Parts C and D. Table 1.2 presents the school-based assessment analysis.

**Table 1.2:** Analysis of Students Achievement in Building Construction Modules

<table>
<thead>
<tr>
<th>PARTS</th>
<th>MODULES</th>
<th>MARKS/PERCENTAGES</th>
<th>%SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0-5</td>
<td>6-10</td>
</tr>
<tr>
<td>A</td>
<td>I</td>
<td>2.44</td>
<td>9.76</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>2.50</td>
<td>5.00</td>
</tr>
<tr>
<td>B</td>
<td>I</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C</td>
<td>I</td>
<td>17.50</td>
<td>50.00</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>35.50</td>
<td>32.50</td>
</tr>
<tr>
<td>D</td>
<td>I</td>
<td>20.00</td>
<td>67.5</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>10.00</td>
<td>55.00</td>
</tr>
</tbody>
</table>

(Source: Vocational School in Southern Zone, 2010)

Teachers agree that one of the factors that influence students’ learning is teaching style. Various inventories, questionnaires, and indexes were produced to identify the student’s learning styles. One of the learning style models is the Felder and Silverman Learning Styles Model (FSLSM), which is designed to identify students’ learning styles based on the information processing and dimensions that students acquire in their learning (Felder and Silverman, 1988). The original FSLSM was developed by Richard Felder and Linda Silverman to address the student learning in engineering education (Felder and Silverman, 1988). However, studies show that the usefulness of FSLSM has since extended to various subject disciplines, such as language, medical, science, and engineering-related disciplines (Chipo, 2007).

The updated FSLSM reduced the five dimensions of learning styles into four because of pedagogical reasons associated with the teaching requirements. The number of dimensions was changed because of pedagogical reasons associated with teaching needs. The four dimensions are, namely, processing, perception, input, and understanding (Felder, 1993). FSLSM is an appropriate learning style model with which to study and interpret students’ learning in vocational education. The Index of Learning Style (ILS) was developed by Felder and Soloman (1997) to measure the dimension of FSLSM. The ILS can help identify the dimensions of learning and the
type of learner based on a 44-item questionnaire. Each dimension is associated with 11 forced-choice items, each either with an option (a) or (b) to match up to one or another category of the dimension. The details of ILS are further explained in the chapter on literature and research methods. FSLSM is a learning style model often used in other subject disciplines that can provide a more detailed description of LS. No specific model of is LS proposed to measure LS for vocational students, but FSLSM characteristics can be used. The dimension of FSLSM and the items in the Felder–Soloman Learning Styles Index are suitable for identifying students’ learning styles in the BC Course (BCC).

In a related research, Muhammad et al. (2011) classified 68 vocational students into four learning types according to the Index of Learning Styles (ILS). The dimension of creative thinking in problem solving among students was also investigated. The results showed that the dominant type of learners was the visual learner. They also observed a significant difference between visual learners who used creative thinking in problem solving (p<0.05). Visual students choose to manipulate ideas as a creative problem solving skill. Other types of learners included active, sensing, and sequential learners. The result showed that the students who are active, sensing, and sequential learners are no different in terms of their problem-solving strategies because they used creative thinking elements.

In summary, students who are visual learners use previous knowledge to solve a problem. They are also able to apply solutions based on pictures to an actual situation. They can also relate the facts to the topic that teachers teach in class. This agrees with the description of a visual learner given by Fleming (2001), who stated that visual learners prefer maps, charts, graphs, diagrams, and different spatial management. Table 1.3 shows the types of learners and their use of creative thinking in problem solving.
Standardized tests do not measure student achievement perfectly. Vocational students do not perform as well on standardized tests as academic students. Based on the analysis above, teachers from three schools were interviewed to discuss how they overcame the problem. They proposed a few techniques for teaching and learning. They concluded that because they must finish the syllabus, they were not able to spend more time helping the weaker students. A checklist showing the techniques used by the teachers to overcome weaknesses in their students is shown in Table 1.4 based on the interviews. This checklist is a modification of a checklist developed by Nurul (2003) and shows how teachers can cater to students’ learning preferences. According to the table below, teachers have no specific way to determine student learning preferences and know of no other way to record their students’ performances beside examination results. This is unfortunate, given teachers should know if their students have the ability to master certain cognitive levels in their lessons.

Table 1.4: Teachers Strategies for Student’s Performance

<table>
<thead>
<tr>
<th>Techniques</th>
<th>Often</th>
<th>Sometimes</th>
<th>Rarely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling style</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation camp</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small group discussion</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal approach</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Special workshop</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self learning approach</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memorizing</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Knowing students preferences</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Variety teaching method</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Source: Nurul, 2003)
According to the feedback from classroom observation (Ruth 1992), the vocational teachers did the following:

i. Used slightly more class time for instructional activities
ii. Spent less time lecturing and explaining or presenting material
iii. Worked more with students in small groups and individually
iv. Used textbooks and worksheets less
v. Used a wider variety of tools
vi. Engaged students more in task or activities in which students exercised a degree of control, such as physical demonstrations, practice and performance, and role playing
vii. Used paper and pencil tests less and performance appraisals more

The basic element in measuring student achievement is the ability of students to master a subject. The cognitive domain is the root of learning. In BCS, the structure of the subjects is based on the cognitive level. Bloom’s Taxonomy (1989) was used in the curriculum, and the specific needs of the vocation were considered. The elements proposed in the curriculum were knowledge, skills, and problem solving. This study merged Bloom’s Taxonomy (1956) with a revised taxonomy by Anderson and Krathwohl (2001) to determine students’ learning abilities in BCS. The elements measured were determined by the criteria evaluated by the SPM and structured from the Malaysian Examination Board (2003). The students’ learning styles were also investigated to determine if there was a connection with the students’ mastery of the subject.

Integrating student learning styles can create a new way of learning, involving skills such as problem solving. A summary was done by Rehm (1987) to interpret the data obtained in a case study of a VE classroom that revealed VE students creating their own styles and processes. They worked more on tasks that allowed them to interact with other students rather than with the teacher. Understanding and identifying student LS may help teachers identify the needs of their students and address them appropriately, as well as help their students achieve their learning goals. Teachers should be aware of their students’ cognitive levels so that they can determine if a student uses more than one LS. Many studies deal with learning styles
in general education, engineering education, or vocational education. However, the majority of adaptive systems focusing on LS incorporate only some aspects of traditional LS models rather than an all-purpose model that shows how an LS can be used as guide for the cognitive, behavioral, and psychomotor skills of a student (Sabine & Silvia, 2007).

1.3 Statement of Problem

The learning process is an interaction between students, teachers, and teaching materials. The emphasis should always be on the process of student learning. Ideally, the way teachers teach should match the way students learn. Teachers should be concerned with the students’ learning styles. Learning styles have a descriptive range, from the relatively fixed natural disposition of the student to the modifiable preferences for learning and studying. Learning styles are a component of the wider concept of personality. Since LS plays such a critical role in the learning process, teachers should not neglect to address how to relate the learning styles into the teaching and learning process, especially with how these factors can contribute the students’ achievement.

Building Construction Course is one of the vocational courses offered in certain Vocational School in Malaysia. It encompasses many areas of study for the BC Industries, such as masonry, carpentry, plumbing, painting, and all areas related to building construction. Students learn both theory and practical skills in BC. The question is, how can they learn to become more effective in the theory portion of their classes if the typical vocational student prefers to learn by doing and practicing?

Vocational students must adapt their skills and knowledge to their lessons. They must develop the ability to solve problems and produce new ideas to prepare themselves for actual work situations. The factor of the student’s learning styles and their academic achievements through cognitive learning were investigated in this study based on the issues concerning a student’s weakness in examination analysis.
and related studies. The analysis of students’ achievements, based on examinations for the BC subject from 2006 to 2009, showed a notable number of students who scored in grade 8E and 9G yearly. This study explores the possibility that one of the factors contributing to this is the students’ learning styles. A few factors were investigated to identify how students in BCC use their LS and academic achievements through cognitive learning. This study was based on the body of existing knowledge on LS and their importance for both students and teachers. This study provided meaningful suggestions on overcoming the problem regarding LS for BCC students, which can be adapted to suit their cognitive learning needs to promote problem solving and generate new ideas, thereby increasing the students’ academic achievements. This study also suggested a cognitive learning framework using LS in BCC to help teachers assess the LS of their students.

1.4 Research Objectives

i. To identify the learning styles of Building Construction students

ii. To identify the students’ perception of their own cognitive learning in Building Construction

iii. To determine the cognitive mastery of students in Building Construction.

iv. To analyze the differences between Felder–Silverman Learning Styles dimensions and the mastery in cognitive learning of Building Construction students.

v. To explore how Building Construction teachers can accommodate their students’ learning styles.
vi. To explore how teachers accommodate students’ learning and cognitive mastery in Building Construction Subject?

vii. To produce a student learning framework for Building Construction Education based on the students’ learning styles and cognitive learning.

1.5 Research Questions

i. What are the types of learners that represent Building Construction Students?

ii. What are the differences between each type of learner in Building Construction based on Felder and Solomon’s Index of Learning Styles?.

iii. How do Building Construction students perceive their own cognitive learning?

iv. How do the students master their cognitive learning in Building Construction subjects?

v. What are the differences between processing dimension (active and reflective learning styles) and the students’ mastery of cognitive learning?

vi. What are the differences between the perception dimension (sensing and intuitive learning styles) and the students’ mastery of cognitive learning?
vii. What are the differences between the input dimension (visual and verbal learning styles) and the students’ mastery of cognitive learning?

viii. What are the differences between the understanding dimension (sequential and global learning styles) and the students’ mastery of cognitive learning?

ix. How can teachers accommodate their students’ learning styles in Building Construction Subject?

x. How do teachers accommodate students’ learning styles in terms of cognitive mastery in Building Construction Subject?

xi. What are the learning framework elements based on the learning styles and cognitive learning of BC Education?

1.6 Hypotheses

**Research Question (ii):** What are the differences between each type of learner, in Building Construction, based on Felder & Solomon’s Index of Learning Styles?

Ho: There is no significant difference between active, sensing, visual and sequential styles among BCC students.

Ha: There is significant difference between active, sensing, visual and sequential styles among BCC students.

**Research Question (v):** What are the differences between processing dimension (active and reflective learning styles) and students’ mastery of cognitive learning?
Knowledge:
Ho: There is no significant difference between active and reflective processing dimensions.
Ha: There is a significant difference between active and reflective processing dimensions.

Skills:
Ho: There is no significant difference between active and reflective processing dimension
Ha: There is a significant difference between active and reflective processing dimension

Problem Solving abilities:
Ho: There is no significant difference between active and reflective processing dimensions
Ha: There is a significant difference between active and reflective processing dimensions

**Research Question (vi)** What are differences between perception dimension (sensing and intuitive learning styles) and students’ mastery of cognitive learning?

Knowledge:
Ho: There is no significant difference between sensing and intuitive learning styles.
Ha: There is significant difference between sensing and intuitive learning styles

Skills:
Ho: There is no significant difference between sensing and intuitive learning styles.
Ha: There is a significant difference between sensing and intuitive learning styles.
Problem Solving abilities:
Ho: There is no significant difference sensing and intuitive learning styles.
Ha: There is a significant difference sensing and intuitive learning styles.

Research Question (vii): What are differences between input dimension (visual and verbal learning styles) and students’ mastery of cognitive learning?

Knowledge:
Ho: There is no significant difference between visual and verbal learning styles.
Ha: There is a significant difference between visual and verbal learning styles.

Skills:
Ho: There is no significant difference between visual and verbal learning styles.
Ha: There is a significant difference between visual and verbal learning styles.

Problem Solving abilities:
Ho: There is no significant difference visual and verbal learning styles.
Ha: There is a significant difference visual and verbal learning styles.

Research Question (viii) What are differences between understanding dimension (sequential and global learning styles) and students’ mastery of cognitive learning?

Knowledge:
Ho: There is no significant difference between sequential and global learning styles.
Ha: There is a significant difference between sequential and global learning styles.

Skills:
Ho: There is no significant difference between sequential and global learning styles.
Ha: There is a significant difference between sequential and global learning styles.
Problem Solving abilities:
Ho: There is no significant difference sequential and global learning styles.
Ha: There is a significant difference sequential and global learning styles.

1.7 Research Conceptual Framework

The framework provides all the parameters, conditions, and support various learning (Kuchi et al., 2003). A research conceptual framework was designed as a guideline to merge the theory, model, and factors to overcome research problems. This study is focused on the two factors investigated, namely, the learning styles and cognitive learning related to students’ academic achievement in BC for Vocational Schools. The variables investigated include the dependent and independent variables concerned on the characteristics of each type of learner according to Felder and Silverman, as well as the level of cognitive learning measuring students’ perception and mastery through their academic achievement. The cognitive learning focused on Bloom’s Taxonomy (1956) and Anderson and Krathwohl’s Taxonomy (2001). This study used BC modules, which focused more on the three major vocational elements, namely, knowledge, skills, and problem solving to measure the cognitive mastery.

Figure 1.7 illustrates the framework used in this study. This study applied the FSLSM (Felder, 1993), which classified learning styles into four dimensions: processing, perception, input, and understanding. Using the Index of ILS proposed by Felder and Soloman (1997), the dimensions were further divided into eight types of learners. These are active, reflective, sensing, intuitive, visual, verbal, sequential, and global. The ILS contains 44 questions to determine the learner type. A taxonomy was used to identify the factors of cognitive learning. The cognitive process was easy to describe using this taxonomy to investigate the differences between the students’ learning styles and their cognitive abilities.

This study used Bloom’s Taxonomy (1956) combined with the revised taxonomy proposed by Anderson and Krathwohl (2001). The original taxonomy
provided carefully developed definitions for each factor in the cognitive domain. The categories were ordered from simple to complex and from concrete to abstract (David, 2002). The levels in Bloom’s Taxonomy are knowledge, comprehension, application, analysis, synthesis, and evaluation. Knowledge is the rote recall of previously learned materials, which includes facts and definitions. Comprehension is described as the ability to make sense of a material. Application is the ability to use learned material in new situations. Analysis is the ability to break a material into its component parts. Synthesis refers to the ability to put parts together and see the greater whole. Evaluation is the ability to judge the value of a material based on specific criteria.

Anderson and Krathwohl’s revised taxonomy used the verb forms of the words used by Bloom in the cognitive dimension. The revised taxonomy contains the following categories: remember, understand, apply, analyze, evaluate, and create. Remember means retrieving relevant knowledge from long-term memory. Understand means determining the meaning of instructional messages. Apply means carrying out a procedure in a given situation. Analyze refers to breaking the material into its constituent parts. Evaluate means making judgments based on criteria. Create means putting elements together to form something new. The combination of the two taxonomies produced the matrix used to categorize the vocational elements in BCS proposed by the Ministry of Education (2006). The vocational elements are knowledge, skills, and problem solving.

Knowledge in BCS is defined as the basic facts that students should know about BC. This is the lowest level in the taxonomy. This study used words from the taxonomy to match the learning outcomes specified in the BC learning modules. Skills are defined as the students’ ability to apply theory to practical tasks. This definition is equivalent to the Application and Evaluation level in Bloom’s Taxonomy. Skill is concerned with practical tasks and work procedures that students should exhibit. The most difficult component in BCS is problem-solving ability, which corresponds with the Analyze and Synthesis categories in Bloom’s taxonomy. The problem background section of this paper states that BCC students have weak problem-solving abilities. One of the purposes of this study is to use the characteristics of learners to provide features based on learning styles to help students overcome this weakness. The arrangement of students’ learning styles, vocational
REFERENCES


David R. Krathwohl (2002). *A Revision of Bloom’s Taxonomy: An Overview*. Theory Into Practice: The Ohio State University


Merriam,S.B, Caffarella,R.S., Wlodkowski,R.J.,Cranton,P. (2003).*Adult Learning Therories, Principles and Application*: University of Phoenix: John Wiley Inc


Muhammad, R.R, Mimi, M.M, Yee,M H, & Tee,T K (2010). *Perceptual Learning Styles of Pre-Service Teachers in Engineering Education.* The 3rd Regional Conference in Engineering Education 2010 (RCEE 2010) and Research in Higher Education, Kuching Sarawak, Proceeding


Reid, M.J (1984). *Perceptual Learning Styles Questionnaires*


Thelen, H., (1954). Dynamics of groups at work. University of Chicago, Chicago, IL


