THE EFFECT OF CRITICAL THINKING SKILLS ON EXAMINATION PERFORMANCE

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ABSTRACT
Business education, which encompasses a broad range of philosophies and techniques, is aimed at developing an understanding of core theories and practical principles of the global environment to meet the current organizational needs. The learning outcome, which in practice is represented by the years of education completed usually equips students with the necessary technical knowledge. But how to develop creativity and analytical and problem-solving skills remains a challenge to many.

The primary purpose of this study has been to identify any differences in the examination performance between students who participated and those who did not participate in the experimental module on critical thinking skills. The focus of this study is to evaluate the effectiveness of this experimental module. The null hypothesis that there is no difference between these two groups was tested and rejected based on both the test of equality of means and the regression analysis.

The sample consists of students enrolled in an auditing module offered at a private college in Malaysia in collaboration with a U.K. university of which some students were and some were not participants of the experimental module on critical thinking skill. A decomposition model is used to determine if there are significant differences between groups.

The most interesting result is the estimated coefficient and t-ratio for the Critical Thinking variable. The estimate provides reasonably strong evidence that participation in the experimental module on critical thinking skills does positively affect the examination performance while considering other factors. First, the findings suggest whether the student has taken this experimental module is a significant predictor variable for students’ performance in the auditing module while the effects of previous academic achievement, gender and age are mixed. Second, the study echoes the contention of Osborne (2000) that critical thinking is a process that can be taught.

INTRODUCTION
“Learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping experience and transforming it” (Kolb, 1984)

Business education, which encompasses a broad range of philosophies and techniques, is aimed at developing an understanding of core theories and practical principles of the increasing dynamic global business environment to meet the current organizational needs. The learning outcome is expected to be an integration of necessary technical knowledge as well as analytical and problem-solving skills. However, “the years of education completed” is generally adopted as a yardstick by prospective employers, which in many parts of the world may reflect only the learning of technical knowledge.
In a conventional environment of higher education, students typically are exposed to a predetermined curriculum in which, semester by semester, they gain knowledge in a sequential, module by module manner. Teachers are expected to know the modules they teach and are responsible for managing and monitoring the students’ learning. With this teacher-directed model of learning, lecture, demonstration, and recitation are the most common classroom teaching techniques used to transmit knowledge with content and in context. However, accumulation of discipline-specific knowledge in this manner is commonly being criticized as leading to inadequate preparation for complex business decision-making. While lacking appropriate understanding of the pluralism and complex nature of business, decision-making is considered a deficiency of the discipline-based teaching. Its effectiveness and efficiency to provide students with core knowledge, skills and competency should not be overlooked.

Consistent with the goal to educate students to become life-long learners while enhancing their cross-functional understanding, developing critical thinking skills is believed to be important and necessary. In spite of the fact that there are growing interests on how students learn academic material and how to develop a multi-disciplinary, integrated learning environment, a lack of empirical research exists concerning how critical thinking skills have an impact on students’ success in learning. More specifically, it is interesting to further explore whether critical thinking skills could be taught as suggested by Osborne (2000).

This issue seems to be of particular interest to some of the U.K. universities which have established full degree programmes in Malaysia as the educational culture of Malaysia differs from that of the U.K. Newman and Lee (1999) suggest that students in Malaysia are “seeking wisdom” rather than “learning to think for themselves” and students are not expected to challenge or question the “experts”. An experimental module on critical thinking skills was therefore designed and introduced to provoke students to ask questions. The course description and objectives of the experimental module are included as Appendix A for reference. This study aims to examine the correlation of critical thinking and academic performance of students in the final year modules of business degrees offered at a private college in Malaysia.

**BACKGROUND**

**Importance of Critical Thinking**

Critical thinking skills are generally believed to be considerably valuable regardless of one’s discipline. These skills may be of greater significance to the accounting and finance modules than ever before, since the accounting educational and professional organizations have been seeking more effective approaches to educate accounting students in response to the developments in information technology and to prepare for the era of knowledge economy. For example, the shifting focus of accounting education from a traditional number-crunching, debits-and-credits curriculum, to one that revolves around business, interpersonal and technology skills, is considered to be one of the most notable observations (Cho, 1999).

In addition, as summarized by Tucker (1999), the Accounting Education Change Commission (AECC) has identified various intellectual skills as the most desired capabilities of graduate accounting students which include the capacity for inquiry, abstract logical thinking, inductive and deductive thinking and critical analysis.

**Objectives of the present study**

While accepting that critical thinking skills
are important to students, the focus of this study is to examine the effectiveness of the experimental module on critical thinking skills designed to enhance learning by “thinking” (Kolb, 1993). Furthermore, it is to encourage concentration on the “deeper”, associative (synthesis and evaluation) levels of knowledge (Bloom, 1972). It is believed that once the students obtain the skills of critical thinking, it will forever be an asset.

It may be worth noting that, as discussed in Newman and Lee (1999), the introduction of this experimental module is to ensure that students who are enrolled in the British degree programs at local colleges in Malaysia receive a learning experience comparable to that received by students in UK while considering some restricting factors such as deficiencies in language, the potentially stressful or threatening school-to-college transition and the differences in the educational cultures.

**Ontological framework**
Recognizing that a universally acceptable definition of “critical thinking in business” has yet to be established despite the fact that the earlier development of critical thinking in the fields of psychology, philosophy and sociology are relevant to the business or accounting education, Newman and Lee (1999) suggest a three-level ontological framework:

- **Observations** – rooted in a time, place and usually an industry,
- **Models or theories** – cause-effect relationships (more often expressed as arguments rather than equations) between observable elements; and
- **Assumptions or a paradigm about what is “proper” to observe and model.**

This framework was implemented in the experimental module to assess students’ critical thinking abilities in which all business-related knowledge is assumed to fall into one of the three categories or strata.

**Ten core skills**
It is interesting to compare the three-level ontological framework with the ten discrete core skills of critical thinking as described by Jenkins (1998):

- Distinguishing between verifiable facts and value claims
- Determining the reliability of a source
- Determining the factual accuracy of a statement
- Distinguishing relevant from irrelevant information, claims, or reasons
- Detecting bias
- Identifying unstated assumptions
- Identifying ambiguous or equivocal claims or arguments
- Recognizing logical inconsistencies or fallacies in a line of reasoning
- Distinguishing between unwanted or unwarranted claims
- Determining the strength of an argument

**Student assessment**
In the experimental module, students are assessed on their abilities to present their opinions in the form of arguments, where reasons/evidences are used to support the opinions made or the conclusions drawn. The strength of the arguments lie in the reasons/evidences used, which the students select from learned theories and models or from observations made (primary or secondary data). When selecting the “raw materials” to form their arguments, students must consider the relevance and adequacy of the material in relation to the opinions/conclusions they make. In this process, one’s ability to recognize the contexts and detect assumptions underlying the raw materials is revealed and assessed. It is in this process of selecting raw materials that the ten core skills of critical thinking identified by Jenkins (1998) are used and, thus, these two approaches are considered to be largely
compatible and the empirical results are comparable.

METHODOLOGY

Data

This study adopts an ex post facto design which examines the effect of an experimental module on critical thinking skills in the examination performance of students. The sample consists of 209 students currently enrolled in a full degree programme offered by INTI College Malaysia in collaboration with the University of Hertfordshire. All students have completed a two-year diploma programme or its equivalent that qualifies them to be admitted into the top-up year studies. Although all students had followed a prescribed curriculum of the two-year diploma programme, 23.9% of the students had participated in the two hours per week experimental module on critical thinking skills while the remaining had participated in the regular two hours per week module on honours project skills (that is, a module on research methodology). The actual number and percentage of students who participated in the experimental module is greater. However, only 209 students were included in the samples as the study is constrained by the availability of examination results at this moment, therefore, the percentage of participation is less than the actual. The examination results of either Auditing or Principles of Corporate Finance are used to compare the performance between these two groups.

Model specification

The analytical framework and the selection of explanatory variables on the determinants of academic performance existing in the literature reveal some modest level of consistency over time. Cook (1997) uses students’ GPA as a measure of academic achievement or learning outcome at the university in his exploration of learning style as a predictor of college academic adjustment. A similar approach was adopted in a study of the effect of teaching methods on examination performance and attitude in which the examination scores were used as the measure of learning outcomes (Marcheggiani, and Sander, 1999). Prior academic achievements were found to be a significant explanatory variable of academic performance in a study conducted by Shyamala and Lee (1992) while gender and age are considered by Jenkins (1998) as well.

Following and extending previous work concerning the correlation of critical thinking and academic performance of students, the underlying relationship is therefore hypothesized as follows and variable definitions are presented in Table 1.

Table 1. Variable Names and Definitions

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ExamScore</td>
<td>Result obtained by the student in either Auditing or Principles of Corporate Finance examination¹</td>
</tr>
<tr>
<td>CriticalThinking</td>
<td>Dummy variable for the experimental module; zero denotes the module was not taken by the student</td>
</tr>
<tr>
<td>PreAchievement</td>
<td>Result obtained by the student in the Sijil Pelajaran Malaysia (SPM)² or the Unified Examination Certificate (UEC)³</td>
</tr>
<tr>
<td>Age</td>
<td>Age of the student</td>
</tr>
<tr>
<td>Gender</td>
<td>Dummy variable for gender; zero denotes female student</td>
</tr>
</tbody>
</table>

¹ Both are final year modules offered in collaboration with the University of Hertfordshire and the examination results have been confirmed by external examiners.

² Or known as the Malaysian Certificate of Education which corresponds to the Cambridge O-Levels Examination and is taken in the eleventh year of School.

³ Taken by students of Independent High Schools, corresponds to the Cambridge A-Levels Examination.
\[ \text{ExamScore} = \beta_1 + \beta_2 \text{CriticalThinking} + \beta_3 \text{PreAchievement} + \beta_4 \text{Age} + \beta_5 \text{Gender} \]

This regression specification is most useful to measure differences between groups and it is adopted since the sample consist of students who were and were not participants of the experimental module on critical thinking skills. A statistically significant value for the dummy variable (i.e. Critical Thinking) would infer differences between the two groups. However, this specification considers Age and Gender to be the relevant socioeconomic characteristics while ignoring any interaction effects.

**EMPIRICAL RESULTS**

As the aim of this study is to assess the difference in examination performance of students who had participated in the experimental module on critical thinking skills relative to the others. The results of the tests of the equality of means are presented in Table 2.

The overall mean difference of 4.81 indicates students who participated in the experimental module obtained a favorable margin over those who did not and the difference is statistically significant with a t-statistic of 2.875. Similar conclusions could be obtained when examining the mean differences of Auditing and Principles of Corporate Finance modules, respectively.

It is tempting to conclude that the teaching of critical thinking skills has considerable positive effect on examination performance. However, the difference between the means of ExamScore may represent the total effect of various other attributes and need to be further decomposed.

Therefore, to confirm the outcome and to compare with the conclusion of Jenkins (1998), the coefficient estimates and t-statistics obtained from the hypothesized regression analysis are set forth in Table 3.

The most interesting result, of course, is the estimated coefficient and t-ratio for the Critical Thinking variable. The estimate

<table>
<thead>
<tr>
<th>Critical Thinking</th>
<th>N</th>
<th>Mean</th>
<th>Std.Dev</th>
<th>Mean difference</th>
<th>t-statistic</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditing</td>
<td>0</td>
<td>74</td>
<td>46.11</td>
<td>11.30</td>
<td>4.60</td>
<td>1.897 .064</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>26</td>
<td>57.2</td>
<td>10.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Principles of Corp.</td>
<td>0</td>
<td>85</td>
<td>50.99</td>
<td>9.77</td>
<td>5.59</td>
<td>2.597 .013</td>
</tr>
<tr>
<td>Finance</td>
<td>1</td>
<td>24</td>
<td>56.58</td>
<td>9.18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ExamScore</td>
<td>0</td>
<td>59</td>
<td>48.72</td>
<td>10.76</td>
<td>4.81</td>
<td>2.875 .005</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>50</td>
<td>53.53</td>
<td>10.18</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-ratio</th>
<th>p-value$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>63.715</td>
<td>9.385</td>
<td>.000</td>
</tr>
<tr>
<td>CriticalThinking</td>
<td>4.592</td>
<td>2.949</td>
<td>.004</td>
</tr>
<tr>
<td>PreAchievement</td>
<td>-.595</td>
<td>-6.533</td>
<td>.000</td>
</tr>
<tr>
<td>Age</td>
<td>-.130</td>
<td>-.414</td>
<td>.679</td>
</tr>
<tr>
<td>Gender</td>
<td>-2.078</td>
<td>-1.482</td>
<td>.140</td>
</tr>
</tbody>
</table>

R$^2 = .227$  Adjusted R$^2 = .212$  F(4,204) = 15.010 (p-value is less than 0.001)

1. The p-value reported in this column is the exact significance level for a two-tailed test.
provides reasonably strong evidence that participation in the experimental module on critical thinking skills does positively affect the examination performance while considering other factors. As anticipated, the results also indicate that the PreAchievement variable is a significant explanatory variable of the examination performance. The negative coefficient indicates a negative relationship between the ExamScore and PreAchievement. It is as expected since the SPM and UEC results are used as the proxy for PreAchievement and both expressed in aggregate whereby the smaller the aggregate the better the performance is.

An examination of the bottom portion of Table 3 rejects any notion that examination performance is either Age or Gender specific since both coefficients are found to be statistically insignificant. These results are largely comparable with Jenkins’ (1998), which is included as Appendix B for comparison, and a graphical illustration of the relationship between ExamScore and PreAchievement is presented as Appendix C.

The observed value of Adjusted R² of 0.212 means that approximately 21.2 percent of the variation in the ExamScore is explained by the various explanatory variables included for which one may argue modifications to the regression specification may be necessary. However, as a structural model of examination performance is not available and this study is aimed for expositional purposes, the significance of R² or the overall significance of the estimated regression should be considered as acceptable based on the estimated F value.

CONCLUDING REMARKS
The primary purpose of this study has been to identify any differences in the examination performance between students who participated and did not participate in the experimental module on critical thinking skills. The null hypothesis that there is no difference between these two groups was tested and rejected based on both the test of equality of means and the regression analysis.

In considering the results, it should be noted that the effect of the experimental module was assessed in the middle of the final year with limited information available. Additional research is planned to provide more in-depth analysis upon students’ completion of the final year studies in August 2000. With additional modules completed, the proposition by Jenkins (1998) that “students’ critical thinking ability develops over the course of their college attendance” may be considered.

In conclusion, the results of this study support the findings of previous research in two ways. First, as reported by Jenkins (1998), the critical thinking skills variable is found to be a good predictor of students’ performance in examinations of a more analytical nature. Second, the study echoes Osborne’s (2000) contention that critical thinking is a process that can be taught.

At the very least, it appears that students with limited exposure to critical thinking skills at the earlier stages of education would be able to develop these most desirable skills with appropriate guidance provided. This finding is encouraging for those whose educational and cultural backgrounds do not support the development of critical thinking skills.

ACKNOWLEDGEMENT
The authors would like to thank Mr. Peter Newman, Resident Tutor from University of Herfordshire, who has developed and conducted the experimental module on critical thinking skills.

REFERENCES
Bloom, B. S. (1972). Taxonomy of Education Objectives: The Classification of


Appendix A

COURSE DESCRIPTION

This course acknowledges the “messy” nature of business-related information, and develops the students’ skills at “processing” such information. This course encourages students to become independent, active learners. This course requires students to think for themselves and to justify their opinions. This course requires students to practice their communication skills in order to enhance their ability to demonstrate their learning and thinking with a written answer.

COURSE OBJECTIVES

The over-arching objective of the course is to prepare students for the final year of the UH degree programmes by accustoming them to a pluralistic and autonomous approach to education, and by requiring them to practice critical thinking (and related writing skills) in response to an assessment question.

Appendix B

Results of Regression Models for Audit Exam Scores: Standardized Beta Coefficients and t Statistics for Independent Variables.

Appendix C

A Comparison of Exam Score between Critical Thinking = 1 and Critical Thinking = 0
## Appendix B. Results of Regression Models for Audit Exam Scores: Standardized Beta Coefficients and t Statistics for Independent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Exam 1</th>
<th>Exam 2</th>
<th>Exam 3</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>.17</td>
<td>-.003</td>
<td>.07</td>
<td>-.13</td>
</tr>
<tr>
<td></td>
<td>(1.24)</td>
<td>(-.02)</td>
<td>(.40)</td>
<td>(-.67)</td>
</tr>
<tr>
<td>GPAa</td>
<td>11.64</td>
<td>15.58</td>
<td>8.95</td>
<td>22.05</td>
</tr>
<tr>
<td></td>
<td>(4.72)*</td>
<td>(5.46)*</td>
<td>(3.06)*</td>
<td>(6.28)*</td>
</tr>
<tr>
<td>CTAb</td>
<td>.12</td>
<td>-.12</td>
<td>.65</td>
<td>.26</td>
</tr>
<tr>
<td></td>
<td>(1.17)</td>
<td>(.99)</td>
<td>(5.44)*</td>
<td>(1.83)**</td>
</tr>
<tr>
<td>Gender</td>
<td>.12</td>
<td>-.71</td>
<td>2.54</td>
<td>1.71</td>
</tr>
<tr>
<td></td>
<td>(.06)</td>
<td>(-.31)</td>
<td>(1.07)</td>
<td>(.61)</td>
</tr>
<tr>
<td>Intercept</td>
<td>22.40</td>
<td>14.99</td>
<td>-1.29</td>
<td>9.93</td>
</tr>
<tr>
<td></td>
<td>(.73)*</td>
<td>(1.57)</td>
<td>(-.13)</td>
<td>(.85)</td>
</tr>
</tbody>
</table>

Model statistics

<table>
<thead>
<tr>
<th>Adj. $R^2$</th>
<th>F value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.29</td>
<td>10.45*</td>
</tr>
<tr>
<td>.31</td>
<td>11.37*</td>
</tr>
<tr>
<td>.41</td>
<td>17.20*</td>
</tr>
<tr>
<td>.40</td>
<td>16.38*</td>
</tr>
</tbody>
</table>

Note: $t$ statistics are given in parentheses.

* Significant at the 0.01 level.
** Significant at the 0.05 level.
*** Significant at the 0.10 level.

a. GPA denotes cumulative college grade point average (4.0 scale) at the beginning of enrollment in auditing class.
b. CTA denotes score obtained on Watson Glaser Thinking Appraisal (80 possible).

Source: Jenkins (1998)

## Appendix C

A Comparison of Exam Scores between Critical Thinking = 1 and Critical Thinking = 0