Applying DEA to Assess English Writing Progress of University Students Using “My Access” in Taiwan

Bernard Montoneri*1, Massoud Moslehpour*2, Huey-Nah Cindy Chou*1

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*1 Providence University, *2 Asia University

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Abstract:

Being aware of the fact that Taiwanese students' English proficiency was falling behind those of many Asian countries, Taiwan's Ministry of Education unprecedentedly funded its three Regional Teaching/Learning Resource Centers (i.e., Northern, Central, and Southern) in 2011 for planning and launching intensive English programs (IEPs) with goals of enhancing university graduates' academic and career competitiveness by increasing their English proficiency from Common European Framework of Reference for Languages (CEFR) B1 to B2 as measured by standardized English proficiency tests.

This study aims at assessing English writing progress of university students using an automated writing evaluation system, My Access, in Central Taiwan Teaching/Learning Resource Center. The study data comes from the Foreign Language Centers of two universities located in the center of Taiwan. This research will analyze the progress in writing and the motivation of students registered for an intensive English program of one month during the summer vacation in 2011. We will use data envelopment analysis (DEA), a robust and reliable quantitative method, to calculate students' relative learning efficiency in English writing. As far as we know, this is the first time DEA is used to evaluate the learning performance of students using My Access.

Keywords: Automated writing evaluation system; data envelopment analysis (DEA); My Access, learning performance
1. Introduction

Being aware of the fact that Taiwanese students’ English proficiency was falling behind those of many Asian countries, Taiwan’s Ministry of Education unprecedentedly funded its three Regional Teaching/Learning Resource Centers (i.e., Northern, Central, and Southern) in 2011 for planning and launching intensive English programs (IEPs) with goals of enhancing university graduates’ academic and career competitiveness by increasing their English proficiency from CERF B1 to B2 as measured by standardized English proficiency tests. Each regional center could decide, based on its accumulated advantageous instructional resources, the learning orientation toward either an academic or a career goal. The learning goal of the IEP of the Central Taiwan Teaching/Learning Resource Center (CTIEP hereafter), with a career orientation, to help the students reach a CEFR B2 level of workplace English skills as measured by Business English Testing Service of Cambridge ESOL (Bulats hereafter) that would enable them to meet the language requirements of future careers. Fees of tuition, accommodation, and meals were fully funded by the MOE for the one-month program. The classes were from 8 am to 5 pm with a 2-hour lunch break, Monday through Friday for four consecutive weeks, with the total curricular time adding up to be 140 hours. Of the seven class periods, five were aimed to the development of workplace English skills instructed by native-English-speaking instructors, and two hours were designated for Bulats preparation. Writing practices using an automated essay scoring system, My Access, was allocated four self-study sessions after supper time with teaching assistants’ guidance and consultation.

The purpose of the writing component was twofold. First, the rationale underlying the self-directed writing sessions was based on the notion of writing as process, which views writing as “a reproduction of previously learned syntactic or discourse structures” and “a process of developing organization as well as meaning” (Matsuda, 2003, p. 21). In light of the process-based approach, invention strategies, multiple drafts, and formative feedback become important in writing development. Second, the CIEP writing component based its design on multiple-draft approach to writing instruction, which sheds light on the effect of teacher and peer feedback on student writing prior to asking students to revise their work. Researchers have agreed that “teacher feedback is most effective when it is delivered at intermediate stages of the writing process, when students can respond to feedback in subsequent revisions and may thus be more motivated to attend to teacher suggestions” (Ferris, 2003, p. 123). Moreover, previous research has reported that students do attend to and utilize teacher feedback, feedback on grammar problems in particular, in their revisions (Hedgcock & Lefkowitz, 1994).

In the self-study online writing session of the CTIEP, a web-based writing program, My Access, was implemented to aid self-directed writing practices assisted by the various editing and writing functions including Graphic Organizer, My Editor, Word Bank, and Thesaurus. In the first week of the program, four pre-selected prompts: (a) Effects of Technology, (b) Job Skills necessary for
Success, (c) Society’s Biggest Problem, and (d) Top Vacation Place, were assigned to the students and due by the last day of the program. That is, the students could have numerous opportunities to revise their drafts according to the online feedbacks until they considered their work final for submission. During the evening self-study sessions, the students first undertook on-line writing practice individually and then peer-editing lead by teaching assistants.

This study plans to conduct a study concerning the learning efficiency in English writing of students using My Access in Taiwan. A non-parametric assessment approach, data envelopment analysis (DEA), with management concept, will be mainly employed in the project to measure the learning progress in English writing and to identify key indicators contributing to students’ learning efficiency. It will explore the static learning efficiency by analyzing test scores and questionnaires concerning students’ learning motivation in English writing. The empirical results expect to develop suitable learning and teaching strategies for both students and teachers using My Access in English writing, to establish a learning role model for inefficient students and to find out their own core strengths and weaknesses to improve their learning efficiency and to enforce their English writing in the future career market.

2. Literature review
2.1. Literature related to English writing and My Access

According to Stern and Solomon (2006), effective writing skill is a foundational goal for most universities, but grading papers can be stressful and time consuming. They conducted an analysis on faculty comments from 598 graded papers written for hundreds of courses from 30 different departments in an American university. They found that most comments were technical corrections (spelling, grammar, word choice, and missing words); comments addressing paper organization and quality of the ideas contained in it (support/evidence for claims, paper structure/organization, voice, and creativity) were absent. Connors and Lunsford (1988) had already found that spelling errors were the most common form of mark on a paper. They also showed that teachers only marked between 30% and 50% of the errors on the papers. However, marking every single error might be counterproductive and discourage students. Teachers should also include compliments and positive comments.

Automated scoring systems can help teachers to correct and to grade essays. My Access is relatively popular in Taiwan, even though there is no Chinese version of the program so far. Using My Access can increase teachers’ motivation to teach writing courses in the sense that this type of course is time-consuming and exhausting. Writing classes are very big and improving students’ writing skill involves correcting multiple drafts (Hyland, 2003; Kroll, 2003). Scoring engines can at least correct some of students’ mistakes and ease teachers’ working load. As a result, instructors will have more time to focus on logic and organizational aspects more than on vocabulary and grammar. Various studies also showed that My Access significantly improves
student academic achievement (Yang, 2004; Yeh, 2004; Wang, 2005; Huang, 2006). Elliot and Mikulas (2004) demonstrated that My Access helps students to make better revisions. Students’ motivation is also influenced by teachers’ mastery of the technology. When the instructor appears to be ill at ease with the scoring engine, it affects students’ learning (Caroll et al., 2001). The role of the instructor is to guide students and to provide post-grading consultation to students (Cheng, 2006). In fact, Yang (2004) showed that when the instructor was able to provide assistance and guidance to students, their motivation was significantly higher.

2.2. Literature related to efficiency assessment using data envelopment analysis

Efficiency can be assessed by applying various quantitative evaluation methods such as stochastic frontier analysis (SFA), regression, statistics, ordinary least-squares (OLS), structural equation modeling (SEM), data envelopment analysis (DEA), and multi-level modeling (MLM). Which method is more appropriate depends on the research environment (Ferrier and Lovell, 1990). DEA is an attractive tool because it can measure the performance of educational institutions, departments and courses. There is a large body of literature concerning DEA. Among the most influential studies, Førsund and Sarafoglou (2002) cite Farrell’s seminal 1957 paper on concepts of efficiency and the study published by Charnes, Cooper, and Rhodes (1978), which was particularly influential in developing and expanding Farrell’s work. Their model, called the “Charnes-Cooper-Rhodes (CCR) model” or “CCR model”, notably includes the function and concept of benchmarking.

Many studies assess the efficiency of universities (Ng & Li, 2000; Abbot and Doucouliagos, 2003; Johnes, 2006; Garcia-Aracil and Palomares-Montero, 2008; Zhou and Wang, 2009) and university departments (Madden, Savage, & Kemp, 1997; Johnes & Johnes, 1993; Colbert, Levary, & Shaner, 2000; Martin, 2006). There is a growing trend to use DEA to assess the efficiency of courses and students (McGowan & Graham, 2009; Ismail, 2009, Montoneri et al., 2011; Montoneri et al., 2012). For example, Montoneri et al. (2011) used an output oriented model of DEA to assess the performance of English writing courses in a university of Taiwan and selected 4 indicators, such as: preparation of teaching contents, teaching skills, fair grading, and students’ learning performance. They showed that some evaluated classes with higher actual values of inputs and outputs have lower efficiency because the relative efficiency of each evaluated class is measured by their distance to the efficiency frontier. According to our knowledge, this is the first time DEA is applied to assess the relative learning efficiency of students using My Access.

3. Methodology

3.1. DEA and CCR model

This study plans to apply data envelopment analysis (DEA) to calculate students’ relative learning efficiency in English writing. DEA, a non-parametric assessment approach, has been
applied in various fields for performance benchmarking and relative efficiencies measurement among evaluated units, commonly called decision making units (DMUs). This approach can also provide analysis of inputs/outputs’ contribution in calculating efficiencies. DEA was initially introduced by Farrell’s (1957) and improved after several modifications by Charnes, Cooper, & Rhodes (1978) and Banker, Charnes, and Cooper (1984). Charnes, Cooper, and Rhodes (1978) converted Farrell’s efficiency measurement concept of multiple inputs and single output to the multiple inputs and multiple outputs. They assumed that the change in inputs will equally and positively reflect to the change in outputs; this model is called constant returns to scale (CRS). The modified version is now so called “Charnes-Cooper-Rhodes (CCR) model or CCR model”. Linear programming approach is used to find out the frontier curves of a group of evaluated units. DMUs inside the frontier curves are inefficient; their relative efficiency value is calculated by the ratio of the DMUs’ distance to that of frontier curves. Consequently, DMUs located on frontier curves are considered as efficient and become role models for the inefficient ones.

3.2. Data source

The study data comes from the Foreign Language Centers of two universities located in the center of Taiwan. The Foreign Language Centers are in charge of planning and offering university-level foreign courses for university students in the center of Taiwan. Their main mission is to enhance students’ foreign language skills in order to prepare for their academic and career goals. In this paper, we study the learning efficiency of 54 students coming from different departments of 15 universities; 28 followed the training offered by University A and 26 by University B. They were qualified for enrolling in the intensive English program and will be considered as evaluated units, called decision-making units (DMUs).

3.3. Characteristics of the research object and of the data source

Subjects of this study were students enrolled in a one-month intensive English program in the summer of 2011 with a primary goal for development of workplace English skills and a secondary goal for improving English writing skills. To be eligible for applying for this intensive English program, university students nationwide must meet requirements of: (a) sophomore or above, (b) non-English major, and (c) English proficiency level of CEFR B1 or above. Here are the characteristics of the data source:

1. Part of the data is based on questionnaires filled out by the students before and at the end of English intensive course.
2. Another part of the data is based on students’ grades, the number of drafts they wrote during the training and their English proficiency level before and after the training.
3. 4 indicators are selected, 2 inputs and 2 outputs. The data concerning the selected indicators is
fed in the software Frontier Analyst to calculate the efficiency values of each evaluated student.

3.4. Selection of input and output indicators

Input indicators:

I1. The rank of student’s average total final score in his/her class in academic year 2010: 1. within the top five, 2. front level, 3. before and near middle level, 4. middle level, 5. after and near middle level, 6. low level.

I2. The level of confidence to upgrade students’ English proficiency one level within a month: 1. extremely low, 2. low, 3. high, 4. extremely high.

Output indicators:

O1. Satisfaction of course content (such as: course themes, content, materials, etc.): 1. extremely high, 2. high, 3. no opinion, 4. low, 5. extremely low.

O2. Satisfaction of student’s self-evaluation of the target achievement in improving his/her English proficiency within a month: 1. extremely low, 2. low, 3. high, 4. extremely high.

4. Empirical study

This paper uses Frontier Analyst to calculate the efficiency values of each evaluated student. The data concerning the 2 inputs and 2 outputs is fed in the software.

4.1 Overall relative learning efficiency analysis

Table 1 is listing the learning efficiency of 54 evaluated students (called DMUs), named from D1 to D54. The DMUs are ranked according to their efficiency, from the highest to the lowest. The average efficiency of 54 DMUs is 0.740. The efficiency of the DMUs D2, D5, D67, D9, D12, D14, D22, D23, D32, D40, and D49, which represent 20.37 % of the evaluated units, have the best performance with a value of 1. Their scores are all on the Frontier curve. It means that these 11 DMUs do not need any improvement in the input items or in the output items because they have reached the optimal state. The other DMUs with efficiency inferior to 1 need further improvement or adjustment in the input or output items. The average efficiency of the inefficient DMUs is 0.673.
Table 1. Learning efficiency and rank of evaluated students

<table>
<thead>
<tr>
<th>DMUs</th>
<th>Efficiency</th>
<th>Rank</th>
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<th>Efficiency</th>
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<td>1.000</td>
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<td>D13</td>
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<td>D8</td>
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<tr>
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<td>D27</td>
<td>0.900</td>
<td>12</td>
<td>D16</td>
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<td>14</td>
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<tr>
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<td>D18</td>
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<td>D15</td>
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CCR score average (all DMUs): 0.740
CCR score average (inefficient DMUs): 0.673

4.2. Study cases

Study case 1

D26 has the penultimate lowest efficiency, 0.500. It means that this student has a relatively low satisfaction of course content and is disappointed by his/her improvement at the end of the training. To obtain a higher efficiency, this DMU needs to make much more effort in order to become efficient. The actual value of D26 concerning 01 (Satisfaction of course content) is 5.00. The target value is 10.00. This DMU needs a 100 % improvement. The actual value of D26 concerning 02 (Satisfaction of having improved at the end of the training) is 2.00. The target value is 6.00. This DMU needs a 200 % improvement.

Concerning the four pre-selected prompts, D26 wrote a total of 10 drafts: 3 on Effects of Technology, 2 on Job Skills necessary for Success, 3 on Society’s Biggest Problem, and 2 on Top Vacation Place. The average of drafts per student for the 54 DMUs is 9.6; the maximum number of drafts is 32. It means that D26 is not inefficient because of a low number of drafts.
The level of D26 was B1 before the training and still B1 at the end of the training. Therefore, D26 does not feel satisfied of the training and believes he/she has progressed little (O2 score is 2: low satisfaction).

Study case 2

D35 has a relatively low efficiency, 0.583. To obtain a higher efficiency, this DMU needs to make much more effort in order to obtain double result from 0.500 to 1 in O1 (Satisfaction of course content) and O2 (Satisfaction of having improved at the end of the training).

Concerning the four pre-selected prompts, D35 wrote a total of 32 drafts: 9 on Effects of Technology, 6 on Job Skills necessary for Success, 4 on Society’s Biggest Problem, and 13 on Top Vacation Place. It is certainly disappointing for this D35 to write 32 drafts and to obtain one of the lowest efficiencies (D35 is ranked 46 out of 54). However, the level of D35 was B1 before the training and B2 at the end of the training (but the test score was 61 at the beginning and 60 at the end). Therefore, D35 feels satisfied of the training and believes he/she has progressed a lot (O2 score is 4: high satisfaction). It could be interesting to determine in a further study what the optimal number of drafts is in order to obtain a learning efficiency of 1. Surely, in the case of D35, writing the biggest number of drafts is not resulting in a high learning efficiency.

5. Conclusion

The paper applies DEA to explore the relative learning efficiency in English writing of students using My Access in universities in the central region of Taiwan. The average efficiency of all the 54 DMUs is 0.740. 11 DMUs do not need any improvement in the input items or in the output items because they have reached a state of relative efficiency. 43 DMUs with efficiency inferior to 1 need further improvement or adjustment in the input or output items. Users’ satisfaction is the key factor to determine whether incorporating My Access into writing instruction is successful. The example of D35 shows that if a student writes a comparatively high number of drafts, it does not necessarily result in a better learning efficiency. It would be interesting to know the average number of drafts which would improve the most students’ motivation and progress in writing. For example, after writing 3 drafts on one topic, do students show a clear increase in their motivation and measurable improvement in their writing? Is their third draft much better than the two previous ones? If students write a fourth draft, is there any significant improvement? Further studies could help answer these questions.
6. References


Portfolio Software My Access. National Penghu University at the 教育部提升技專院校學生外語能力專案會議.


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ACERP2013 - The Third Asian Conference on Ethics, Religion and Philosophy

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ACETS2012 - The First Asian Conference on Education, Technology & Society

**Friday November 8 - Sunday November 10, 2013**
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