International Journal of English Linguistics; Vol. 6, No. 5; 2016
ISSN 1923-869X E-ISSN 1923-8703
Published by Canadian Center of Science and Education

The Effect of Using Automated Essay Evaluation on ESL Undergraduate Students' Writing Skill

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Received: July 24, 2016 Accepted: August 14, 2016 Online Published: September 23, 2016

doi:10.5539/ijel.v6n5p54 URL: http://dx.doi.org/10.5539/ijel.v6n5p54

Abstract

Advances in Natural Language Processing (NLP) have yielded significant advances in the language assessment field. The Automated Essay Evaluation (AEE) mechanism relies on basic research in computational linguistics focusing on transforming human language into algorithmic forms. The Criterion® system is an instance of AEE software providing both formative feedback and an automated holistic score. This paper aims to investigate the impact of this newly-developed AEE software in a current ESL setting by measuring the effectiveness of the Criterion® system in improving ESL undergraduate students' writing performance. Data was collected from sixty-one ESL undergraduate students in an academic writing course in the English Language department at Princess Norah bint Abdulruhman University PNU. The researcher employed a repeated measure design study to test the potential effects of the formative feedback and automated holistic score on overall writing proficiency across time. Results indicated that the Criterion® system had a positive effect on the students' cores on their writing tasks. However, results also suggested that students' mechanics in writing significantly improved, while grammar, usage and style showed only moderate improvement. These findings are discussed in relation to AEE literature. The paper concludes by discussing the implications of implementing AEE software in educational contexts.

Keywords: Automated Essay Evaluation, academic writing, language Assessment, Saudi ESL undergraduate students

1. Introduction

Scholarly research has long depicted academic writing as a complex socio-cognitive construct involving a continuum of activities (Omaggio, 1993). Many national and international education standards have placed more emphasis on the Common Core State Standards (CCSS) (OECD, 2012; Ananiadou & Claro, 2009). The CCSS necessitates that students manifest highly proficient writing skills, including summary and synthesis. The CCSS underlies the mechanisms of most, if not all, the available standardized English proficiency texts, such as ITELS and TOEFL.

The issues involved in both academic writing improvements and assessment are often just as complex as the construct of writing itself. Scholarly research into writing shows that instructional feedback is the most efficient way of improving writing (e.g., Wilson et al., 2014; Graham et al., 2011; Anderson et al., 1985). Hattie & Timperey (2007) define instructional feedback as providing information that indicates levels of correctness as well as a means of improvement. More pertinent to the aims of the present paper is the role of individualized and instant feedback given to students that is indicated in the scholarly research as improving the students' writing proficiency (e.g., Covill, 1997; Etchison, 1989; Fitzgerald, 1987). Unfortunately, this process places an enormous workload on classroom instructors who are in charge of reading and correcting a large number of essays per any writing assignment. As a result, teachers may be unable to assess and correct students' written work as often as they wish. Meanwhile, instructional feedback related to writing performance is not only time-consuming but also problematic due to inconsistency and instructor-centeredness (Wilson et al., 2014; Grimes & Warschauer, 2008; Lee et al., 2009). The degree to which instructors provide accurate and comprehensive feedback also remains unclear. As Zamel (1985) reported, instructors are often inconsistent, arbitrary and sometimes contradictory.

In response to scholars' research into the effects of instructional feedback on writing proficiency, recent studies

have placed great emphasis on utilizing NLP and Artificial Intelligence (AI) in providing students with both an automated holistic score and immediate feedback. Scholar research in the AEE area began in 1960s and has been growing rapidly (e.g., Burstein et al., 1998; Burstein et al., 2004; Shermis & Burstein, 2013). The rationale for using these computing methods is to provide a valid, consistent and time-saving system for assessing student errors and for providing instructor feedback and comments. A number of AEE systems have sought to provide both automated individualized scores and feedback. Research into AEE varies in scope and includes studies that have explored the usefulness of AEE techniques on writing proficiency (e.g., Rudner & Liang, 2002; Attali, 2004; Franzke et al., 2005; Wang, 2011). And those that have compared human to automated evaluation in terms of reliability and validity (e.g., Cohen et al., 2003; Kulik, 2003; Wang & Brown, 2007; Bejar, 2011; Bejar, 2012).

As some educational institutions are implementing various AEE systems, further research is necessary to investigate the effectiveness of these recently developed systems in terms of improving students' overall writing. Within the field of AEE research, little attention has been given to the implementation of AEE systems in the English as a Second Language (ESL) context. Therefore, the present case study examines the effect of utilizing AEE on Saudi undergraduate ESL writing performance, an area that has never been investigated in this body of literature. This research is guided by the hypothesis that AEE tools are beneficial in terms of overall ESL writing improvement. Specifically, two main issues are addressed within the scope of this investigation: a multi-level quantitative analysis investigates the positive effect of utilizing AEE on ESL undergraduate students' writing proficiency as well as the kinds of errors that more dissipate through the use of AEE. The following review of the literature provides a brief overview of AEE advances, including its history, different systems and potential applications as well as empirical studies conducted in this area.

2. Literature Review

2.1 Automated Essay Evaluation

Considering the complexity of writing assessment and improvement, researchers in the field of AEE have worked on developing a variety of computer-based systems that automate the process of both scoring and providing feedback. Practical AEE efforts date back to the early 1960s when researchers began to seek to develop automatic scoring applications. Page's article, "The Imminence of Grading Essays by Computer" (cited in Shermis & Burstein, 2013), began the tradition of AEE research. A stable working version of Page was released in 1973 (e.g., Shermis & Burstein, 2013). According to Page, technology can be used as a tool by instructors burdened with hours of grading writing assignments. The concept may have been before its time: word processing packages were not to become available until the beginning of the next decade, leading to many objections regarding the idea of displacing human raters.

Pioneering investigations into the area of AEE were initiated in the 1980s with the work of the Writer's Workbench (MacDonald et al., 1982). Based on the reviews of Warschauer & Ware (2006) as well as Ebyary & Windeatt (2010), Table 1 provides a detailed description of the most well-known AEE systems in terms of producing companies, software engines, targeted areas of writing assessment, statistical approaches to evaluation and types of scoring and feedback

Table 1. The most well-known AEE systems

Company	Software	Areas to Be Measured	Statistical Approaches	Scoring	Feedback
MI Measurement Incorporated	PEG	Fluency, diction, syntactic complexity	Regression	Holistic and trait scores (Note 1)	Feedback
ETS English Testing Centre	The e-rater®	Grammar, usage, mechanics, style and organization	Regression	Holistic score	Detailed Individualized feedback
Pearson Knowledge Analysis Technologies	IEA	Content, mechanics and style	Latent semantic analysis regression	Holistic and trait scores	Limited individualized feedback
Vantage Learning	Intelli-Metric —tm	Cohesion, coherence, content, discourse, syntactic complexity, variety and accuracy	Artificial intelligence	Holistic and trait scores	Individual feedback

The AEE system chosen for the present study is e-rater®, the AEE platform manufactured by the Educational testing Service (ETS) that provides formative feedback along with an automated holistic score. This system's automated scoring application has been used for the TOEFL IBT as an independent rater for the purpose of scoring the writing independent writing task (see Enright & Quinlan, 2008 for the use of the e-rater® system in the TOEFL IBT independent writing task). The following section summarizes empirical studies into the effects of AEE on writing improvement.

2.2 Automated Essay Evaluation and Writing Improvement

Significant interest has grown gradually but steadily over the last decade in the field of AEE research, particularly in terms of investigating the effect of utilizing AEE systems on improving writing. Underpinning this interest is many studies indicating the critical role of formative feedback on students' writing improvement (e.g., Black & William, 1998; Vygostsky, 1978). This interest grew sharper when scholarly research documented that the agreement between human raters and the e-raters® evaluation system is 87%-97% (Burstein et al., 2003; Valenti et al., 2003). However, most of the empirical research conducted to investigate the effect of utilizing AEE systems relates to English as the native language rather than English as a second language. Studies exploring the effects of utilizing AEE systems on writing have varied in their contexts, methodological design and participants.

Many studies documented in the AEE area of research have investigated the effect of AEE systems on grade 6-10 students within the L1 context. Shermis et al. (2008) utilized a hierarchical linear study design to examine the effect of the e-rater® system on writing improvement in this group of students. Their analysis includes different measures, holistic scores, word counts, word usage and errors committed in grammar, style, mechanics and usage. The data included the final drafts of seven different student essays over 11months. Results indicate a significant improvement in the students' writing. Recently, Wilson et al. (2014) examined the effect of immediate instructional feedback provided by the PEG system on the overall writing quality by investigating data from grade 4-8 students. The researchers applied a three-level hierarchical linear study to identify the effects across different revisions. They found that certain groups of students scored higher on their first drafts, including females and more proficient writing students. They also observed that there was no significant transfer effect in subsequent prompts.

Applying an experimental study, Kellogg, Whitford, & Quinlan (2010) examined the influence of individualized automated feedback on writing quality using the e-rater® system. They randomly assigned undergraduate students to three different groups depending on the amount of feedback they received from thee-rater® (zero feedback, moderate feedback and constant feedback). Students who received constant feedback demonstrated reduced errors in grammar, mechanics, usage and style in their final drafts. Ebyary & Windeatt (2010) applied questionnaires, interviews, and focus groups to investigate the effects of using the Criterion® systems with 549 Egyptian trainees and EFL instructors. The investigation focused on attitudes towards using the Criterion® system and whether there was a noticeable influence on the writing strategies used by students. They noted the existence of generally positive effects on the students' planning strategies in their revised drafts as well as positive attitudes towards using AEE systems.

Few studies have investigated which areas of automated feedback are most effective in enhancing students' overall writing (grammar, lexis or organisation/structure).Focusing on aspects of content and organization, Lee et al. (2009) applied a web-based evaluation application that provides students with instant individual feedback on both content and organization. Through an experimental study with twenty-seven students assigned randomly to experimental or control groups, Lee et al. (2009) reported that there were no significant effects of applying a web-based critiquing tool with adult EFL learners in regard to both the content and the organization of students' writing.

In summary, the relevant empirical studies in the field of AEE systems suggest positive effects of using AEE systems on overall writing improvement. However, only a handful of studies have explored the effectiveness of AEE systems on EFL students' overall writing quality. Therefore, further research is required to test the efficiency of these systems and to determine which areas in the writing construct can be effectively improved via AEE systems.

In ESL writing research, as Silva (1993) argues, the task of writing in L2 is generally more constrained and difficult than L1. Pertinent to the present study, Process Approach has dominated the field of L2 writing since the 1970s. It focuses on the processes of idea generation, drafting, giving and receiving feedback, and revising. Related to L2 writing improvement, Ferris (2011) emphasizes the positive role of corrective feedback in L2 writing. According to Ferris (2011), the comprehensive marking of errors and strategies for correcting them are preferable to direct correction. However, the degree to which L2 instructors provide accurate and comprehensive

feedback is unclear. Zamel (1985) reported that instructors are often inconsistent, arbitrary and contradictory. It is argued that the AEE application used in the present study has a significant influence on the standardization of the process of both evaluating writing errors and providing feedback to students.

Though AEE is increasingly adopted, it has never been used in any Saudi Arabia educational settings. This study presents an account of an empirical study conducted at Princess Norah bint Abdulrahman University where an AEE system was used for the first time. Investigating the effectiveness and implications of utilizing AEE in the current setting will contribute to our understanding of AEE as well as pedagogical enhancement of writing courses and curriculum design. For practicality and ease of use, the Criterion® system was chosen for study administration and data collection. In the next section, an overview is provided of the Criterion® scoring mechanism.

2.3 The Criterion® System

The Criterion® system combines an automated scoring feature and corrective feedback. Two complementary functions have been developed through NLP methods: critique and e-rater® version 2.0. Critique consists of program software designed to provide immediate evaluation and feedback in terms of grammar, mechanics, usage, discourse and stylistic features. Meanwhile, the e-rater® implements statistical measurements in extracting linguistically-based features from an essay based on corpora that has been processed and inputted into the application. The Criterion® application provides a holistic score on the writing assignment by applying a statistical model determining the association between extracted features and overall writing proficiency. The instant score provided by the Criterion® system is based on four categories of features. As illustrated by Criterion Online Writing Evaluation Services, these core categories include grammar, mechanics, usage, and style.

The Software Sustainability Institute has undertaken a software evaluation of Criterion®, releasing their detailed multi-criteria report in November 2011 regarding sustainability, maintainability and usability of the system. This evaluation report provides a high-level description of the audience for the software and its inner workings. It also gives a high-level overview of the software that consists of clear, step-by-step instructions. Criterion® is a web-based instructor-led instrument that provides learners with a variety of tools to plan, compose and amend their writing assignments. It offers a virtual classroom where instructors can create classes, design assignments, make announcements and give diagnostic feedback. According to the Criterion® developers, the program has been used in a variety of educational settings including primary schools, high schools as well as higher education institutions. In the current study, an AEE system was integrated into an academic writing course for the first time. It is hoped that the remarks and observations obtained from this study will contribute to further investigation in the AEE field. The following sections outline the use of the Criterion® in the present research.

2.3.1 How the Criterion® System Works

The Criterion® system offers a virtual classroom where instructors can create classes, design assignments, make announcements and give diagnostic feedback. In a friendly easy-to-use, The Criterion® homepage offers a variety features as illustrated in the following figure.

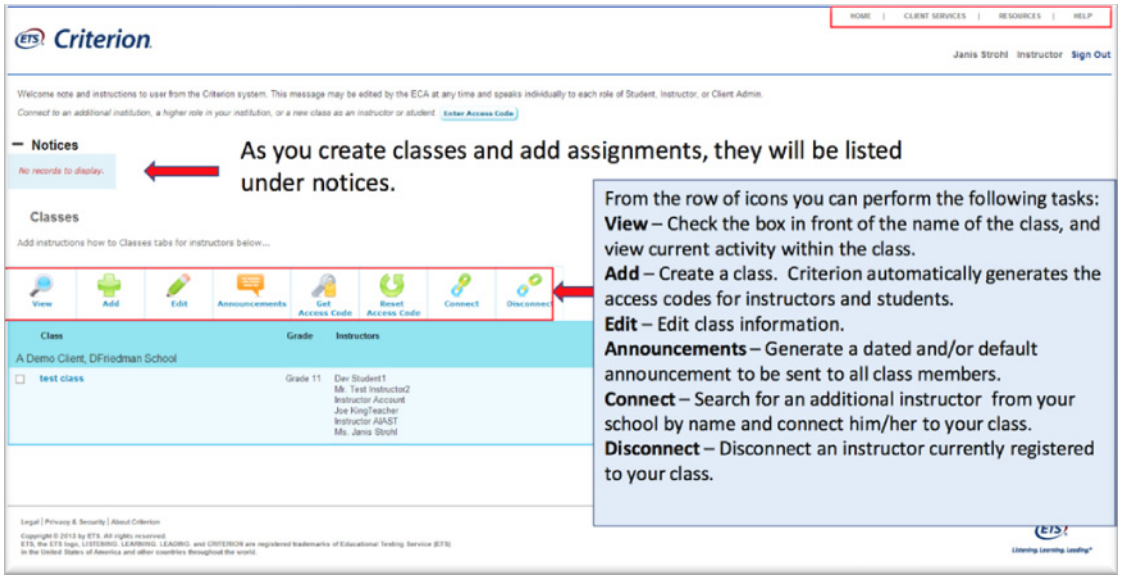


Figure 1. The criterion® homepage

Using the basic functions of the Criterion® is conducted through five main phases.

1) Preparing writing topics

The Criterion® system offers a variety of topics, levels and modes (persuasive, informative, expository, narrative, and argumentative). Instructors can also choose other topics and design their own prompts. Time limit and number of attempts are also chosen in this phase. The following figure illuminates these different options.

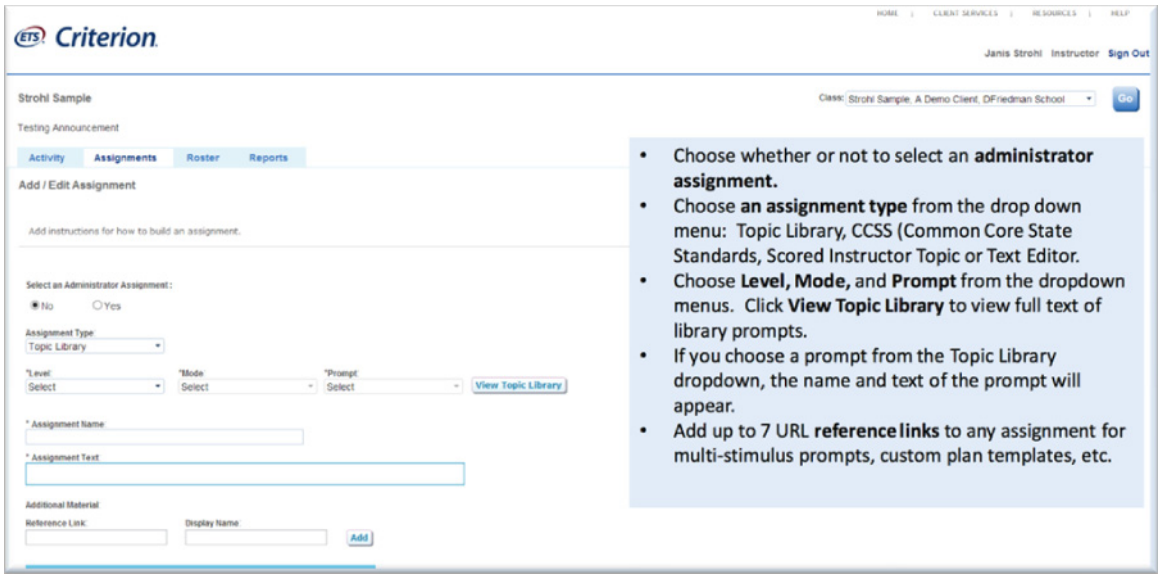


Figure 2. Creating a writing assignment

2) Composing the writing assignment

Students log in and plan, compose and revise their writing assignments. Different planning templates are available to help students in prewriting strategies.

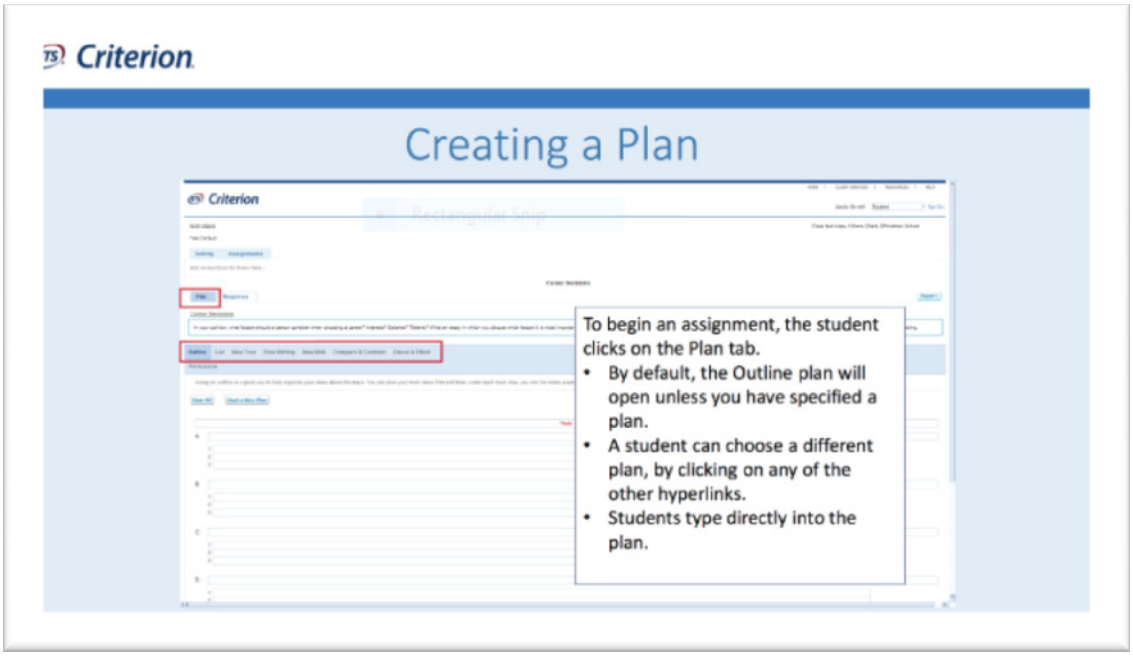


Figure 3. The plan/response window

3) Submitting the assignment and receiving an immediate score

Once students submit the writing assignments, an automated score and diagnostic feedback are given within 10 seconds.

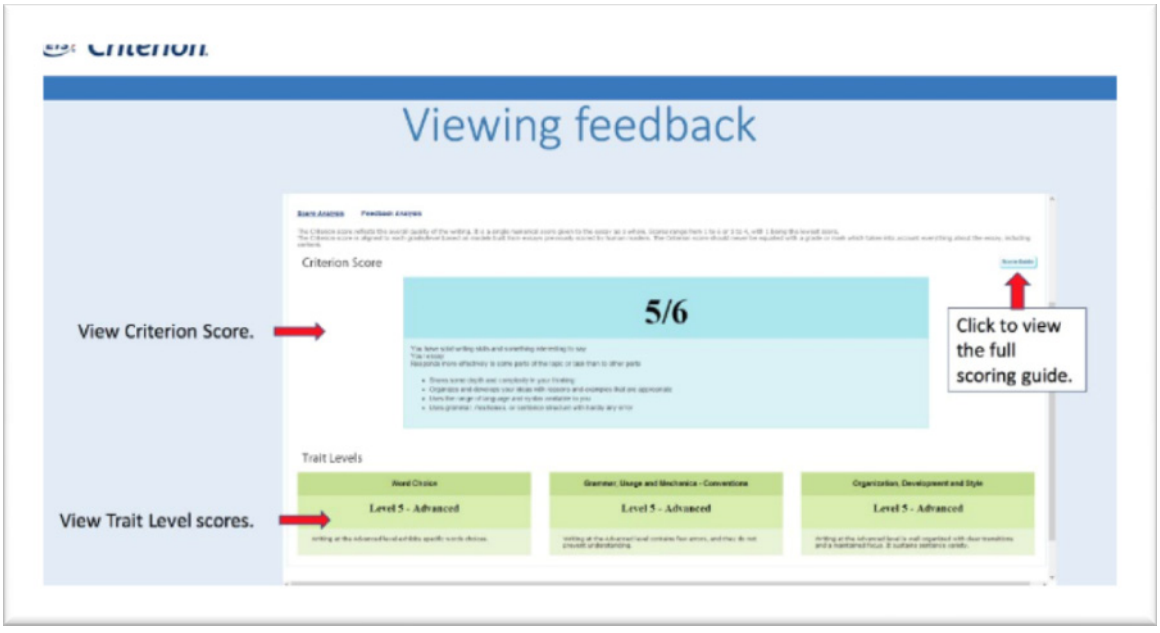


Figure 4. Viewing feedback

4) Revising and re-submitting the assignment

Specific feedback of each category of errors is given.

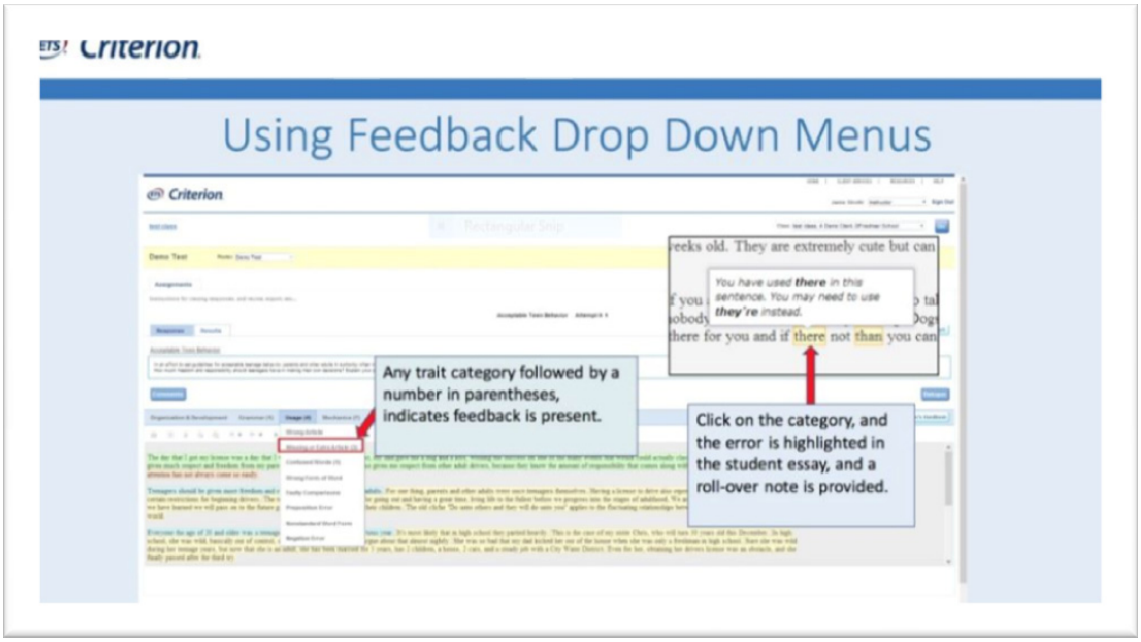


Figure 5. Specific trait feedback

Based on the provided diagnostic feedback, students revise and fine-tune their writing. Reviewing errors involves identifying the category error, numbers of errors in each category, highlighting errors and providing suggestions and advices. All these procedures are illustrated in the following figure.

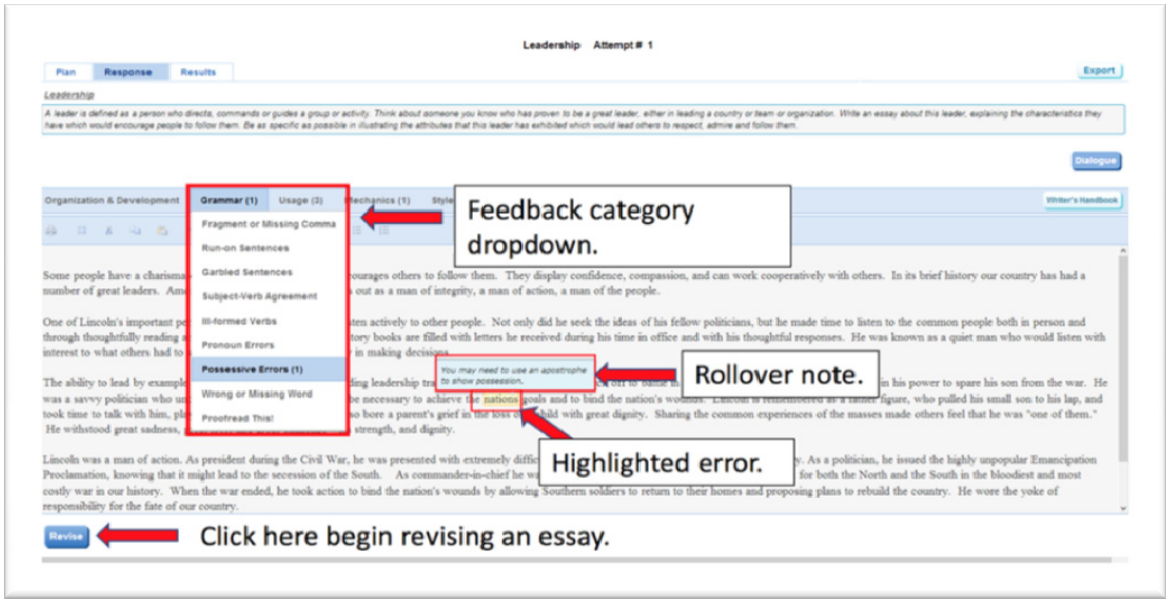


Figure 6. Reviewing errors

5) Personalized feedback is added.

In this phase, instructors add their comments on students' submitted assignments, create dialogue and give suggestions.

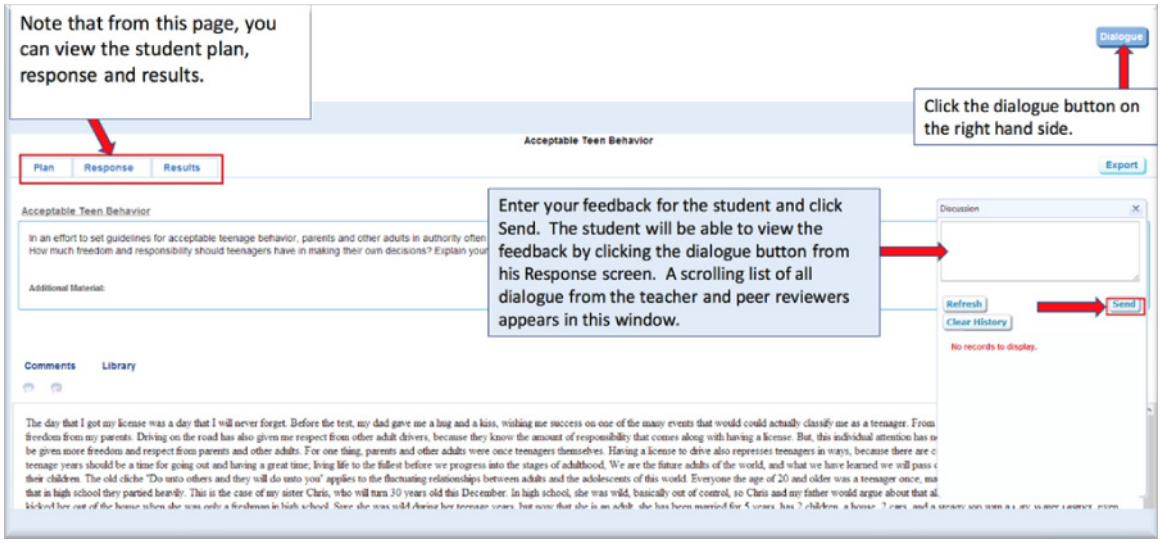


Figure 7. Personalized feedback screen

3. The Present Study

3.1 Research Questions

RQ1: Is there a significant statistical difference indicating a positive effect on improving ESL undergraduate students' writing skill following the use of the Criterion® system?

RQ2: What areas of the writing construct appear to improve with the use of the Criterion® system and which areas appear to be unaffected?

3.2 The Context

The undergraduate writing course under study seeks to provide learners with the writing skills necessary to compose a variety of text types in an acceptable to high proficient level. Data was collected through ten different essays submitted by sixty-one EFL undergraduate Saudi female students enrolled in the English Language department between January 2015 and September 2015. The students are provided with ten different essay prompts. The prompts for these ten essays include a variety of topics such as technology, loneliness, wisdom, education, media and team building. A total of 610 essays were submitted and collected automatically via the Criterion® system. Holistic and trait scores as well as automated feedback were assigned for each submitted essay. The students are homogenous in terms of age, gender and educational background but heterogeneous in terms of their English proficiency levels (based on progress reports).Students initially were given a preliminary tutorial session illustrating the system's basic functions.

3.3 Methodological Design

In order to answer the first question posed in this study, a repeated measure design study was administered to identify the effect weight of utilizing automated feedback on students' overall writing quality. A repeated measure design is used in experiments where participants are given more than one treatment and each participant is measured two or more times based on the dependent variable. First, a test of significance, the t-test, was performed in this study to determine if there is a significant variance between the students' pre-test scores (Condition A- the students' first submitted essays) and the students' post-test scores (Condition B- the students' last submitted essay).The matched pair's t-testis used in experiments where two scores, grades or quantities are taken for each participant. It is typically used in studies with before-treatment and after-treatment measurements. Second, a one-way repeated measures ANOVA test was applied to the data in order to assess statistically significant variance in mean scores over the three conditions of treatment. To answer the second research question, students' committed errors were accumulated according to the different writing constructs (grammar, usage, mechanics and style) and compared using descriptive quantitative means.

3.4 Data Analysis

3.4.1 Research Question One

Table 2 reports the descriptive statistics for the students' first performance (condition A), while Table 3 illustrates the same information for their last performance (condition B). As shown below, with a mean of (3.9344) and standard deviation (SD) of (1.223), condition B demonstrates a logical slide in performance compared to condition B with a mean of (2.2787) and SD of (0.9684). The SD was (Hi = 4.00, Low = 1.00) in condition A and (Hi = 6.00 Low = 1.00) in condition B. The median was (2.00) in condition A and (4.00) in condition B, a number that demonstrates a noticeable improvement in students' general performance. The matched-pairs t-test was applied to the data, revealing a statistical difference between the two conditions.

Table 2. Descriptive statistics of condition A

Descriptive Statistics							
	Mean	Standard Deviation	Median	Variance	N	Sum	Y-Squared
Group A	2.2787	0.9684 Hi = 4.00 Low = 1.00	2.00	0.9377	61	139	373

Table 3. Descriptive statistics of condition B

Descriptive Statistics							
	Mean	Standard Deviation	Median	Variance	N	Sum	Y-Squared
Group B	3.9344	1.223 Hi = 6.00 Low = 1.00	4.00	1.4956	61	240	1034

Table 4 illustrates the results of the t-test to determine if the variance between the students' initial and last writing performance was significant. The t-statistic was significant at the .05 critical alpha level, t (120) = -8.29, p < .05. Statistical results show that condition A is significantly different from condition B, and we are 95% confident that the mean difference lies between 0.6791 and 2.6324.

Table 4. Results of the t-test

Descriptive Statistics			
	Mean	Standard Deviation	N
Group A	2.2787	0.9684	61
Group B	3.9344	1.223	61
Independent Samples t-Test			
t-Statistic	-8.29	Result	
Degrees of Freedom	120	Reject the null hypothesis.	
Critical Value	1.9799	Conclusion	
95% Confidence Interval	[0.6791, 2.6324]	Group A is significantly different from Group B, t (120) = -8.29, p < .05. We are 95% confident that the mean difference lies between 0.6791 and 2.6324.	
t-Value	-8.2895		
Degrees of Freedom	114.0073		
Two-Tailed p-Value	< 0.0001		
95% Confidence Intervals	[-2.0514, -1.26]		

To trace improvement in student performance over the three measurement times (Condition A, Condition B, and Condition C), a one-way ANOVA test was administered. Table 5 below shows the means and the variance of the three conditions.

Table 5. Results of the One-Way repeated measures ANOVA test

Analysis of Variance (One-Way)						
Summary						
Groups	Sample Size	Sum	Mean	Variance		
Condition A	61	140.	2.29508	0.94481		
Condition B	61	202.	3.31148	0.9847		
Condition C	61	239.	3.91803	1.34317		
ANOVA						
Source of Variation	SS	df	MS	F	p-level	F crit.
Between Groups	82.04372	2	41.02186	37.60394	0.%	3.04615
Within Groups	196.36066	180	1.09089			
Total	278.40437	182				

The ANOVA analysis reveals three important results. First, the analysis includes an F ratio of (37.60394) ($p < 0.05$), indicating that there is a significant variance between the three conditions in terms of their overall scores. Second, the ANOVA demonstrates significant improvement. Table 5 shows that the sum of the scores was (140) in condition A, (202) in condition B and (239) in condition C. These figures show a gradual improvement in the students' overall performance through the use of the Criterion® system. Third, the variance in condition A was (0.94481), (0.9847) in condition B and (1.34317) in condition C. This variance indicates that the students had begun to show noticeable variations in regards to their general writing improvement in the second phase of the implementation. The source of the variance can be explained by investigating the kinds of errors that were eliminated in students' submitted essays and when this self-correction began, a topic covered in the second research question.

3.4.2 Research Question Two

The second research question posed in this study is concerned with identifying areas within the writing construct that improved through the use of the Criterion® as well as those that did not. Students' errors for all submitted essays have been tallied and summarized in the following figure.

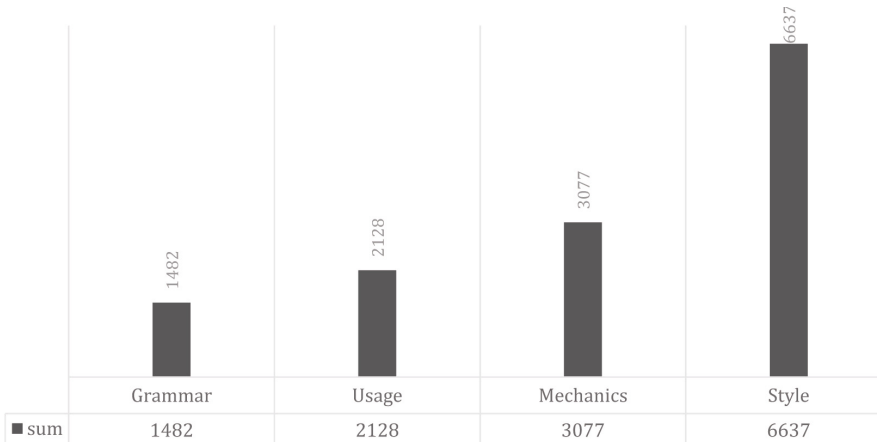
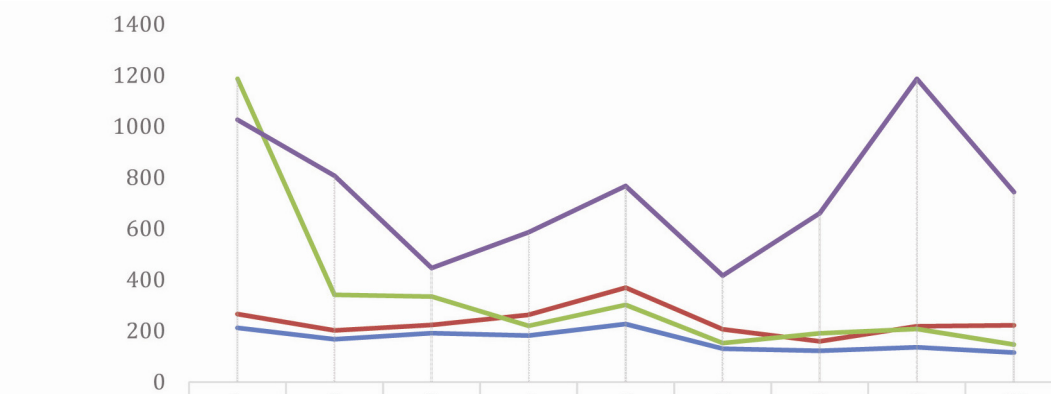


Figure 8. The number of student errors in grammar, usage, mechanics and style

As shown in Figure 1, errors in style ranked the highest, followed by mechanical errors and errors in usage. Grammatical errors were the least common. The following figure illustrates the distribution of these errors across the ten submitted essays.



	1	2	3	4	5	7	8	9	10
Grammar	212	167	191	182	227	130	122	136	115
Usage	266	202	223	263	369	206	159	218	222
Mechanics	1186	341	334	219	302	152	190	207	146
Style	1026	807	446	586	767	416	660	1186	743

Figure 9. The distribution of errors among the students' ten submitted essays

As shown in Figure 1, mechanical errors were the most common among students writing their first essay (1186) followed by errors of style (1026). By comparison, there were far fewer mistakes in grammar (212) and usage (266). In students' fifth submitted essay, both mechanical and stylistic errors significantly decreased. Mechanical errors continued to be eliminated until the students' last submission, indicating a significant improvement with only (146) in the students' tenth submitted essay. However, stylistic errors show only moderate improvement between the fifth and tenth essay. Apparently, no significant improvement occurred with regards to grammatical errors in the fifth submitted essay. Moreover, errors of usage increased from (266) to (369) and eventually decreased to only (222).

4. Discussion and Implications

The current paper has aimed to fill the gap in AEE research in the second language context by presenting a longitudinal study investigating the effects of AEE tools on ESL undergraduate students' writing. It has quantified students' levels of improvement and identified areas of the writing construct that appeared to improve and those that did not. The results obtained regarding the first research question are consistent with the inclusive research indicating the critical influence of both automated scoring and automated feedback on writing improvement (Shermis et al., 2008; Wilson et al., 2014; Kellogg et al., 2010). Using a repeated- measure approach measuring improvement across ten consecutive submissions, the research demonstrates that the Criterion® system is beneficial to students' overall writing improvement. The mean of the students' scores on their first submission was (2.28), and increased significantly in the last submission at (3.93), as illustrated in Table 4 above. The mean difference between the students' first overall performance and their last one was statistically significant (between 0.68 and 2.63). The total number of errors diagnosed and detected by the Criterion® system in the students' first submission was (2.600), which declined significantly to only (1.226).

This significant improvement results from the variety of Criterion® tools that assist both the process of automated scoring and individualized automated feedback. The Criterion® provides instructor with an archive of essay topics with a variety of levels and modes. The instructor can also create his own topics. It also offers online tracking of learners' portfolios including submitted essay, progress and an overall all evaluation of writing skills. Furthermore, the instructor can even customize the system instructions to best select level-appropriate writing resources and feedback. The Criterion® also projects summary class reports that analyze the learner's overall progress and patterns of errors. The availability of all these options results in more writing assignments assigned to learners involving more opportunities to practice writing; more time to assist learners in acquiring the higher-order skills of writing; and more effective interaction between instructor and learners. Moreover, the Criterion® system provides learners with the core features that are the most essential in improving non-native English learners' writing skills: prewriting strategies in the drafting process, friendly, easy-to-use online planning tools, immediate feedback, opportunities to make revisions and content-related instructor feedback (e.g., Covill, 1997; Etchison, 1989; Fitzgerald, 1987). The mechanism underlying the Criterion® system is in accordance with

Anderson's (1985) approach of language learning. Anderson's approach is stated in three consecutive stages: construction, transformation and execution. The stage of construction involves planning for the task by brainstorming, using mind-mapping strategies and outline. The transformation stage is when language rules are practiced to transform intended meanings into the form of writing, composing and revising. The execution stage is related to the physical process of composing the text.

However, the students' writing improved mostly in mechanics after using the Criterion® system. These types of errors significantly declined. Errors related to style constitute the majority of students' committed errors throughout the study, and show moderate improvement compared to improvement in mechanics. Similarly, areas of grammar and usage showed only moderate improvement. These results align with Lee et al. (2009) who reported that there were no significant effects of applying a web-based critiquing tool with adult EFL learners in regard to both the content and the organization of students' writing. The results of the present study align also with the argument of Warschauer & Grimes (2008) who did not support the use of the Criterion® system nor My Access tools in first language context, claiming that the effectiveness of such automated tools reside only at the level of mechanics, including punctuation, spelling and grammar. The results of Research Q2 in the present study confirms what Warschauer & Grimes (2008, p. 4) indicated in their study that AEE systems "remain relatively error-prone and insensitive to individual learners' skills and needs". Like any other technological tool in educational context, AEE systems should be implemented with an awareness of its benefits and flaws.

The findings obtained from the present study suggest a number of issues that should be taken into consideration when implementing AEE systems in educational contexts. First, a distinction has to be drawn between such systems' scoring and supporting functions. The Criterion® system, like many other AEE systems, has proven efficient for the purposes of assessing, certifying and classifying students in terms of their writing proficiency levels. However, caution is advised when utilizing the Criterion® system for instructional purposes and assisting students during drafting, composing and revising. The Criterion® system cannot replace human review that encourages students to be involved cognitively in the writing process. Second, the Criterion® system has great potential for tracking progress and generating individualized student portfolios, including areas of strength and weakness. Portfolios have been depicted as crucial pedagogical tools integrating both assessment and instruction in the context of learning and teaching writing. Hamp-Lyons (l994) generated numeral portfolios obtained through the Criterion® system to facilitate instruction and assessment. Third, different language proficiency levels in the L2 should be taken into account while utilizing the Criterion® system in instructional feedback. Beginner students will not benefit from the feedback given by the system nor suggestions for editing and correcting. Future research is needed to target the correlation between proficiency levels and areas of improvement.

In the present study, the utilization of the Criterion® system is allowing the complex analysis of writing tasks for both assessment and instruction. It provides an in-depth understanding of how AEE should be conceptualized and operationalized in the context of writing assessment and instruction. However, AEE research technology continues to evolve. This changing environment calls on all AEE stakeholders to become involved in shaping the future development of AEE technology as current features could still be improved. Perhaps additional noteworthy studies are needed to address the integration of AEE technology into writing curricula. Instructions and guidelines on how to integrate AEE systems into writing contexts also are needed for those seeking to design materials for writing classes and for instructors seeking to apply AEE systems in their classrooms.

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Notes

Note 1. A holistic score gives a general indicator of the text's writing based on common sets of evaluation criteria. A trait score, on the other hand, gives a single indicator of one of the core features of writing (i.e., organization, grammar, mechanics, etc.). It therefore allows the provision of suggestions for areas of weakness and strength.

Note 2. Condition A represents the students' first submitted essay. Condition B represents the students' fourth essay. Condition C represents the students' last essay.