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Changes in Revision Behaviours of L2 Writers in an Intensive English for Academic Purposes Program

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Abstract: Revision constitutes an important component of the writing process that integrates text interpretation, reflection, and production. Although previous studies have offered useful insights into the revision behaviour of L2 writers at different levels of proficiency using off-line measures, little is known about the online processes of revision. In this study, I used keystroke logging to investigate longitudinal changes in the revision processes of postgraduate and undergraduate students in the context of an intensive English for Academic Purposes (EAP) program. Twenty-five postgraduate and 14 undergraduate students participated in this study. The keystroke logging program Inputlog was used during two essay writing sessions at the beginning and at the end of the course to observe how the participants revise their essays and to get insights into their on-line writing processes. Keystroke logging data were coded in terms of the orientation and location of revisions. The results revealed that postgraduates produced more content-oriented revisions at the end of the programme than at the beginning. The opposite trend was observed for the undergraduates, who revised their essays significantly less frequently at the end than at the beginning of the EAP program and made more mechanical revisions than postgraduate writers. The findings highlight fundamental differences in the developmental trajectories of revision processes between postgraduate and undergraduate students. These differences caused by previous academic writing experience and language proficiency should be considered in developing materials for EAP programs. In the paper, I also discuss benefits of using keystroke logging to investigate L2 writers' revision processes.

Keywords: *Revision behaviours, writing process, keystroke logging.*

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Introduction

Revision is an essential part of the writing process and plays a particularly important role in academic contexts. Several studies have investigated how L2 writers at different levels of proficiency revise their essays (e.g., Faigley & Witte, 1981; Manchón et al., 2009; Roca de Larios et al., 2008; Roca de Larios et al., 2001; Zamel, 1983), but no research to date has focussed on the longitudinal changes in L2 writers' revision behaviours in the context of intensive academic programs. The current study contributes to this line of research by investigating the differences in revision processes of undergraduate (UG) and postgraduate (PG) student L2 writers over time. Understanding how revision processes develop gives us insights into how the allocation of attention to various aspects of the written product changes across proficiency levels. This information can assist in raising L2 writers' awareness of efficient revision strategies and also be helpful for instructors of academic writing.

In this paper, I first review the relevant literature on revision processes and behaviours of L2 writers followed by the overview of the previous studies on keystroke logging. Then I describe the methodology of the study, which consists of the description of the research context, participants, instruments and procedures of data collection and analysis. This is followed by the presentation of findings and the discussion of the results. I conclude the paper by summarising the key findings and hypothesising about the main theoretical, methodological and pedagogical implications of this study.

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Literature Review

Revision Process in the Cognitive Models of Writing

Researchers' interest in the processes of L2 writing, including the process of revision, has been sparked by studies of L1 writers' behaviours and cognitive thought processes. As Zamel (1982) pointed out, "writers go back in order to move forward" (p.197); thus, writing is never a linear process, rather it is characterised by a recursive pattern. Revision refers to "any change at any point in the writing process.... [These] changes may or may not affect meaning of the text, and they may be major or minor." (Fitzgerald, 1987, p.484). In other words, not only the changes in the final version of the written text, but also all changes in the partly composed text, can be viewed as instances of revision.

Research on second language writing has been inspired by various models of writing (Bereiter & Scardamalia, 1987; Chenoweth & Hayes, 2001; Hayes, 1996/2012; Hayes & Flower, 1980), of which revision constitutes an essential component. In the earliest and most well-known cognitive model of writing, Hayes and Flower (1980) viewed the process of revision, or *reviewing*, as they refer to it in the model, as being recurrent and systematic throughout the process of text production. In a later version of the model developed by Hayes (1996), revision integrates basic cognitive processes, such as text interpretation, reflection, and text production. Being complex but essential activities in revision, reading and writing both imply heavy costs on the cognitive resources and working memory. In the revision process, writers check the content of their written text and revise it if they find that the written product contradicts their intended objectives. This might involve correcting different kinds of linguistic errors as well as changing the content produced so far. Whenever the reading and evaluation of the text produced does not satisfy the writer or they realise that an error has been made, the reviewing process results in revision (Hayes & Flower, 1980). Thus, while reviewing constitutes an internal mental process aimed at evaluating what has been produced compared to what has been planned, revision represents an external process that results in certain physical modifications or corrections to the text.

Bereiter and Scardamalia (1987) also proposed a detailed analysis of cognitive processes of writing in their "knowledge-telling" and "knowledge-transforming" models. According to the scholars, novice writers often tend to employ a "knowledge-telling strategy", which results in a written text that mostly consists of ideas and information retrieved from the writer's long term-memory. More skilled writers, however, can transform ideas and information and construct new knowledge as they write. Furthermore, expert writers demonstrate evidence of reflective thinking during the process of writing. They frequently develop elaborate plans before writing, modify them radically while writing, and revise initial drafts extensively. Therefore, expert writers' texts are tailored to the needs of the reader, and these writers can develop profound understanding of what they are writing about.

Empirical Research on Revision Behaviours of L2 Writers

Various factors including student's writing expertise, their level of second language proficiency, the type of task they are working on, the mode of writing and the time constraints, might influence the nature and frequency of revisions they make in the process of writing (Barkaoui, 2007/2016). A sizable amount of research (e.g., Faigley & Witte, 1981; Manchón et al., 2009; Roca de Larios et al., 2008; Zamel, 1983) has shown that skilled and unskilled writers differ in terms of what, when, how often and why they revise in the process of writing. Skilled writers have been found to make more revisions of different kinds, especially organisation and meaning-oriented ones, which often constitute major changes to the content, at times giving the essay a different direction. Less skilled writers, on the other hand, tend to engage in fewer higher level revisions and focus more on making surface changes, such as grammatical, lexical and mechanical corrections, e.g., spelling and punctuation, in their writing, rather than revising the content of what they have already composed (Faigley & Witte, 1981; Zamel, 1983). In accordance with Bereiter and Scardamalia's models of writing (1987), skilled writers in an L2 also appear to be more flexible in their approach to writing, i.e., they sometimes reconsider the idea of the whole paragraph by rereading and revising bigger chunks of text, while at other times, they choose to review only a few sentences. In contrast, unskilled L2 writers mostly attend to grammatical and syntactic changes in their essays. These differences in revision behaviour between more and less skilled L2 writers are often explained with reference to working memory capacity limitations (Alamargot & Chanquoy, 2001; Barkaoui, 2016; Chanquoy, 2009; Stevenson et al., 2006). Since the writing processes of less skilled student writers are not fully automatized and require conscious attention, they might not have sufficient cognitive resources left in working memory for revision. Expert writers, however, are less likely to experience such cognitive overload because many of their writing processes are automatised (Barkaoui, 2016; Chanquoy, 2009).

Expertise in L2 writing has also been shown to influence how attention is allocated to various cognitive activities at different stages of the writing. Research findings show that proficient L2 writers tend to be involved in a range of cognitive writing processes while composing their texts (see Roca de Larios et al., 2008). They were found to be more intensively engaged in planning, evaluation and revision compared to less experienced writers. Skilled L2 writers also allocated more time to understanding the essay prompt and interpreting the writing task at the initial stage of the writing process; thus, they largely engaged with revisions in the final stage of composition. In contrast, unskilled writers were involved in the actual process of revision both at the beginning and in the end of the writing process,

which took a considerable proportion of their writing time. As pointed out by Manchón et al.'s (2009) study also revealed that more experienced and proficient L2 writers made flexible decisions on the allocation of attentional resources during the process of writing. At a lower proficiency level, students were mainly concerned with lower-level aspects of writing such as language issues, whereas with the increase of L2 proficiency, they attended to both lower and higher-level concerns in the process of revision. Importantly, the more proficient the writers, the more often they engage in deeper cognitive processing by revising their writing for meaning, organisation, writing style and discourse-level issues.

Keystroke Logging in L2 Writing and Revision Research

Keystroke logging software has recently become very popular in L1 and L2 writing research (Leijten & Van Waes, 2006; Révész et al., 2019; Strömqvist et al., 2006; Van Waes et al., 2009). The use of *Inputlog*, i.e., one of the logging programs, has created multiple opportunities for examining the cognitive processes of L2 writers including planning, composition and revision. This program works by registering and storing different types of input including keystrokes, mouse movements and clicks for later processing and analyses. In contrast with other methods of data collection, keystroke logging programs are relatively non-obtrusive, and thus ensure "an ecologically valid research context" (Van Waes et al., 2009, p.41).

A number of studies focusing on revision processes of writers with different levels of skills have used keystroke logging programs (see Barkaoui, 2007/2016; Choi, 2007; Lindgren & Sullivan, 2006; Révész et al., 2017; Stevenson et al., 2006; Thorson, 2000). Many of these studies have shown that significantly more linguistic and conceptual revisions were made by the writers in their L2 than in their L1 (Lindgren & Sullivan, 2006; Stevenson et al., 2006; Thorson, 2000). Keystroke logging studies have also demonstrated that second language writers generally tend to make more language-focused than content-focused revisions (see Barkaoui, 2016; Révész et al., 2019; Stevenson et al., 2006). Furthermore, a more thorough focus on linguistic revisions was not found to prevent L2 writers from concentrating on the conceptual content of their texts. According to Révész et al. (2019), the actual balance between the content and language-oriented revisions varies from study to study.

The comparison of high- and low-proficiency L2 writers using key-stroke logging data has shown that for both groups of writers, language-oriented revisions prevailed over the content-oriented ones (Choi, 2007). The results of studies with regard to the frequency of revisions at different proficiency level, however, are inconclusive. In Choi's (2007) study the higher level students made more revisions of both content and linguistic nature than the lower level group. A possible explanation for this might be the tendency of less proficient writers to revise more frequently at the planning stage, i.e., before they would begin the actual typing.

Barkaoui's (2016) findings, however, indicated that low proficiency L2 writers undertook more revisions for form, typography, and content than writers in the high proficiency group. In Stevenson et al.'s (2006) research less proficient L2 writers made more linguistically-oriented and typographic revisions than those at higher level of L2 competence. This finding is likely to be related to the lack of automaticity of orthographic processing, which, according to Stevenson et al. (as cited in Barkaoui, 2016), might have increased the typing demand on writers' working memory. This, in turn, could have inhibited students' attention to other aspects of writing. As regards the location of the revisions, less proficient writers were found to revise their text for typographic errors as they were writing, while more proficient writers edited typing errors at the end of the writing process (Barkaoui, 2016). Choi (2007) also found that the more proficient group of writers made more distant revisions, i.e., in the preceding and following sentences compared to the less proficient group. This result might imply that the higher level students' writing process is more recursive in nature and they are able to move back and forward more frequently while writing than the lower level students. Choi explained this difference between high and low proficiency writers with reference to the higher writing fluency of proficient L2 students and their relative ease of expressing their intended meaning in writing.

A number of conclusions can be drawn from the keystroke logging research conducted so far in terms of revision behaviours and strategies of skilled and unskilled L2 writers. First, the students with more extensive writing experience and high L2 proficiency tend to view writing as a recursive cognitive process rather than a linear product. Second, expert writers spend more time planning their essays, while novice writers tend to dedicate a rather limited amount of time to planning before they start the actual composing process. Finally, as stated by Barkaoui (2007), the focus of revision of skilled and unskilled writers differs considerably. More competent and experienced writers tend to revise their assignments at both global and local levels, prioritising global aspects (e.g., content, organisation, style of writing). However, less skilled writers are more inclined to revise their texts at local level (e.g., lexis, grammar, mechanics) rather than carry out the macro-level revisions such as altering the content of the text or resolving rhetorical and organisational problems.

Although previous research has offered a number of useful insights into revision behaviours of L2 writers, no longitudinal studies that would investigate the changes in L2 revision behaviours have been conducted. Furthermore, no developmental studies have been carried out in the context of highly intensive EAP programs to investigate the impact of these programs on student-writers' approach to revision. These intensive EAP programs are offered by many

universities to bridge gaps in prospective students' L2 writing skills, and therefore it is important to evaluate what changes in writing behaviours they can bring about within a relatively short time.

The current study aims to fill this gap by answering the following research questions:

RQ1: How do writers' revision behaviours change in an intensive EAP program in the case of a) students who intend to undertake undergraduate studies in the UK and b) prospective postgraduate students who have completed their undergraduate degree in their home country?

RQ2: How do the revision behaviours of prospective undergraduate students studying on the EAP program compare to the revision behaviours of prospective postgraduate students studying on the same program?

The Operationalisation of Revisions in this Study

With the aim to analyse revisions made by the students throughout the process of writing, I coded all revisions, including deletions, additions and substitutions using *ATLAS.ti* software according to two dimensions, i.e., (a) *orientation*, as suggested in Stevenson et al. (2006), and (b) *location*. As regards orientation, I examined whether revisions were aimed at changes of linguistic form or whether they could be categorised as conceptual revisions. According to Lindgren and Sullivan (2006) and Stevenson et al. (2006), changes at the level of 'form' were defined as revisions of linguistic expression, where the writer modifies and manipulates the surface features of the text, such as wording, grammar or spelling, but does not intend to change the meaning. Form-oriented revisions were subdivided into the following categories: *vocabulary*, *grammar*, *spelling*, and *punctuation*. Revisions at the vocabulary level included replacing the words or phrases with their synonyms or non-existent words or word forms with existing ones. Revisions for grammar involved grammatical changes to the text, such as editing for tense, articles, prepositions, verb forms, word order, etc. Spelling-oriented revisions were orthographic changes which could not be classified as typographic errors. Punctuation-targeted revisions involved changes such as adding, deleting or substituting commas, full stops, semicolons, hyphens, apostrophes, as well as capitalisation.

As regards the alterations at a conceptual level, these were identified as *content* modifying revisions aimed at the modification of the informational content of the written text (Stevenson et al., 2006). Finally, all mechanical changes to the text were identified as *typographic revisions* and defined as the ones that are made accidentally when the writer presses the wrong key knowing how a word is spelt. Some of the following were labelled as typing revisions: incidentally typing adjacent letter on the keyboard, e.g., 's' for 'a' or 'm' for 'n', reversing letters in a word, e.g., 'form' for 'from' or 'their' for 'there', or typing the form of the word that does not exist and does not conform to the orthographic rules, such as 'mooore' for 'more'. A decision has been made to exclude typographic revisions from the analyses in this study since these revisions concern motor activities, which are non-linguistic in nature. The other dimension of analysis, *location*, focussed on where different categories of revisions occurred. The three different locations were the introduction, main part and conclusion of the essay.

Methodology

Research Context

The study was conducted on a pre-session English for Academic Purposes (EAP) summer programme in 2012 and 2013. The EAP programme is an intensive four-week course offered by a large British university. The central aims of the EAP programme are to develop students' academic reading and writing skills, to improve their critical thinking ability, and to raise learners' awareness of the skills and strategies they might employ while studying at a university in the UK. The EAP programme is primarily aimed at students with IELTS scores of 5.5 to 6.5 (B1 to B2 on the Common European Framework of Reference [CEFR], Council of Europe, 2001) and who received a conditional offer from their university because their level of English language proficiency did not meet the minimum entry requirements. Students get 15 hours of in-class teaching per week on the EAP programme, and are expected to study approximately 15 hours a week independently and complete written assignments. These assignments take the form of argumentative essay writing tasks. The assignments become progressively more demanding and require a more detailed analysis and evaluation each week. After students complete an assignment, they receive formative written feedback from their tutor. Although linguistic improvement is not the primary focus of the EAP curriculum, and students do not receive any explicit language instruction, linguistic errors, such as grammar, vocabulary and spelling errors, are generally highlighted in the feedback and discussed in the tutorials.

Participants

Prospective undergraduate and postgraduate students studying on an intensive four-week EAP programme participated in the study. The background information on all participants is given in Table 1. The undergraduate group consisted of 14 students, with the ages ranging from 18 to 21 (mean age of 19.4), whereas the postgraduate group was represented by 25 students, whose ages ranged from 21 to 34, with a mean age of 23.2. There were more female than male students in both groups, i.e., 12 female and 2 male students in the undergraduate group; 21 female and 4 male

students in the postgraduate group. The majority of participants were of Chinese L1 background. The main degree programmes that they intended to study on after the pre-session course were as follows: Accounting and Finance, Business Studies, Economics and Media Cultural Studies. In terms of students' English language proficiency, the IELTS overall and IELTS writing scores gained by prospective undergraduate students were slightly lower than the scores of prospective postgraduate students. Thus, the undergraduate students could be considered as 'independent users of the language' (B2 level on the CEFR), while the postgraduate group was identified as 'proficient users of the language' (C1 level on the CEFR). Both prospective undergraduate and postgraduate students studied English at school in their home countries but had only limited experience of academic writing in English. None of the students had prior experience of living in English-speaking countries.

Table 1. Participant background information

		UG students	PG students
Gender	Male	2	4
	Female	12	21
Age	Mean	19.4	23.2
	Range	18-21 years	21-34 years
L1 background	Chinese	14	17
	Japanese	0	3
	Thai	0	5
L2 learning experience	Length of learning English	10 years	11 years
	Length of staying in the UK	2 weeks	2 weeks
English language proficiency	Mean IELTS listening	6.3	6.4
	Mean IELTS reading	6.2	6.8
	Mean IELTS speaking	5.9	6.3
	Mean IELTS writing	5.8	6.3
	Mean IELTS overall	5.9	6.7

Instruments

All participants were expected to complete two argumentative writing tasks, one at the beginning and the other in the final week of the pre-session program. All written assignments that students do on the EAP program are focused on argumentation. Both writing sessions were conducted in a computer lab, where students were required to write an essay of between 250 and 350 words using a keystroke logging programme Inputlog (Leijten & Van Waes, 2006, 2013). I assumed that the participants would find writing an essay on a topic related to education particularly interesting and relevant, and would be able to support their arguments with various examples from their academic life. Therefore, the essay prompts chosen to be used in the present study were as follows:

Topic A: Exams cause unnecessary stress for students. *How far do you agree?*

Topic B: Any student caught cheating in school or college exams should be automatically dismissed. *How far do you agree?*

The order of the tasks was counterbalanced; thus, half of the participants did the task on topic A in the first session and the task on topic B in the second session. The other half of the students wrote the essay on topic B at the beginning and the essay on topic A at the end of the study. Multivariate Analyses of Variance (MANOVAs) were applied to the data set to check for significant differences due to the effect of the topic. No significant differences were found between the groups on any of the linguistic measures with regard to the topic they wrote about.

Data Collection Procedures

In adherence to the research ethics guidelines, approval to conduct the study was granted by the university prior to collecting the data. As regards the recruitment of participants, three English teachers working on the EAP program recruited the students from their classes and conducted the consent procedures following the given instructions. Participation in this study was on a voluntary basis. At the beginning and at the end of the program, two writing sessions were organized outside of the class hours. During these sessions the students were given the argumentative essay tasks to complete in no longer than 45 minutes. The participants were not expected to use any reference books or dictionaries while working on the task. The writing tasks had been piloted with another group of L2 learners of English with a similar background as the participants of my study. The pilot showed that the tasks were manageable to accomplish within the allocated time.

The 'record' function of the keystroke logging software Inputlog was used to capture all key presses and mouse movements made by the students' while typing their essays. This methodology was chosen to be used in this study because unlike other methods, it appears to be effective, while being unobtrusive for collecting the data about revision

processes. It was expected that the use of Inputlog would enable us to see not only the final outcome, i.e., the text produced by the writer, but also the process of revision, i.e., what and when the writer revises and how the text develops. The detailed computer-generated keystroke logging data was retrieved in order to provide valuable insights into students' on-line writing processes.

Data Analysis

The data were not only recorded but also analysed with the aid of Inputlog, which generated the raw output in the *summary analysis* and *revision analysis* files. I also used *ATLAS.ti* for coding the types of revisions made by the participants. To standardise the process of coding and ensure its consistency, the coding scheme was adapted early in the process of data analyses, and each category was defined. Approximately a quarter of the data set was double-coded by another researcher with a PhD in Applied Linguistics. This was done in order to ensure the consistency of coding and determine its reliability. The inter-rater reliability (Cohen's kappa) for the main categories of revisions was 0.87 for the *orientation* of revisions, and 0.79 for the *location* of revisions. Statistical analyses were carried out using SPSS (Statistical Package for Social Sciences) version 16.0. Since the revisions data were not normally distributed, nonparametric tests were used for statistical inference. I applied the Wilcoxon signed-rank test, a non-parametric equivalent to the paired sample t-test, to examine the revision behaviours of the students as well as to identify the differences between the two groups. Effect sizes was calculated and absolute effect sizes of 0.1 to 0.29 were taken as indicating a small effect, from 0.3 to 0.49 a medium effect and greater than 0.5 a large effect (Cohen, 1969).

Findings

Orientation of Revisions

I analysed the changes in writers' revision behaviours in terms of *orientation*, i.e., content, vocabulary, grammar, spelling and punctuation-oriented revisions. Due to the fact that the variables were not normally distributed, the Wilcoxon signed-ranks test was used to examine changes in the writers' revision behaviours from Time 1 to Time 2. As Tables 2 and 3 show, no significant change over time was observed in the PG group of student-writers. However, it is apparent from Table 4 below that the students in the UG group reported significantly fewer revisions at the content level at Time 2 than at Time 1. Wilcoxon signed-ranks tests have also revealed a statistically significant over-time difference in the total number of revisions made by the UG writers. From the data presented in Tables 2 and 4, it can be clearly seen that they made significantly fewer revisions at Time 2 than they did at Time 1.

Table 2. Descriptive statistics for the orientation of revisions

Orientation of Revision	Time	Group	Mean	SD
Content	Time 1	PG	29.1	19.52
		UG	38.85	19.8
	Time 2	PG	30.26	23.16
		UG	23.7	13.92
Vocabulary	Time 1	PG	48.97	27.2
		UG	42.18	23.91
	Time 2	PG	53.39	30.73
		UG	36.49	19.18
Grammar	Time 1	PG	45.33	19.4
		UG	55.45	23.37
	Time 2	PG	41.39	20.41
		UG	44.32	25.38
Spelling	Time 1	PG	25.73	19.57
		UG	27.4	15.58
	Time 2	PG	24.99	15.83
		UG	25.55	22.02
Punctuation	Time 1	PG	29.77	15.73
		UG	58.02	34.87
	Time 2	PG	27.58	19.49
		UG	56.18	35.19
Total	Time 1	PG	178.67	62.75
		UG	232.36	80.93
	Time 2	PG	176.2	66.85
		UG	186.24	77.13

Table 3. Results of Wilcoxon Signed-ranks tests for PG: changes from Time1 to Time2

Measures	Z	p	r
Content	-0.336	0.737	-0.048
Vocabulary	-0.821	0.412	-0.116
Grammar	-1.009	0.313	-0.143
Spelling	-0.202	0.840	-0.029
Punctuation	-0.982	0.326	-0.139
Total revisions	-0.390	0.696	-0.056

Table 4. Results of Wilcoxon Signed-ranks tests for UG: changes from Time1 to Time2

Measures	Z	p	r
Content	-2.794	0.005*	-0.528
Vocabulary	-1.099	0.272	-0.208
Grammar	-1.412	0.158	-0.267
Spelling	-1.726	0.084	-0.326
Punctuation	-0.282	0.778	-0.053
Total revisions	-2.103	0.035*	-0.397

Note. * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

Location of Revisions

Changes in the writers' revision behaviours were also analysed in terms of *location*, i.e., revisions made in the introduction, the main part and the conclusion of the essay. Due to the fact that the variables were not normally distributed, the Wilcoxon signed-ranks test was used to examine overtime changes in the location of writers' revisions. From Tables 5 and 6, it can be seen that the analysis for the location revealed no significant change over time in the PG group. In contrast, several significant findings emerge in terms of the location of revisions in the UG group. UG students edited their writing significantly less frequently in the introduction in Time 1 than in Time 2 ($Z = -2.982$, $p < 0.003$, $r = -0.422$); the effect size was identified as medium. There were other significant findings, i.e., the number of content ($Z = -2.542$, $p < 0.011$, $r = -0.48$), and grammar-oriented revisions ($Z = -2.605$, $p < 0.009$, $r = -0.492$) in the introduction declined from Time 1 to Time 2. The effect sizes were medium in both cases.

Table 5. Descriptive statistics for the location of revisions (frequency per 1,000 words)

Measures	PG students				UG students			
	Time 1		Time 2		Time 1		Time 2	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<i>Content</i>								
Introduction	33.48	32.58	40.63	53.23	54.57	30.87	27.54	22.94
Main Part	24.10	18.20	27.01	19.72	35.23	18.34	25.32	18.39
Conclusion	33.07	74.24	17.37	22.72	20.63	22.46	11.22	12.73
<i>Vocabulary</i>								
Introduction	62.18	43.35	81.84	59.09	54.16	30.90	35.29	28.78
Main Part	47.05	25.81	48.41	31.88	38.11	26.10	36.33	17.33
Conclusion	70.48	67.72	45.80	43.31	18.65	26.75	29.61	27.32
<i>Grammar</i>								
Introduction	49.21	37.95	62.69	52.87	93.68	52.59	46.76	43.47
Main Part	41.99	24.06	37.39	20.39	44.86	23.49	44.32	18.46
Conclusion	41.13	38.24	46.12	34.82	37.42	35.27	34.24	27.68
<i>Spelling</i>								
Introduction	43.08	44.44	33.91	37.76	41.75	21.95	23.4	24.22
Main Part	21.26	18.17	23.47	17.20	35.38	18.45	22.16	16.16
Conclusion	21.30	32.10	29.41	27.33	34.71	31.29	34.65	39.00
<i>Punctuation</i>								
Introduction	47.28	44.66	39.55	33.27	76.85	64.19	62.44	43.73
Main Part	23.99	16.34	25.83	20.31	51.92	26.81	52.14	32.26
Conclusion	32.87	61.81	19.49	20.46	46.13	34.35	39.92	50.24
<i>Total</i>								
Introduction	235.23	121.90	262.62	155.13	324.34	135.12	195.78	109.28
Main Part	158.20	68.31	167.21	72.13	205.51	58.33	180.28	58.98
Conclusion	198.29	161.76	155.28	74.87	157.53	87.67	149.64	104.87

Another set of analyses examined the revision behaviours of the two groups of writers in further detail. In order to do so, comparisons were drawn between various kinds of revisions made in the introduction and the main part, the main part and the conclusion, and the introduction and the conclusion of their written texts. The Time 1 and Time 2 data of both groups were looked at separately as part of the analyses. The results of the Wilcoxon signed-ranks tests for the postgraduate group of writers are presented in Table 6.

Table 6. Results of Wilcoxon Signed-ranks tests (PG students)

Measures	Time 1			Time 2		
	Z	p	r	Z	p	r
<i>Introduction-Main Part</i>						
Content	-0.955	0.339	-0.135	-0.886	0.376	-0.125
Vocabulary	-2.139	0.032*	-0.303	-2.892	0.004**	-0.409
Grammar	-1.009	0.313	-0.143	-1.762	0.078	-0.249
Spelling	-2.343	0.019*	-0.331	-0.525	0.600	-0.074
Punctuation	-2.435	0.015*	-0.344	-2.193	0.028*	-0.310
Total	-3.135	0.002**	-0.443	-2.704	0.007**	-0.382
<i>Main Part - Conclusion</i>						
Content	-0.943	0.346	-0.133	-2.190	0.029*	-0.310
Vocabulary	-0.525	0.600	-0.074	-1.224	0.221	-0.173
Grammar	-0.336	0.737	-0.048	-1.229	0.219	-0.174
Spelling	-1.400	0.162	-0.198	-0.686	0.493	-0.097
Punctuation	0.552	0.581	-0.078	-1.429	0.153	-0.202
Total	-0.363	0.716	-0.051	-0.821	0.412	-0.116
<i>Introduction-Conclusion</i>						
Content	-1.315	0.189	-0.186	-2.833	0.005**	-0.401
Vocabulary	-0.202	0.840	-0.029	-2.946	0.003**	-0.417
Grammar	-1.514	0.130	-0.214	-1.143	0.253	-0.162
Spelling	-2.419	0.016*	-0.342	-0.792	0.523	-0.158
Punctuation	-1.704	0.088	-0.241	-2.386	0.017*	-0.337
Total	-1.978	0.048*	-0.280	-2.973	0.003**	-0.421

Note. * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

Regarding prospective PG student writers' revision behaviours, several statistically significant trends were observed. The comparison of the revisions made at Time 1 in the introduction and in the main part, showed that more revisions in total were made in the introduction than in the main part of the essays ($Z = -3.135$, $p < 0.002$, $r = -0.443$). Specifically, PG students made significantly more editing for *vocabulary* ($Z = -2.139$, $p < 0.032$; $r = -0.303$); *spelling* ($Z = -2.343$, $p < 0.019$, $r = -0.331$); and *punctuation* ($Z = -2.435$, $p < 0.015$, $r = -0.344$) in the introduction than in the main part of the essay. The effect sizes were medium on all three measures. A similar pattern could be detected at Time 2 as the PG group revised their text more frequently in the introduction than in the main part. Statistically significant findings were obtained for the *vocabulary*-targeted revisions ($Z = -2.892$, $p < 0.004$, $r = -0.409$), revisions at the *punctuation* level ($Z = -2.193$, $p < 0.028$, $r = -0.31$) and revisions in *total* ($Z = -2.704$, $p < 0.007$; $r = -0.382$). The effect sizes for all variables were medium.

PG writers also revised their essay more frequently in the introduction than in the conclusion at both Time 1 and Time 2. In the pre-test more revisions for *spelling* ($Z = -2.419$, $p < 0.016$, $r = -0.342$) and all revisions in *total* ($Z = -1.978$, $p < 0.048$, $r = -0.28$) were made in the introduction. In the post-test the significant findings emerged in terms of the revisions at the levels of *content* ($Z = -2.833$, $p < 0.005$, $r = -0.401$), *vocabulary* ($Z = -2.946$, $p < 0.003$, $r = -0.417$), *punctuation* ($Z = -2.386$, $p < 0.017$, $r = -0.337$) and all revisions in *total* ($Z = -2.973$, $p < 0.003$, $r = -0.421$), all effect sizes being medium. As regards the comparison of revision behaviours in the main part and the conclusion, the only statistically significant difference was observed at Time 2, for the revisions at the *content* level. PG students edited their texts for content more frequently in the main part than in the conclusion of their essays ($Z = -2.190$, $p < 0.029$, $r = -0.31$). The effect size was in the medium range. Likewise the PG group, UG students made significantly more revisions in the introduction part than in the main part or the conclusion of their essays (see Table 7). At Time 1, significantly more revisions overall ($Z = -3.107$, $p < 0.002$, $r = -0.439$), regarding *content* ($Z = -2.229$, $p < 0.026$, $r = -0.421$), *vocabulary* ($Z = -2.291$, $p < 0.022$, $r = -0.433$) and *grammar* ($Z = -3.045$, $p < 0.002$, $r = -0.575$) were made in the introduction than in the main part. The effect sizes for content, vocabulary and revisions in total were medium while the effect size for grammar was large. Students revised their texts more frequently overall ($Z = -2.731$, $p < 0.006$, $r = -0.386$), for *content* ($Z = -2.731$, $p < 0.006$, $r = -0.516$), *vocabulary* ($Z = -2.542$, $p < 0.011$, $r = -0.480$) and *grammar* ($Z = -2.605$, $p < 0.009$, $r = -0.492$) in the introduction than in the conclusion. The effect size for the revisions at the content level can be characterised as large and all other effect sizes as medium. No significant differences emerged in the comparison of the revisions made in the main part and the conclusion.

At Time 2, no statistically significant differences were found between the introduction and the main part of the essay on any of the revision measures of the prospective UG students. The comparison of revisions in the introduction and the

conclusion revealed only one difference regarding the revisions at the *punctuation* level ($Z=-2.062$, $p<0.039$, $r=-0.390$), the effect size being medium. Finally, UG students carried out significantly more content-oriented revisions in the main part of the essay ($Z=-2.103$, $p<0.035$, $r=-0.397$) than in the conclusion; the effect size being medium.

Table 7. Results of Wilcoxon Signed-ranks tests (UG students)

Measures	Time 1			Time 2		
	Z	p	r	Z	p	r
<i>Introduction-Main Part</i>						
Content	-2.229	0.026*	-0.421	-0.408	0.683	-0.077
Vocabulary	-2.291	0.022*	-0.433	-0.345	0.730	-0.065
Grammar	-3.045	0.002**	-0.575	-0.220	0.826	-0.042
Spelling	-0.847	0.397	-0.160	-0.175	0.861	-0.033
Punctuation	-1.601	0.109	-0.303	-1.224	0.221	-0.231
Total	-3.107	0.002**	-0.439	-0.282	0.778	-0.040
<i>Main Part – Conclusion</i>						
Content	-1.922	0.055	-0.363	-2.103	0.035*	-0.397
Vocabulary	-1.915	0.056	-0.362	-0.722	0.470	-0.136
Grammar	-0.973	0.331	-0.184	-1.224	0.221	-0.231
Spelling	-0.596	0.551	-0.113	-1.223	0.221	-0.231
Punctuation	-0.596	0.551	-0.113	-1.350	0.177	-0.255
Total	-1.601	0.109	-0.226	-1.287	0.198	-0.182
<i>Introduction-Conclusion</i>						
Content	-2.731	0.006	-0.516	-1.783	0.075	-0.337
Vocabulary	-2.542	0.011*	-0.480	-0.785	0.433	-0.148
Grammar	-2.605	0.009**	-0.492	-1.013	0.311	-0.191
Spelling	-0.973	0.331	-0.184	-1.569	0.117	-0.297
Punctuation	-1.099	0.272	-0.208	-2.062	0.039*	-0.390
Total	-2.731	0.006**	-0.386	-1.726	0.084	-0.244

Note. * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

Discussion

The research questions in this study were examined with the aid of the keystroke logging tool Inputlog, which captured UG and PG students' on-line writing processes and revealed some interesting observations regarding their revision behaviours on an intensive EAP program.

The first research question sought to determine how writers' revision behaviours change over the course of four weeks of studying on an intensive EAP course in the case of prospective undergraduate and postgraduate students. The statistical analyses revealed no significant effects of Time on revision behaviours of the PG student writers in terms of the orientation of revisions. Interestingly, the UG writers started to make significantly fewer content- targeted revisions at the end of the EAP course compared to the beginning of the course.

With respect to the location of revisions, it was found that UG students revised their writing in the introduction part significantly less frequently at Time 2 than at Time 1. Importantly, they made noticeably fewer content and grammar-targeted revisions at the end compared to the beginning of the EAP course. The decline in the number of revisions made by the UG group could be explained by the interplay of a number of factors. One of the likely explanations, as suggested by Chenoweth and Hayes (2001), is that with increased proficiency, the accuracy of students' writing also improves, and they no longer need to revise their texts so frequently. Furthermore, fewer instances of revisions made by the writers at the end of the four-week EAP course is perhaps not surprising given that the students no longer needed to go back to the drafted introduction and make changes to what they had written. They might have planned and preserved the ideas in mind and drafted them as one introductory paragraph only after the rest of the essay was composed. One might infer that after having studied on an intensive EAP course for a month, the students gained confidence as academic writers and learnt to prioritise reviewing their essays for general improvement rather than revising them for minor linguistic errors (see Barkaoui, 2016). In other words, they began to revise their writing by ear, characterised by Silva (1993) as introducing changes to what they wrote on the basis of what actually 'sounds' good, rather than merely editing written texts for specific linguistic and mechanical flaws.

Turning to the analysis of PG student writers' revision behaviours, no statistically significant differences were observed from the beginning to the end of the EAP course as far as the orientation and location of revisions are concerned.

The second research question used in this study investigated how the revision behaviours of undergraduate students studying on the EAP program compare to the revision behaviours of postgraduate students studying on the same

program. A noteworthy finding based on the keystroke logging data analyses is that UG student writers, on the whole, made significantly more revisions than PG student writers. This conclusion is in line with those of previous studies, e.g., Barkaoui (2016), Choi (2007) and Stevenson et al. (2006), who also discovered that those writers who are more experienced and more proficient in the target language appear to revise their texts significantly less frequently both at the conceptual and linguistic levels. According to Rijlaarsdam et al. (2004) as cited in Stevenson et al. (2006), writers with more problems in their texts probably revise more, while writers who are initially able to produce a better text less need to revise. A possible explanation for this might be that PG students who tended to be more skilled as writers, generally more proficient in English than UG students and not having trouble in generating ideas and choosing appropriate lexical items for their texts were able to produce fluent and accurate texts that do not require major revision unlike the text produced by less experienced and less proficient writers. Significant differences between the UG group and the PG group of writers were also observed in terms of the punctuation-oriented revisions. From the data in Table 2 and Table 3, it is apparent that UG student writers made significantly more mechanical revisions than PG writers. One might infer that reduced attention given by PG writers to mechanical changes can be potentially explained in the following way. Having overall had more expertise and confidence as academic writers, the PG group was able to produce texts that required considerably less revision, particularly at the level of mechanics (Chenoweth & Hayes, 2001). Another plausible reason for more frequent revisions at the level of punctuation made by UG writers compared to PG writers is the tendency of the less proficient group to get easily distracted by local mechanical problems thus failing to sufficiently concentrate on the substantive meaning of the text (Bereiter & Scardamalia; 1987, Choi, 2007; Revesz et al., 2019; Zamel, 1983). Such behaviour is typical of less skilled writers who often tend to prioritise surface revisions because they are considerably easier to make and require less cognitive effort. Consequently, writers' focus on lower-level revisions might lead to attention conflict, i.e., fewer resources available for revising other aspects of the text. One other possible explanation for UG writers' increased emphasis on mechanics during the process of revision is that novice writers often believe that what matters most in writing is the accuracy of the text produced (Barkaoui, 2016). Interestingly, students' previous experience as writers and their perception of the audience of their texts might influence the orientation of their revisions. According to Porte (1996), based on teachers' feedback on their essays, students tend to believe that language accuracy and mechanics are of greater importance to their scores than the content of their writing. These results are in agreement with Barkaoui's (2007) findings which showed that more and less competent writers, on the whole, tend to prioritise different aspects of writing during the process of revision. Having gained more expertise as academic writers, PG students seem to have become better aware than UG writers of the importance of introducing changes at the global level rather than making surface-level punctuation-targeted revisions to their writing.

Another interesting finding made on the question of location of revisions was that both PG and UG writers revised their texts significantly more frequently in the introduction than in the main body and the conclusion of their essays. These results are likely to be related to reflective thinking and planning that student writers seem to be involved in while drafting the introduction of their essay. In line with Bereiter and Scardamalia (1987), writers tend to make numerous modifications to their texts in early stages of the writing process.

Conclusion

To briefly summarise the findings of the study in terms of the Research Question 1, the results of the analyses showed no significant effects of Time on the orientation of revisions made by the PG student writers studying on the EAP course. However, the findings have demonstrated a notable change over time regarding the content-oriented revisions made by the UG group of writers. The number of revisions made in total as well as the number of revisions at the content level has declined significantly from Time 1 to Time 2.

Regarding the location of revision, by the end of the four-week course, the UG writers had started to revise their essay introductions for content and grammar significantly less frequently than they did at the beginning of the course. Moving on to the Research Question 2, several interesting conclusions were drawn in terms of the differences in revision behaviours of the UG and PG groups of writers. Firstly, significantly more revisions in general were made by UG writers compared to PG writers. Furthermore, the UG group made more punctuations-targeted revisions than the PG group while studying on the EAP programme.

Implications

A useful pedagogical implication of this study is that teachers of writing need to make their students aware of the importance of reviewing and revising their essays for content since this aspect is particularly valued by both markers of the essays and by the general audience. Writing teachers should make their students aware of the importance of revising the essay content and structure before turning "to the linguistic side of the text (academic genre characteristics, language)" (Breuer, 2017, p. 39). It is important to note that these cannot be all done simultaneously because of the large cognitive demands in academic writing. This change of students' beliefs about writing might have a positive effect on their revision behaviours (Barkaoui, 2016). It might also be helpful for teachers to allocate some time during their writing classes to explaining to their students what specifically, when and how to revise in their

assignments. Finally, teachers should give learners further guidance by emphasising that one should better focus on one specific activity at a time rather than attempt to accomplish two or more processes simultaneously. Specifically, planning the content of the essay and revising some linguistic and mechanical errors at the same time might negatively impact the writing outcome. It has, therefore, been recommended by the researchers to avoid overloading the working memory by addressing one activity at a time (Hayes & Chenoweth, 2006).

An important methodological contribution of this study lies in the application of the keystroke logging methodology to collect and analyse the quantitative data. This unobtrusive tool allows one to record all keystrokes and mouse movements and store the data for later processing. It, thus, “ensures an ecologically valid research context” (Van Waes et al., 2009, p. 41). In particular, the keystroke logging software Inputlog assisted me with on-line revisions analyses as potential window to cognitive processing. The present study also provides additional evidence with respect to the importance of students’ engagement in revision procedures throughout the writing process. Students need to be encouraged that the essays should be revised for content and organisation prior to considering the specific grammatical, lexical and mechanical aspects of writing. Also, teachers need to emphasise that a backtracking strategy, which involves rereading the text that has been written, might assist students considerably when evaluating and reflecting on what they have written. Rereading their essay gives writers multiple opportunities to identify the flaws and inconsistencies which they did not notice the first time and helps them to generate some ideas for their writing.

Limitations

Despite the significance of its findings the present study is not without limitations which should be followed up by further research. First, as regards the research participants, since the numbers in both groups were relatively low, individual differences might have masked the patterns that could have emerged had the sample size been larger. It might be thus useful in future to replicate the research so that the results might be confirmed by a study with a larger sample size.

A further shortcoming of the study is that the participants represented a population with relatively homogenous language proficiency, B1 and B2 levels according to CEFR scale. It may, therefore, be worthwhile to investigate student writers’ performance across a wider range of proficiency levels to better understand the genuine patterns of their linguistic and cognitive development on the programme.

Another potential limitation of this study concerns the participants’ computer skills including the typing style and typing speed were not taken into consideration. As rightly pointed out by Michel et al. (2020), the students who are not touch-typists are more likely to lose track of their writing by looking at the keyboard.

Although this study has a number of limitations, it attempted to contribute to the fields of SLA and second language writing by investigating the changes in revision behaviours of undergraduate and postgraduate writers on a highly intensive pre-sessional EAP program. A number of interesting findings made as a result of the analyses demonstrated that this research was a worthwhile attempt to investigate the efficiency of intensive EAP teaching for second language learners’ writing skills advancement.

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