Second Language Learners’ Pauses Over Different Times Intervals in L2 Writing Essays: Evidence From a Keystroke Logging Program

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ABSTRACT

Purpose. Several studies have been conducted to analyse students’ pauses during first language and/or second language writing to indicate the magnitude of the underlying cognitive processes learners have. Majority of studies have examined students’ pauses at a threshold 200ms. However, little is known about recording second language learners’ pauses at different pauses’ times over different types of genres. The current investigation reports a case study of L2 learners’ cognitive processes by recording their

Відмінність пауз студентів, які вивчають другу мову L2, за інтервалами часу в написанні есе: докази за допомогою програми реєстрації натискання клавіш

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Purpose. Several studies have been conducted to analyse students’ pauses during first language and/or second language writing to indicate the magnitude of the underlying cognitive processes learners have. Majority of studies have examined students’ pauses at a threshold 200ms. However, little is known about recording second language learners’ pauses at different pauses’ times over different types of genres. The current investigation reports a case study of L2 learners’ cognitive processes by recording their

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pauses (<500ms, <1000ms, and <2000ms) during L2 writing in response to multiple genres prompts.

**Design / methodology / approach.** Twenty-five postgraduate students were asked to write three essays over three weeks, and their writing processes were recorded using a keystroke logging program (Inputlog, 7, Leijten & van Waes, 2013). Data was triangulated using a log file from the keystroke logging program, a process graph for writing behavior through different stages, and a visual video recording of their captured screens during writing behaviours.

**Findings.** Results found that the students paused over sentence and paragraph boundaries and their pauses between paragraphs were significantly higher in writing narrative essay than in their argumentative essays at pauses intervals <500 and <1000ms respectively. In turn, their pauses between sentences in an argumentative essay were significantly higher than their pauses in a descriptive essay at <500, <1000 respectively. However, there were no significant differences across word boundaries over genre types.

**Conclusions.** The current study extends the previous literature in examining the underlying cognitive processes during L2 writing tasks as the trendy issue of psycholinguistics. Knowing the cognitive processes is crucial in diagnosing the students’ difficulties in writing L2 essays as advanced technology has the potential to explore intrusively the accurate cognitive processes learners involved during writing tasks.

**Originality / value.** This paper is innovative in examining a state-of-the-art issue and has implications to the field of psycholinguistics.

**Key words:** pauses, genre, writing, cognitive processes, keystroke logging program.

**Introduction**

There has recently been a new trend for L2 researchers to investigate L2 learners’ cognitive processes when learners involve in productive skills; speaking and writing (see for example a special issue on L2 writing process, published in Studies in Second Language Acquisition, Volume, 41, issue 3, 2019). This trend is premised by the claim that identifying how the mind works to process a foreign language is one of the central issues of psycholinguistics as writing is “stepchild of psycholinguistics” (Bonin & Fayol, 1996: 145). Identifying L2 cognitive processes during writing may help instructors diagnose the difficulties faced by L2 learners and thus assist them in adopting a remedy plan to improve their learning outcomes (Révész, Michel & Lee, 2019; Zhang et al., 2016). Understanding difficulties during students’ writing processes helps instructors to better improve students’
writing quality, augments learners’ awareness of their writing progress, and increases students’ self-regulation of their writing (Conjin, 2020). Pausology is an indicative behaviour of ones’ cognitive processes as it entails working memory load resulting from the difficulty of a second or a foreign language (Chenue et al., 2014; Xu & Qi, 2017). Research found that longer pauses and much revision during writing indicate working memory burden and limited cognitive capacity that may hinder fluency of writing (Michel et al., 2020; Mohsen, 2021; Révész et al., 2017; 2019). Therefore, studying pauses during writing processes may reflect underlying cognitive processes learners experience during L2 writing (Mohsen & Qassem, 2021; Lindgren et al. 2008; Spelman, Lindgren & Sullivan, 2008; Leijten et al., 2019). Several attempts have been proposed to address and find answers to several gaps in the literature as understanding L2 writing behaviours from psycholinguistics perspectives may help instructors identify the source of difficulty in L2 writing and make informed decisions to overcome these difficulties (Révész & Michel, 2019). Many recent studies (e.g. Révész, Kourtali & Mazgutova, 2017; Révész, Michel & Lee, 2019) have attempted to empirically explore what learners are thinking of when they pause during producing written form; do they struggle at the lexical unit, at the syntactic level, or at the technical form? Does type of genre affect difficulty in writing? If so, which genre does significantly affect cognitive processes? How about the proficiency level of students' writing? Do experienced learners pause as much as inexperienced writers? Do other demographic factors such as age and gender affect learners’ cognitive processes? However, the focus of this paper is to explore and to answer a different issue. In other words, it attempts to explore how L2 learners pause over times across different types of genres by recording their pauses across the lexical boundaries; words, sentences, and paragraphs, using the keystroke logging program (Leijten & Van Waes, 2013).

**Literature Review**

Writing involves several cognitive processes that a typical writer undergoes. It is evident that writing is one of the L2 productive skills that is viewed by learners as hard to master especially beginners who had low exposure to foreign language and usually suffer from poor
vocabulary knowledge, hesitation, false start, incomplete sentences, and short expressions to draft. These difficulties are operationalized by long pauses when initiating the writing or pauses across lexical unit such as word, sentence, and paragraph boundaries, which considerably affect mental activities of learning to write a second language (Barkaoui, 2019; Michel et al., 2020; Medimorec & Risko, 2017; Mohsen, 2021; Mohsen & Qassem, 2021; Révész, Kourtali & Mazgutova, 2017; Révész, Michel & Lee, 2019). With the advancement of a new technology in the modern age, pauses can be recorded and reported numerically by a log report generated from the Keystroke logging program, which helps instructors and researchers depict what goes on the learners' mind during writing processes. It is argued that pauses on initial writing is an indicator of planning involvement in what to write and how to brainstorm and generate ideas (Révész, Michel & Lee, 2019). Research suggests that pauses at word boundaries indicate learners’ obsession with micro-level difficulties such as spelling, punctuation and grammar, while pauses at the sentences level and clause level may refer to learners’ involvement in macro-level issues such as retrieving ideas and organizing thoughts (Medimorec & Risko, 2017). It has been also argued that pauses before high textual units (sentences and paragraphs) indicate learners’ involvement in planning and drafting processes to produce the text, and that demands high cognitive burden in students’ mind while pauses between high textual units are expected to be higher than the lower textual unit (pauses between words) (Révész, Michel & Lee, 2019). The literature indicates that there are other factors that may affect pauses and revision such as proficiency level (Xu & Ding, 2014), keyboard typing skills (Alves et al., 2007; Barkaoui, 2016, 2019), and type of prompted genre (Mohsen & Qassem, 2021; Spelman, Lindgren & Sullivan, 2008). The focus of the current study is to investigate how genres affect the students’ pauses at different pauses thresholds.

Trouble in processing L2 writing is not a main issue for beginning learners, though they paused less significantly than inexperienced writers (Xu & Xia, 2019), but even experienced writers suffer from inability to produce rhetoric text fluently without pauses as writing is viewed as difficult to fully translate one’s ideas into a written form. Indeed, there are other factors which make writing hard to perform like the style, the flow of writing, the organization of ideas, and the appropriate use of vocabulary. These difficulties compel writers to pause as to
retrieve ideas, reformulate sentences, create their views and arguments, and choose eye-catching expressions and vocabulary that convey the meaning clearly and coherently. Similarly, the writing genre may play an integral role in learners’ pauses because some writing genres are easy to execute while others are hard to compose (Van Waes & Leijten, 2015). For example, research found that pauses in argumentative writing are significantly higher than descriptive genre because argumentative genre demands many cognitive processes to generate ideas and refute counter-argument claims (Medimorec & Risko, 2017; Mohsen & Qassem, 2021).

The current study is guided by Kellogg’s (1996) model which states that writing a text includes three main recursive and non-cyclical cognitive processes: planning, drafting, and monitoring. According to Kellogg et al. (2013), writing does not include only language production, but writers should bear in mind that ideas must be initially generated and organized in their mind, their mental activities must operate to think how to adequately translate what is in their mind to a meaningful written form. Once the text is placed on a paper or a computer there might be a revision to what is written to make sure the intended meaning is conveyed as planned. The last step (revision) may be left out by poor learners as they have insufficient resources in their working memory, leading to undeveloped L2 writing output (Xu & Xia, 2019). All these cognitive processes create a burden for working memory specially for learners with low- proficiency level who are unable to automatize the second language. Research revealed that working memory capacity is limited and many cognitive processes imposed by working memory may delay some linguistic functioning. As a result, writers may ignore some cognitive processes such as revision and that may lead to working memory burden (Michel et al., 2020). Research also found that advanced learners may pause higher, write in longer bursts, revise more at the clause and sentence level, and spend less time on tasks than the beginning learners (Zhang et al., 2016). All this evidence is supported by log data generated from the keystroke logging program.

Keystroke logging program is software that records all students’ behaviours during writing and generates report data about their pauses, revision, fluency, and sources. The log data contains a numerical report for every stroke made by learners. It can provide learners a report about their behaviours; their pauses, revision, and fluency (an example of recording students’ processes during writing is given in the following
This would help learners understand their writing practices, their faults, their linguistic abilities, and their proficiency level (Zhang et al., 2016). Teachers can also understand their students’ difficulties in writing, their writing competencies, and their strategies adopted during writing. In the past, students’ cognitive processes were measured traditionally using observation and think aloud protocol in which learners were asked after the task to verbalize what they were thinking of when they paused at different locations and these perceptions were recorded and then interpreted. This method is limited as there may be a chance for obtrusiveness, subjectivity, and inadequacy (Mohsen & Qassem, 2021).

**Figure 1**
A sample of a student’s writing processes recorded by Inputlog typing the words “Today the internet”

<table>
<thead>
<tr>
<th>Pause</th>
<th>Duration (ms)</th>
<th>Word(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pause 23</td>
<td>1365 ms</td>
<td>Today</td>
</tr>
<tr>
<td>Pause 24</td>
<td>585 ms</td>
<td>the</td>
</tr>
<tr>
<td>Pause 25</td>
<td>375 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 26</td>
<td>208 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 27</td>
<td>923 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 28</td>
<td>1203 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 29</td>
<td>743 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 30</td>
<td>590 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 31</td>
<td>785 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 32</td>
<td>3154 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 33</td>
<td>719 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 34</td>
<td>308 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 35</td>
<td>1454 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 36</td>
<td>2031 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 37</td>
<td>335 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 38</td>
<td>235 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 39</td>
<td>1555 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 40</td>
<td>231 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 41</td>
<td>270 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 42</td>
<td>256 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 43</td>
<td>910 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 44</td>
<td>301 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 45</td>
<td>238 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 46</td>
<td>263 ms</td>
<td></td>
</tr>
<tr>
<td>Pause 47</td>
<td>938 ms</td>
<td></td>
</tr>
</tbody>
</table>
There has been much research conducted in the past few years, analysing students’ pauses in response to different writing genres prompts, considering pauses are indicative of higher-level processes (Révész, Kourtali & Mazgutova, 2017). Poor learners tend to pause more as working memory uses up many resources, consequently, they tend to be involved in low-level skills of writing such as lexis, grammar, and spelling (Medimorec & Risko, 2017). Therefore, this issue is investigated in research to reflect how much learners pause, at what level they paused, and the cognitive processes underlying these pauses. Type of genre affects students’ processes as some genres are easy to write while others are hard to process (van Waes & Lejiten, 2015). Research found that students paused more in argumentative writing rather than descriptive tasks. For example (Mohsen & Qassem, 2021) compared students’ pauses at two different genres; argumentative versus descriptive essay, and found that students paused more at argumentative writing. Students reported more pauses at word boundary level, meaning that they held a high cognitive process at monitoring mechanical errors and retrieving words from their memory. Similarly, Medimorec and Risko (2017) found that pauses at argumentative essays were significantly higher than pauses at narrative essays at different pauses intervals (300–100, 100–1999, 2000 ms and more). The justification is that argumentative writing demands high-cognitive processes in planning, generating ideas for refuting and requires more linguistics skills such as vocabulary and more complex sentence structure (Kellogg et al., 2013). Concerning pauses at lexical boundaries, there were significant differences at word boundary at the three different intervals, significant at sentence level at 300–999 ms intervals, and no significant differences at paragraph boundary between the two genres. Limitations of Medimorec and Risko (2017) are that they examined pauses in students’ mother tongue writing. Examining pauses behaviors in response to different L2 writing genres is still not examined in L2 literature as to the best of the author’s knowledge.

Likewise, Van Waes and Leijten (2015) recorded students’ pauses at different time intervals (<200, <500, <1000, <2000) for two expository texts written in L1 and L2. The log data from the Inputlog revealed that pauses were higher in L2 than in L1 in terms of pauses at the lower textual unit (within words and between words). However, there were no significant differences between pauses in L1 and L2 in
regards to high-textual units (sentences). They found that pauses at the time interval (<200ms and <1000ms) were statistically significant for L2 than L1, suggesting that learners demanded high cognitive processes at the sentence level which reflect that learners struggle to plan and formulate the ideas both in L1 and L2. Conversely, pauses at the micro-level were higher in L2 than in L1 as learners might lack the linguistics competence in their L2 writing and struggle to polish the mechanical errors occurring between words such as spelling and punctuation. Alves et al. (2007) looked at how typing skills affected the students’ pauses at narrative writing using students’ verbal report. They found that students demanded much cognitive processes at the revising stage compared to planning and drafting phases.

Though the major standard threshold for writing pauses among researchers is 200 ms, there was no full consensus among researchers to limit pause threshold at 200ms. Some factors may play a pivotal role in increasing/ decreasing pauses such as typing proficiency (Barakaoui, 2016; 2019; Leijten et al., 2019). Therefore, some researchers adopted different pauses intervals as pauses are operationalized as the inability to produce a word in writing that exceeded the time needed for inscribing symbols through the keyboard or mouse during typing or a hand at handwriting (Medimorec & Risko, 2017). Therefore, this study aims to explore different cognitive processes experienced by L2 learners when responding to three genres, using keystroke logging program to track their pauses at different times intervals. In generality, there was a paucity of research, to the best of the author's knowledge, in tracking pauses at different times intervals. (e.g, around 1000 ms, 2000 ms and more) over lexical boundaries; word, sentence, and paragraph), Van Waes and Leijten (2015) is an exception. It is also of a paramount interest to examine the students’ pauses over narrative essays as it has not been much investigated in the L2 writing research, to the best of the author’s knowledge, except Medimorec and Risko (2017) who examined pauses over argumentative varus narrative essays in the students’ mother tongue. However, no single attempt in the L2 literature seems to track the students’ cognitive processes during involvement in L2 narrative essay. Therefore, the study attempts to answer the following question: “How do L2 learners pause at different boundaries; word, sentence, and paragraph in responding to argumentative, narrative, and descriptive genres across different pauses intervals?”.
Methodology

Participants
Thirty-seven postgraduate Arab students were invited to write 3 essays on Inputlog (7) over three weeks in the first semester of the academic year 2020–2021. Their ages were between 25–30. They enrolled in the first year of MA TESOL and they had been studying a course entitled “Academic Writing” over one semester, where they were trained how to write different genres in response to different prompts. The number of participants were 37 but only 25 students’ writing processes were recorded as some students faced difficulties in submitting the task, some submitted their works, but they were incomplete, and some could not install the software as their operating system was Mac, which is not compatible with Inputlog. Students’ proficiency level was measured in their IELTS scores where their mean scores in writing band was 4.7. This is a requirement made by the concerned department for eligibility of MA enrolment. The participants received learning online during the COVID-19 where the mode of teaching was converted into online teaching format. The participants were told verbally that their participation is voluntary, and they had the right to withdraw any time, and their grades would not be affected in case they did not take part in the study.

Writing prompts
As the author’s interest is to measure students’ pauses over words, sentences, and paragraph boundaries; therefore, an essay writing type best fits the research objectives. Three writing essays were recorded by the participants in response to three prompts; (1) argumentative essays where students were asked to respond whether experience or qualification was important for one’s’ career, (2) descriptive essay where they were asked to write the pros and cons of the Internet, and (3) narrative essay where they were required to write about a disastrous day in their life. These prompts were taken from IELTS writing test 2. The students had already been trained how to write different essays and received corrective feedback from their instructor throughout the semester. Every essay was given 60 minutes to complete. These prompts were selected as the participants were familiar with and they would not face difficulties in generating ideas about such issues.
Second Language Learners’ Pauses Over Different Times Intervals...

Adherence to Ethical Standards

The participants were told verbally in advance that their participation would be voluntary and for research purposes. Those who agreed to take part in the experiment clicked on a link that was created to join the experiment. They were also told that they had the right to withdraw anytime and would have no harm if they declined or withdrew from experiment involvement.

Procedures

Those who agreed to participate were asked to download the software and install it to their computers. They were already trained how to record their essay over the Inputlog and how to submit their responses. They received one session training on the use of the software on writing one paragraph until the author made sure that they fully mastered how to write over the Inputlog and submit their responses to the author. The experiment was carried out virtually in the ir usual class at time of COVID-19, where educational institutions were fully locked down. The students usually received one lecture per week tackling different genres; how to write a good essay by giving examples and asking them to write an essay, then after submitting their essays, corrective feedback was provided later on every student's assignment. The class contained 37 students, divided into two sections, and all of them were asked to write their essays over the Inputlog. Only 25 students’ recordings were eligible to be analysed as some students confronted technical problems during either essay’s inscription, submitting the assignments online, or their assignments were incomplete.

Data Analysis

Descriptive statistics were used to collect means and standard deviation about the pauses over three types of essays for every student and in total. Pauses were recorded over the word, sentence, and paragraph boundaries. Pauses times were used 500, 1000, and 2000 ms (Van Waes & Leijten, 2015). Descriptive statistics were collected to see
the means and standard deviation for the pauses times over genre types. Inferential statistics were also computed to see the differences among the pause’s times over the genre types. As the number of the sample is less than 30, the normal distribution of data was violated. Non-parametric test was used to run the comparative analysis. All the statistical analyses were calculated at .05 level.

**Results**

**Q1. How do L2 learners pause at different boundaries word, sentence, and paragraph in responding to argumentative, narrative, and descriptive genres across different times pauses intervals?**

To answer the study question, Table 1 shows the means and standard deviation of pauses across word, sentences, and paragraph boundaries over different pauses intervals. It also shows inferential statistics across lexical boundaries. To understand the significant differences across genres, Kroskal Wallis test was used as the data was not normally distributed due to the small size of the sample. I followed Plonsky and Oswald (2014) for the interpretation of effect size; d= .2-.4 is low, .5 is medium, and .8 is large. Table 1 shows the means and standard deviations of the text boundaries over the genre type, the p value, and the effect size.

<table>
<thead>
<tr>
<th>Text boundary</th>
<th>Pauses intervals</th>
<th>Genre type</th>
<th>P</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Argumentative</td>
<td>Descriptive</td>
<td>Narrative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Md</td>
<td>SD</td>
<td>Md</td>
</tr>
<tr>
<td>word</td>
<td>&lt;500</td>
<td>4.89</td>
<td>1.46</td>
<td>3.11</td>
</tr>
<tr>
<td></td>
<td>&lt;1000</td>
<td>7.96</td>
<td>4.71</td>
<td>3.75</td>
</tr>
<tr>
<td></td>
<td>&lt;2000</td>
<td>13.43</td>
<td>13.21</td>
<td>4.92</td>
</tr>
<tr>
<td>Sentence</td>
<td>&lt;500</td>
<td>4.92</td>
<td>1.40</td>
<td>2.52</td>
</tr>
<tr>
<td></td>
<td>&lt;1000</td>
<td>7.13</td>
<td>2.31</td>
<td>2.76</td>
</tr>
<tr>
<td></td>
<td>&lt;2000</td>
<td>7.36</td>
<td>2.54</td>
<td>7.73</td>
</tr>
<tr>
<td>paragraph</td>
<td>&lt;500</td>
<td>3.40</td>
<td>1.11</td>
<td>2.69</td>
</tr>
<tr>
<td></td>
<td>&lt;1000</td>
<td>4.17</td>
<td>1.48</td>
<td>2.93</td>
</tr>
<tr>
<td></td>
<td>&lt;2000</td>
<td>4.83</td>
<td>1.55</td>
<td>3.93</td>
</tr>
</tbody>
</table>

* = statistically significant at .05.
Table 1 shows that the higher the time intervals, the higher the pauses are. No significant differences were found among the genre type over word boundary, indicating that the genre type was almost the same that students found hard to process, and thus they paused more across all the essay type. Results revealed that students’ pauses length between sentences were significantly higher for argumentative essay ($M=4.92$, $SD=1.40$) than for the descriptive essay ($M=2.52$, $SD=.57$) across <500 ms, ($Md=3.32$) $U=8.00$, $p<.05$, $\eta^2 = 1.17$. The effect size is very high, indicating that students had much trouble in argumentative essays as they paused significantly across the sentence boundary. Likewise, students’ pauses length between sentences boundary were significantly higher in argumentative essay ($M=8.60$, $SD=5.47$) than the descriptive essay ($M=2.52$, $SD=.57$) at the pause interval <1000ms ($Md=4.9$) $U=6.70$, $p<.05$. $\eta^2 = 1.14$. This suggests that the students faced much complexity in high-thinking level when involved in the argumentative essay than their difficulty in the descriptive essay.

There are also statistically significant differences between students’ pauses between paragraphs for the benefit of the students’ narrative essay ($M=7.18$, $SD=5.44$) over the argumentative essay ($M=2.93$, $SD=.29$) at the pauses interval <1000ms ($Md=3.32$) $U=7.81$, $p<.05$, $\eta^2 = .78$. Similarly, students’ pauses between paragraphs were significantly higher in the narrative essay ($M=8.21$, $SD=4.82$) than their pauses in the argumentative essay ($M=3.93$, $SD=.74$) at the pauses intervals <2000 ($Md=8.62$) $U=9.32$, $p<.05$, $\eta^2 = .89$. This also indicates that learners’ concerns with macro-skills in the narrative genre are higher than in the argumentative genre. Concerning other pauses intervals, there are no statistically significant differences among the genre types across the sentence boundary at 1000, 2000ms intervals. Further, no statistically significant differences were indicated across the paragraph boundary over the genre type ($p>.05$).

**Process graph**

The process graphs were used to denote one student’s processes during different times intervals. Ali (pseudonym) is a proficient writer who wrote long essays. Inputlog portrays the process, product, pauses and revision. As it is difficult to exhibit all the graphs for the participants, I provide here a sample processing graph of Ali’s narrative essay at different pauses times (Figure 2).
The graph shows the processes for the students with blue lines while the products are with green lines. The product line indicates the produced textual output of the student with an accumulative number of letters and characters on the right hand of the graph (Y axis), while the left hand of the graph reflects the time spent for pauses per 500 ms. The scattered dots throughout the graph represent the pause's location. It is shown that Ali paused at different stages of writing; planning, reformulation, and revision. The graph denotes the number of characters produced (1631, words 381 characters) (Figure 3).

Figure 2
Processing graph at 500ms

Figure 3
Processing graph at pauses 1000 ms
The graphs show that Alis’ pauses decrease when pause times increase. He exhibited more pauses at 500 ms than other pauses at 1000 s and in turn his pauses at 1000 ms were less than his pauses at 2000 ms (Figure 4).

**Figure 4**
Processing graph at pauses 2000 ms

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**Video recording**
The program can provide the video recording of students’ writing by pressing the icon “Play” in the top bar of the Inputlog. Ali paused at the beginning to choose the best title for writing the title of a new essay. After he wrote it, he paused and started writing the first sentence. He was a fast typist, he used to revise the word immediately. After writing the first paragraph, he paused and then revised it by inserting new words or clauses and then he moved to the second paragraph.

He did the same for the second and the third paragraph until he finished writing the essay. Surprisingly, he did not revise the whole essay. Even the third paragraph was not well-formatted as it was divided into two paragraphs by mistake. Ali is a professional writer, he made few pauses and deletions, but his burst was high. The program
Discussion

The current study sought to explore how a sample of the current study pauses at different intervals across lexical boundaries; word, sentences, and paragraphs over different types of essays writing. It attempts to find out the underlying cognitive processes L2 learners have from psycholinguistics perspectives in responding to different prompts and the implication of pauses over lexical boundaries. Guided by Kellogg’s model of cognitive processes, this study examines how L2 learners paused at different stages of writing; planning, drafting, and revising. The triangulation of data collection tools used in this study demonstrated how working memory might be burdened by the lack of automaticity in a second language to easily convert what is in the writer's mind into a rhetorical written form. Writing pauses are the indicative of students' cognitive processes as they reflect the inability to inscribe a text fluently as mind is much involved in either finding out the appropriate expression, organizing the ideas and thoughts, or polishing out the mechanical errors such as spelling, punctuation, grammar,
or formatting. The result of the current study supports Kellogg’s (1996) model which serves as the theoretical guide of the current study in that students' cognitive processes in writing tasks are planning, drafting, and monitoring. Findings revealed that L2 writers paused during these three stages as they found some difficulties in generating ideas, translating these ideas in a written form, monitoring the text, and finalizing it in a very effective and meaningful way.

The result of the current study shows that the postgraduate students did not pause much at the word level as pauses between words might indicate learners’ concerns with addressing micro level issues such as spelling and grammar and this could use up the students’ resources, shift the focus on mechanical errors, and thus negatively affect the quality of the final produced output (Zhang et al., 2016). On the other hand, the participants paused higher at the sentence and paragraph levels, indicating the students’ involvement is in a higher-cognitive level of thinking such as generating ideas and arguments that support the essay prompts, organizing ideas, providing evidence to support their arguments, or refute the counterarguments by giving evidence and providing data that could persuade the reader. A possible explanation for such findings is that the participants of the current study were familiar with writing essays, and they did not involve in high-cognitive load in finding out the appropriate use of words and did not suffer from language competency. Therefore, their pauses at word level were not significant.

Concerning pauses over genre type, the results are consistent with previous findings (Mohsen & Qassem, 2021; Van Waes & Leijten, 2015) that students found argumentative writing hard to produce as it demands a high cognitive load. They did not experience a problem over the word boundary but paused more across sentence and paragraph boundaries, indicating a high level of thinking of how to support the arguments or refute the unconvinced arguments. However, the students did not significantly pause over descriptive essay across different pauses intervals as the participants did not encounter a problem in generating ideas and describing facts as they did in argumentative and narrative essays. Conversely, the students paused significantly higher in narrative essays than the argumentative essay over <1000 ms and <2000 ms. This indicates that narrative essay might be difficult to compose as
they were involved in a very high cognitive load in thinking of good plot, attracting the reader with a series of incidents, expressing feelings, reaction, complication, and writing a good ending for the narration. This is reflected from the screenshot of the processes graph for the narrative essay which exhibits a high cognitive load a student had during involving in high-cognitive process when writing a narrative essay. This result contradicts Medimorec and Risko’s (2017) findings as they found that students paused higher in argumentative essays than narrative ones, justifying that argumentative genre demands much cognitive burden than the narrative essays. A plausible explanation of Medimorec and Risko’s (2017) results is that their students wrote in their mother tongue and they did not experience difficulties in finding out rhetoric expressions to narrate a story or an event, while the participants of the current study were required to write in a foreign language where their memory working resources were involved in high-cognitive thinking to struggle to find out narrative expressions and high macro skills to translate what they thought to a coherent fluent writing. Findings also indicate that the lower the pause interval time, the higher the interval times, the less the pauses are. That means students need much practice to overcome their difficulties to master essay writing.

The results of the video recording show that the students paused at the beginning of writing the essay, indicating the learner was thinking of how to organize ideas, how to brainstorm to generate the title of the essay, how to organize the incidents, and to express these ideas fluently and clearly in a high standard of writing. The learner did not pause much at the word level and paid much consideration to macro-level issues as he produced many sentences and created more than three paragraphs, indicating a high cognitive level he was engaged, and the focus was to ensure that the narrative essay he was engaged in would be clear and meaningful. However, the student did not revise the whole essay when finalizing the draft of the essay. This reflection might contradict the previous research that experienced writers paused a little but revised more. This strategy might differ from one writer to another; some writers might think that they wrote well and no need to revise, though it is a crucial step in ensuring the good quality of the produced writing output. A possible explanation for that he was abided by time as he used up the allotted time to finish the task and did not find time to revise the whole essay.
Conclusion

The current study extends the previous literature in examining the underlying cognitive processes during L2 writing tasks as the trending issue of psycholinguistics. Knowing the cognitive processes is crucial in diagnosing the students’ difficulties in writing L2 essays as advanced technology has the potential to explore intrusively the accurate cognitive processes learners involved during writing tasks. The findings of the study support the previous literature that learners are involved in high cognitive processes as moderated by types of genres; descriptive, argumentative, or narrative. Results found that some genre types such as argumentative and narrative essays affected the students’ cognitive load as they demanded a high level of thinking and might use up the students’ resources of their working memory. Other genre types such as the descriptive essay tends not to affect students’ working memory as this genre does not demand much cognitive processes. These high cognitive loads may affect the quality of the writing output as some resources were used up by some learners and some necessary stages in writing may be left out to compensate for the difficulties learners experience. The findings of the current study indicate that the postgraduate learners engage in macro level of writing such as generating and organizing ideas, retrieving the appropriate words and expression, and thinking of a good flow from one paragraph into another and the coherence of sentences and paragraphs. This is reflected by their pauses over sentence and paragraph boundaries where they experienced difficulties in planning and organizing their ideas, thinking of how to refute the counter-balancing ideas, and keep the flow of the essay. Students did pause at the word boundary, resulting in no significant effects of the genre type over the word boundary, suggesting that students exceeded the cognitive-low level of revision and drafting, and their focus was much on the content rather than on the form.

Limitation, Implications and Tips for Future Research

Though the current study is timely and investigated a state-of-the-art issue, it cannot be free from shortcomings. First, the small number of participants which make the findings hard to be generalized
to a wider population. Future studies are recommended to recruit a high number of participants to come up with more reliable findings. Other types of genres are highly recommended to explore how students pause at other essays such as reading into writing essays and expository essays. Moreover, other data collection tools are highly advised such as eye-tracking programs to reach a more accurate interpretation to what goes in students’ minds as indicated by eye-movement. Therefore, future projects are recommended to tackle these issues when investigating underlying cognitive processes during L2 writing. The current study investigated one behaviour of writing activities, which is pause. Future studies could look for other writing behaviours such as revision and fluency. Other moderator variables would be preferably investigated by future research such as proficiency levels of learners and gender. These variables could affect the students’ cognitive processes during writing.

Pedagogically, teachers are advised to identify the students’ difficulties during writing essays, to realise what students think when they pause or delete. Instructors are also requested to identify students’ strategies during writing, and whether they adhere to all the three stages of L2 writing. To overcome pauses, students are recommended to write over the keyboards so as not to encounter technical issues during typing a response to writing prompts. Teachers were also recommended to involve students in L2 writing activities to overcome inefficiencies in writing. They are also advised to guide students to focus on a high-thinking level of writing such as organization of ideas, keeping on flow from one section to another, writing coherence, and avoiding overreaching statements.

References


Відмінність пауз студентів, які вивчають другу мову L2...


АНОТАЦІЯ

Мета. Було проведено кілька досліджень, присвячених аналізу пауз учнів під час письма на першій та / або другій мовах з метою виявлення масштабів когнітивних процесів, котрі лежать в основі навчання. У більшості досліджень вивчалися паузи учнів на пороговому рівні 200 мс. Проте мало що відомо про реєстрацію пауз студентів, які вивчають другу мову, пауз у різні час у різних жанрах. У цьому дослідженні представленні приклад вивчення когнітивних процесів студентів L2 шляхом запису їх пауз (<500 мс, <1000 мс і <2000 мс) під час письма на L2 при складанні текстів різних жанрів.

Методики і процедура дослідження. Двадцять п’ять студентів попросили написати по три есе протягом трьох тижнів, а їхнє письмові процеси записувалися за допомогою програми реєстрації натискань клавіш (Leijten & van Waes, 2013). Для тріангуляції даних використовувався лог-файл програми реєстрації натискань клавіш, графік процесу письма на різних етапах, а також візуальний відеозапис екрану під час письма.

Результати. Результати показали, що студенти робили паузи на межах речень і абзаців, і їхні паузи між абзацами були значно більшими при написанні розповідного есе, ніж при написанні аргументативного есе з інтервалами між паузами <500 і <1000 мс відповідно, і, в свою чергу, їхні паузи між реченнями в аргументативному есе були значно більшими, ніж їхні паузи в описовому есе з інтервалами <500, <1000 відповідно. Проте значних відмінностей між жанровими типами на межах слів виявлено не було.
Висновки. Це дослідження розширює попередню інформацію у вивченні когнітивних процесів, котрі лежать в основі завдань з письма на L2, що є актуальним питанням психології. Знання когнітивних процесів має вирішальне значення для діагностики труднощів студентів при написанні письмових завдань.

Оригінальність / цінність дослідження. Представлена робота є інноваційною у вивченні актуального питання і має значення для психології.

Ключові слова: паузи, жанр, письмо, когнітивні процеси, програма реєстрації натискань клавіш.

Мохсен Али Мохаммед. Отличие пауз студентов, изучающих второй язык L2, по интервалам времени в написании эссе: доказательства с помощью программы регистрации нажатия клавиш

АННОТАЦИЯ
Цель. Было проведено несколько исследований, посвященных анализу пауз учащихся во время письма на первом и/или втором языках с целью выявления масштабов когнитивных процессов, лежащих в основе обучения. В большинстве исследований изучались паузы учащихся на пороговом уровне 200 мс. Однако мало что известно о регистрации пауз студентов, изучающих второй язык L2, пауз в разное время и в разных жанрах. В данному исследовании представлен пример изучения когнитивных процессов студентов L2 путем записи их пауз (<500 мс, <1000 мс и <2000 мс) во время письма на L2 при написании текстов разных жанров.

Методики и процедура исследования. Двадцать пять студентов попросили написать три эссе в течение трех недель, а их письменные процессы записывались с помощью программы регистрации нажатий клавиш (Leijten & van Waes, 2013). Для триангуляции данных использовался лог-файл программы регистрации нажатий клавиш, график процесса письма на разных этапах, а также визуальная видеозапись экрана во время письма.

Результаты. Результаты показали, что студенты делали паузы на границах предложений и абзацев, и их паузы между абзацами были значительно выше при написании повествовательного эссе, чем при написании аргументативного эссе с интервалами между паузами <500 и <1000 мс соответственно, и, в свою очередь, их паузы между предложениями в аргументативном эссе были значительно выше, чем их паузы в описательном эссе с интервалами <500, <1000 соответственно. Однако значительных различий между жанровыми типами по границам слов обнаружено не было.

Выводы. Настоящее исследование расширяет предыдущую литературу в изучении когнитивных процессов, лежащих в основе задач по письму на L2, что является актуальным вопросом психології. Знание когнитивных процессов имеет решающее значение для диагностики трудностей учащихся
при написании эссе на L2, так как передовые технологии имеют потенциал для интрузивного исследования точных когнитивных процессов учащихся во время выполнения письменных заданий.

Оригинальность / ценность исследования. Данная работа является инновационной в изучении актуального вопроса и имеет значение для области психолингвистики.

Ключевые слова: паузы, жанр, письмо, когнитивные процессы, программа регистрации нажатий клавиш.