Understanding and Evaluating the User Interface Design for Creative Writing

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ABSTRACT

Recent decades brought us technological advances which have been able to significantly improve the writing activity. Everyone writes, and everyone has a wide variety of creative writing tools for that. In this paper, we present a study with 23 user experiences and interviews, regarding four different writing environments in a within-subject design. We obtained a deep understanding of which tool promotes higher levels of satisfaction and creativity during the process of creative writing. First, we compared the creative writing Dimensions (Serendipity, Haven, Evolution and Shuffle), combined with the Technology Acceptance Model dimensions. Through distinct evaluation methods, we discuss the results about how the usage of different creative writing environments can produce results that allow a better understanding of the user interface design process for users.

CCS CONCEPTS

• Human-centered computing - User centered design

KEYWORDS

Creative Writing tools; Human Computer Interaction; Creativity Support Tools; User Interface Design; User Experience Design.

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1 INTRODUCTION

Writing has been one of the most important developments of human civilization, but people are often unaware of how long and complicated this path has been [1]. Writing is one of the oldest and most important human activities, dating back as far as the 3200 BCE. In the beginning, writing was used in the form of pictures or convention signs. In today's schools, teachers present writing as something that has always existed [1]. Nevertheless, we never actually know how important this ancient and refined technique of expression and communication is [2,3]. However, the intensification of digital computing accelerated writing in all its forms, in our digital world 80% of our texts are created with the help of computer systems [2]. People in today's society have much easier access to reading and writing, and also creating new ways of writing such as using characters and abbreviations, reminding us of what some ancient civilizations used to do [3]. Moreover, writers still face lack of ideas, and therefore the lack of words to write [3]. Writer's block is described as a condition characterized by the inability to come up with original or novel ideas, regardless of the topic being worked on [4]. Almost everyone is familiar with writer's block and most of us have experienced it in some degree. Creative writing is an essential activity, not just in the education sector, where it is often used as a pedagogical tool to increase literacy, but also in the filmmaking, advertising, video games, broadcasting industries and in much more sectors [1]. Creative writing can be also used to build positive relationships and encourage people from all backgrounds dialogue across diverse communities. Some of the writing tools that are currently available attempt to initiate the creative process, for example by providing story prompts, while others focus on creating a distraction-free interface where writers can focus on their craft. The problem, however, there are very few studies about what make a good user interface design for creative writing, as there is no consensual approach on how to evaluate them.

In this paper we used triangulation methods [5], involving several temporal metrics, self-report and external judgments to assess satisfaction and creativity of users in four different writing environments: Microsoft Word, Scrivener, OmmWriter and Ulysses. We also explore how current tools can give us useful insights in order to develop a novel tool for supporting the creative writing process and how to help people overcome writer's block. The remaining of this paper is organized as follows: in the next section, we revise related work and then present a section describing our study. After that, we present the results with statistical support.

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Finally, we make a discussion of our results that also includes some reflections on the entire experience.

2 BACKGROUND

2.1 Creativity writing environments

Sometimes writing might not be as easy as it seems, as there are millions of subjects a writer can write about, thousands of ways to spread the same idea, hundreds of tools to use to help them write. Deciding what to write about can sometimes be surprisingly tricky. Whether you are scripting a novel or imagining a new commercial, the process of writing depends on prewriting that leads you after to a draft, and then to be revised. The work continues in the editing and finishing with a beautiful version of the main objective (a new novel, a document, etc.) [1]. However, during that process, writers often face a common problem known in this area as writer's block [1].

Writers refer to writer's block as the inability to write, despite the desire and ability to do so. There are different reasons for this situation to happen. Aspects such as stress, fear or simple problems with organization or prioritization can be the cause for it [6]. There are currently some possible solutions to this issue and each writer seems to have its own way to deal with it. Writers need to look for ways to get creative and finish their work.

Creative writing is a field that will continue to develop because it is not only related to human creativity and to the significance of words as tools of human communications, but because it celebrates individuals as well as cultures [1]. Some researchers, such as Steidle and Weirth [7] have investigated how the physical environment can improve the creative writing process. They report that messy, dark, noisy environments can actually stimulate creativity. In fact, dim lighting and darkness can encourage freedom of thought and can lead to a generation of ideas. Others researchers such as Shah et al. [8] have started to investigate creative writing with neuroscientific methods and the act of writing with some elements that characterized the process by a high hierarchical organization, and goal-directed thinking. The elements were task environment, the writer's long-term memory and the writing process. All of them combined with some techniques like brainstorming show that creative writing activated motor and visual brain areas for handwriting and additionally, cognitive and linguistic areas. Subsequently writing is often a collaborative activity and an approach to supporting creativity to encouraging awareness, for cases involving distributed collaboration activities.

Farooq et al. [9] analysed three groups collaborating on a research task in a distributed setting and identified four breakdowns in creativity: (i) Minority ideas were under-considered; (ii) Novel ideas were easily lost; (iii) There was a lack of critical evaluation of perspectives; and (iv) Reflexivity was weak during convergence [9]. More recently, Gramenos notes that (a) There is no reliable way to tell if an idea that seems to be stupid is ground breaking or actually is stupid; (b) Ignorance can be synonymous with bias-free; and (c) Nonsense is far more powerful than sense and can provide solutions to problems that logic may deem unsolvable [10]. Christiaans [11] suggest that as long as no absolute criterion of creativity exists, the assessment of creativity remains dependent on subjective judgment. He refers that design can include more objective aspects that mainly involve the functionality and technical quality of the design.

Creativity includes discovery or invention of a significant idea, pattern, method, or device that gains recognition from accepted leaders in a field [12]. Certainly, well-designed creative writing tools can help users in generating multiple levels of satisfaction, efficiency and creativity during the process of writing and tracking their creativity choices.

2.2 Dimensions for creative writing tools versus Technology Acceptance Model

Guzman et al. [13], based on user research, recognized that the activity of creative writing was based on several different aspects. They frame the results from the user research and they identified a set of design dimensions for creative writing tools: *Serendipity* (writers find inspiration everywhere and tie places and people into their work), *Evolution* (writers confront and evaluate several alternatives while writing), *Shuffle* (writers should be able to write and see their ideas in a nonlinear fashion) and *Haven* (writers need a sense of isolation and calm while writing).

The Technology Acceptance Model (TAM) attempts to predict and to explain computer-usage behaviour, offering both researchers and practitioners a direct, pragmatic instrument to measure a given technology's degree of acceptance [14]. It is simple to use, and it is a cost-effective tool for evaluating applications, reliably predicting whether they will be accepted by users [14]. Based on the framework of Campos [15], we designed our framework (Fig. 1) that is basically an extension of TAM to compare the creative writing dimensions with that model as mentioned before.

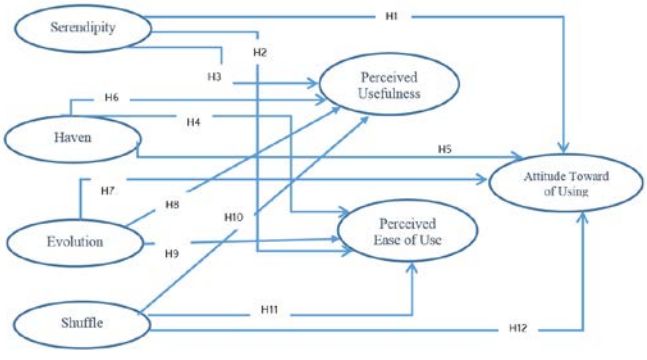

Figure 1: Hypotheses considered in our framework.

We are basically considering the influence of the different creative writing dimensions on each of the TAM's constructs: Perceived Usefulness (PU) – the extent to which the user expects the system to improve his job performance within an organizational setting; Perceived Ease of Use (PEU) – the degree to which the user believes the system's use will be free of effort and Attitude toward Using (AU) – the user's desire to use or favorableness

feelings towards using the system [14]. We employed hypotheses such as for example- H1: Serendipity influences Attitude toward of Using.

3 USER STUDY - CHALLENGE TO WRITE

We used an experimental design based on a within-subject setting to investigate the influence of different creative writing tools in the users' self-perceived satisfaction and creativity during a writing task. Since the study was geared towards understanding writing environments, as a prerequisite we recruited only participants that reportedly enjoy writing and had computer and Internet experience since our questionnaires are all online. To control for carry-over effects, the order of the conditions was counterbalanced between subjects.

3.1. Conditions

How to effectively design a usable user interface for supporting creative writing has been a challenge for UI designers. Everyone writes, and everyone has a large market of creative writing tools for that. We selected four different creative writing tools:

I) MS Word - *baseline*: One of the most used tools, Microsoft Word has a larger variety of formatting options, including a variety of colour choices, the ability to change font-weight and many other things that allows also users easy and near-instant textual input.

II) Scrivener - *many features to discover*: Users can write and perform research at the same time. It is the most popular one for professional writers. With Scrivener, writers can organize content easily but this UI can also be a way to distract or annoy users [16].

III) OmmWriter - *calm and relax environment to write*: This tool is clean and light, with music to provide inspiration to writers and a full screen mode [17].

IV) Ulysses - *concentrate and write*: Very minimalistic and focused tool can keep all writers texts neatly stuffed in its intuitive library [18].

3.2. Task

Participants had to write a specific challenge using the addressing tool. Examples of the writing challenges included: *"It was a smile that darkness could kill…*"; *"You are walking through a field with your best friend…"; "And you thought dragons didn't exist…"; "If your life was a cartoon…"*. These were conceived by one of the authors. Experts in creative writing and literature evaluated them before the experience, taking into account the degree of difficulty, in order to be as homogeneous as possible. The time was limited (5 minutes) for each writing challenge.

3.3. Participants

This experiment was conducted during two weeks and involved 23 participants (6 females and 17 males) aged between 18 and 35 years old (M=24.5; SD=5.4). They were recruited through a university-wide mailing list. We lead one session per person. All subjects were naïve to experimental conditions. All participants assumed that they write more than two hours per day.

3.4. Measures

During this study, we used the dimensions of creative writing (*Serendipity*, *Evolution*, *Shuffle* and *Haven*) to compare with the dimensions from the Technology Acceptance Model (TAM) and we made correlations with both, to determine the user's perceived satisfaction.

The survey was divided into two parts. The first part was based on the following creative writing dimensions as stated above: Serendipity, Haven, Evolution and Shuffle [14,15]. Four questions were designed for each dimension. The questions were developed by us and were based on previous studies [15]. Participants ranked a 7-point Likert with the evidence scale for 1 (not really) and 7 for (yes, very much). The second part of the survey was based in the Technology Acceptance Model (TAM) [14] with questions regarding three dimensions: Perceived Usefulness, Perceived Ease of Use and Attitude toward Using. Participants ranked a 7-point Likert with the evidence scale for 1 (not useful / disagree), 4 (neutral), 7 (very useful / agree). The questionnaire can be accessed online[2].

A reasonable statistic to measure the efficiency and making comparisons to single tools across different instances of use and to determine how efficient the tool can be, we used the number of words written and also the average word length [19].

We collected qualitative data with a semi-structured interview with questions such as: *"Did you enjoy to write in this environment?"; "This environment gave you more conditions to be more creative?"; "The writing challenge helped you initiate your writing?"; "Is there any comment would you like to add?"; "The time was limiting your creativity?"*, in order to know the participant's view about the whole experience. When analysing creativity, in this study, we used a panel of judges. External judges are also often used in creativity research to rate person's overall creativity or to rate a person's creative product [3,5].

We recruited five experts in Creative Writing, English Literature, Arts and Psychology to rate the creativity of all written data per writing challenge. They were not involved in the participatory sessions in any way and rated individually the written data by assessing a database without knowing which tool the participants had used. They were asked to provide a value ranked in a 7-point Likert with the evidence scale for 1 (not really) and 7 (very much) taking into account the three creative abilities per answer: Flexibility, Originality and Elaboration from Torrance Thinking Creative Test (TTCT) to support the evaluation [20].

3.5. Procedure

A preliminary evaluation was conducted with five participants to examine the feasibility and accuracy of the data collection and identify potential bias. They were asked to write a short story dur-

[2]https://docs.google.com/forms/d/1Y7iwsfRVPm-tkHWm166YSC_Rz4HnS291iA1uR2W_hEM/viewform

ing ten minutes using each creative writing tool. Participants reported that ten minutes was too long. It was considered the study may be conducted according the procedure but with less time for each writing challenged.

Participants were brought individually to a quiet room in our research laboratory (Fig. 2), previously prepared for the experiment. For the examination, we used two laptops computers with a screen size of 13.3 inches and a display resolution of 1920x1080 pixels.

When participants entered the room, they were asked to sit and before they started the experience, the experimenter ran the tool and asked them if they wanted to change little things in the environment, such as font size/type or something else. They had a few minutes to know each tool. We did this because we were using different tools that they could be unfamiliar with as a way to reduce bias or any aversion to a given tool. During the experiment, the participants were seated alone to eliminate any noise from the tools (some tools have background sounds) and also to not compromise the study with distractions.

When they finished the writing challenged, they were asked to fill the survey that captured the user's perceived satisfaction. Finally, participants were interviewed based on their experience using the tools.

The total time per user took over thirty minutes, it included the instructions, experiment and post-experimental semi-structured interviews. Participants were allowed to take breaks between each experimental condition.

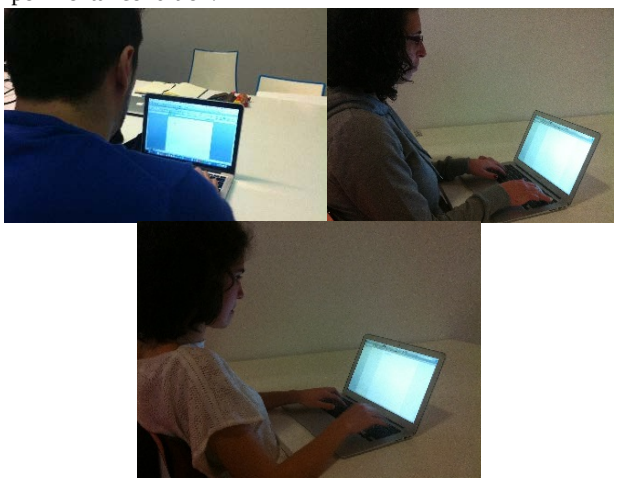

Figure 2: Performing the study in the research laboratory: Participants were seated alone in a quiet room to answer the writing challenges.

4 RESULTS

We analysed the results from a perspective that triangulates the data from the questionnaire, the statements of the interviews and the quantitative measurable information of the writing challenges. We also discuss the particularities of each participant tool to elucidate the potential design qualities of singles features from each tool. We used SPSS 22 [21] for all statistical analysis.

Which tools can promote higher levels of satisfaction?

To assess the reliability of our questionnaire we used Cronbach's alpha [22]. The polarity of the scale was taken into account. Table 1 exhibits results for reliability analyses (internal consistency) for questions in each dimension.

Table 1: Results of Cronbach's alpha.

		Cronbach's alpha
Creative writing dimensions	Serendipity	.804
	Haven	.791
	Evolution	. 777
	Shuffle	.800
TAM	Perceived Usefulness	.889
	Perceived Ease of use	.882
	Attitude Toward Using	.874

Results show that the average inter-correlation among the items as well as the number of test items can be considered consistent [22] in the scale used from the questionnaire (seven-point Likert scales). We compared the creative writing dimensions (*Serendipity, Shuffle, Haven, Evolution)* with the TAM dimensions, performing tests of correlation using Spearman's correlation coefficient [22] to verify if the creative writing dimensions influences the TAM dimensions. Table 2 shows the results regarding the correlation values we obtained between dimensions.

Table 2: Correlation between survey items

	Ulysses	Scrivener	OmmWriter	MS Word
H1	.953**	.695**	.569**	.723**
H2	.885**	.786**	.678**	.510**
H3	.823**	.599**	.704**	.738**
H4	.832**	.701**	.710**	.503**
H5	.897**	.816**	.865**	.654**
H6	.682*	.712**	.900**	.738**
H7	.891**	.628**	.805**	.719**
H8	.839**	.755**	.843**	.790**
H9	.867**	.507**	.736**	.399*
H10	.872**	.620**	.668**	.812**
H11	.760**	.541**	.532**	.717**
H12	.788**	.719**	.683**	.788**

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Results are significant and the correlation values are positive. Therefore we can assume that the hypotheses are supported. The tools were significantly related to user's perceived satisfaction as shown previously, $p<.001$. From H9, Microsoft Word was correlation-significant at $p<.005$.

Creative writing dimensions & TAM versus Conditions

Table 3 exhibits statistical results for each creative writing dimensions and TAM dimensions in each tool.

Table 3: Average (SD) for each Creative Writing Dimensions and TAM dimensions in each tool.

		Ulysses	Scrivener	OmmWriter	MS Word
Creative Writing dimensions	Serendipity	4.5 (1.33)	4.7 (1.40)	4.9 (1.19)	4.6 (1.33)
	Haven	**5.1 (1.43)**	**4.6 (1.28)**	**5.5 (1.36)**	**4.3 (1.43)**
	Evolution	**4.7 (1.49)**	**4.2 (1.37)**	**5.3 (1.28)**	**3.9 (1.37)**
	Shuffle	4.3 (1.34)	4.2 (1.49)	4.6 (1.22)	4.7 (1.49)
TAM	Perceived Usefulness	4.4 (1.68)	4.7 (1.46)	4.9 (1.57)	4.5 (1.46)
	Perceived Ease of Use	5.3 (1.57)	5.3 (1.40)	5.5 (1.34)	5.1 (1.30)
	Attitude Toward Using	4.9 (1.81)	4.9 (1.44)	5.2 (1.42)	4.8 (1.50)

Testing differences between each tool and creative writing dimensions using ANOVA with repeated measures with a Greenhouse-Geisser correction, the mean scores for *Serendipity* dimension (F (2.526, 55.563) =0.512, p>.05) and the mean scores for *Shuffle* dimension (F (2.558, 56.267) =0.845, p>.05) did not exhibit any significant differences. A repeated measures ANOVA with the Greenhouse-Geisser correction determined that mean scores for *Haven* dimension differed statistically significantly between tools (F (2.563, 56.391) =4.241, p<.05). Post hoc tests using the Bonferroni correction revealed that MS Word (M=4.3; SD=1.43) when compared with Ulysses (M=5.1; SD=1.43) was not statistically significant (p=.180). Were also not statistically significant (p=1.000) when participants used MS Word when compared with Scrivener (M=4.6; SD=1.28). However, participants when used OmmWriter (M=5.5; SD=1.36) was statistically significantly different when compared to MS Word (p<.05) and also when compared to Scrivener (p<.05). Therefore, we can conclude that participants when using OmmWritter, the tool elicits a statistically significant sense of isolation and calm while writing.

Using an ANOVA with repeated measures with a Greenhouse-Geisser correction determine that mean scores for *Evolution* dimension differed statistically significantly between tools (F (2.785, 61.267) =5.351, p<.05). Post hoc tests using Bonferroni correction revealed that participants when used MS Word (M=3.9; SD=1.37) when compared with Ulysses (M=4.7; SD=1.49) and with Scrivener (M=4.2; SD=1.37) was not statistically significant (p=.128; p=1.000, respectively). However, participants when used MS Word when compared with OmmWriter (M=5.3; SD=1.28) the difference was statistically significantly (p<0.05). Also when participants used OmmWriter when compared with Scrivener (p<.05). Therefore, we can conclude that participants when using OmmWriter, the tool elicits a statistically significant to several alternatives while writing.

When we analysed the TAM dimensions between each tool, using an ANOVA with repeated measures with a Greenhouse-Geisser correction, the mean scores for Perceived Usefulness (F (2.879, 63.334)= 0.704, p>.05) and the mean scores for Perceived Ease of use (F (2.655, 57.755)= 0.335, p>.05) and the mean scores for Attitude toward Using (F (2.815, 61.933)= 0.404, p>.05) did not exhibit any significant differences.

Triangulating the results with the interviews' statements allowed us to support that the experience and appraisal of the creative writing environments varied among participants. Some users described their experiences, usually emphasizing the tool they felt better with.

"I liked this tool because it allows us to concentrate and write freely, with this essential background environment."- [P7, Ulysses]*; "The music helped me not to be distracted."*- [P19, OmmWriter]*; "This feature with auto-correction is better because we do not waste time checking whether the text is correct or not."*- [P22, Scrivener], *"The type of letter and the self-correction feature helps the writing process"*– [P4, Scrivener]*; "Undoubtedly the full-screen in this tool allows abstraction and concentration to write"* – [P16, Ulysses]*; "This tool is good for when we already know what we want to write; this environment allows concentration"* - [P2, OmmWriter]*; "(...) music and the background can inspire you to write more and to be concentrated."*- [P8, OmmWriter]*; "(…) is the most engaging and does trigger thoughts to write without first thinking of them."* - [P6, OmmWriter].

Did the tool lead to increased output?

The results were analysed from a perspective that triangulates the amount of words written, the average word length during a fixed amount of time, and the interviews to the participants. We started counting the number of words written per participant in each tool.

Regarding the results (Table 4) obtained with the count of words written, we also considered the average word length (that gives us the mean number of characters per word) for us to have more results to be analysed [19]. Because of technical reasons on the process of saving data, we only have written data for 20 participants using the tool Ulysses. We used the Skewness and Kurtosis and Kolmogorov-Smirnov tests (p<0.05) to analyse the deviation data normality, and our sample has a deviation from normality.

Table 4: Average (SD) for amount of words written, amount words length in each tool.

	Ulysses	Scrivener	OmmWriter	MS Word
amount of words written	94.2 (45.48)	93.6 (37.93)	93.3 (47.93)	87.3 (46.80)
amount word length	522.95 (249.27)	494.45 (201.37)	516.70 (273.31)	469.30 (231.93)

Using an ANOVA with repeated measures with a Greenhouse-Geisser correction, the mean scores for amount of words written (F (2.505, 47.598) = 0.375, p>.05) and the mean scores for the average word length (F (2.323, 44.128) = 0.707, p>.05) did not exhibit any significant differences. As the results shows, we could

not find any effect that impaired the efficiency during the process of creative writing despite the use of different tools.

Which tools can promote higher levels of creativity?

From TTCT [20,23] the panel of judges took into account the definitions of flexibility, originality and elaboration to analyse the creativity of each answer in the writing challenges.

Using OmmWriter participants exhibited higher creativity scores (Table 5) than the using the other tools (MS Word, Scrivener and Ulysses). However, using Friedman's ANOVA, this difference was not found to be statistically significant (Fr (3) =2.96, p>.05).

Semi-structured interviews, conducted after the study, suggested that the participants considered that the writing challenges were the cause for triggering the writing process (34.8%), while others considered that writing challenges didn't increase the creativity levels for writing, because it limits the thinking (17.4%). On the other hand, 47.8% of the participants considered that both writing challenges and the tool makes a good trigger for the writing process. As stated in the interviews:

"The tools are engaging and the sentences are inspiring"- [P6]; "They are both useful." –user9; "The writing challenge helps, such as the environment and the relaxing music"-user15; "The writing challenges and the tool makes flow the text to write" – [P21].

Table 5: Statistics from expert rating about creativity

	Ulysses	Scrivener	OmmWriter	MS Word
Median	4.00	4.00	5.00	4.00
St. Deviation	.923	1.142	.733	.995
Mean	4.30	4.40	4.70	4.40
St. Error	.206	.255	.164	.222

Five (5 out of 23) participants said that they had a *"block in their minds"* during writing, and reported being distracted to change some features (such as font colour, type and back-ground) only after a certain time since they started to write. One participant, after starting the experience with one tool, stopped writing after one minute and a half and waited for the timeout. When we asked him why he did that, he said*: "I didn´t remember anything to write, and I lost creativity"- [P6, Scrivenner]*. He stated that it was not anything related to the tool itself, he simply couldn't find anything to write. 34.78% of the participants enjoyed writing with Scrivener.

From a qualitative perspective, 30.43% users had not realized that the time had passed when they were using the OmmWriter tool or Ulysses (26.08%). All participants did not consider the fixed time a reducer of creativity or writing. , e.g.,

"I lost track of time" – [P23]; "I was completely concentrated to write down everything that came to my mind." – [P7]; "The thoughts were falling"- [P1]; "I was oblivious to write, I enjoyed the experience"- [P3]; "The time passed quickly; I was enjoying writing"-[P22].

When asked about what made them loose track of time, participants said that it was the environment of each tool that provided them that sense. For instance: *"This environment provided a special engagement so that I could write and loose time"- [P18, OmmWriter]; "It was good to be writing with this environment and I lost track of time"-[P10, Ulysses].*

When we asked about which other features they felt that could have also influenced them, they said that it was the music and the minimalistic features. When participants were interviewed, 43.5% of them expressed genuine interest in the background soundtrack. Others assumed that the background soundtrack helped to focus initially, but then could distract them, *"although the tool allowed the flow of ideas, after some while it only distracted."[P14].*

Finally, regarding the user's intention to adopt the tools, it was clear that they demonstrated a positive attitude towards using them. 17.39% of the participants disliked MS Word.

5 DISCUSSION

In general, we could acquire that participants were excited about writing in different environments and the novelty of this type of experience might be one possible explanation. However, as they weren't familiar with all environments, the factor of novelty was facilitating to a great extent. They were concentrated on the writing moment and it was clear that all participants felt somewhat creative during the experiment.

Results show that creative writing dimensions such as *Haven* and *Evolution* had a substantially significant effect, while using the creative writing tool OmmWriter. This tool could stimulate a sense of isolation and calm in users while writing as well give them several alternatives while writing. Despite the fact that some participants didn't enjoy the feature present in OmmWriter such as the background soundtrack, most of them really liked it and expressed natural and absolute interest in this type of features. Therefore, we can assume that this particular feature can give writers the ability to make them write more and can also provide additional values.

Another interesting finding about features of creative writing environments are the minimalistic features such as the background desktop, full screen mode and auto-correction features. In the light of this finding, we believe it is important to improve design in user interfaces for writing, but taking into account this type of features.

As Norman [24], suggests, designing computer systems for people is especially difficult for a number of reasons, but the final goal is always a user interface that provides an intelligent and pleasant tool. The author also suggests that design must be considered as a whole, and not an isolated piece.

This study, despite being small, is a contribution to the field of HCI especially in the development of UI's for creative writing as suggested the use of this type of features. We could note during the experience that participants were expectant and curious to know what tools would be used, maybe because they only knew

one. In a qualitative way, we could also see them focused and in absolute concentration during the activity. According to the interviews, some participants lost track of time, others were deeply involved with the task of writing.

Csikszentmihalyi [25] defines this state of consciousness called flow as "*a state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will continue to do it even at great cost, for the sheer sake of doing it.*" Also Norman [26] states that the trick to be focused is to avoid interruptions. This was possible in our experience and supports the loss of self-consciousness as reported from our qualitative data.

According to the interviews, some participants lost track of time, others were deeply involved with the task of writing. Addition relevant findings in this experience include the fact that participants considered both writing challenges and different environments generated a good trigger for the writing process. Therefore, we observed that a feature such as "writing prompts" could be a good kick-start to the creative writing process and a useful feature that can be designed and incorporated in this type of tools.

The question we raised was: Can certain user interface features can promote higher creativity levels of satisfaction and creativity, during the process of creative writing? Our findings corroborate aspects regarding user satisfaction and leave a door open to creativity that can be extended through more research in this area.

One limitation of this study is the subjective way of measuring the creativity of the tools with a panel of judges. Despite this limitation, we didn't want to lose the opportunity to have more findings about the tools. We chose experts that have a great experience in the evaluation field in order to reduce the potential bias. We used the definitions of flexibility, originality and elaboration TTCT [20], to restrain the subjectivity.

Another limitation of this work is that we did not asses creativity with self-report scales by each user after using each tool, and we only have qualitative data about it. Our study also, does not consider the long-term usage of these specific tools. Therefore, conclusions are limited to an inchoate usage of the different creative writing user interfaces. However, this is still very useful data, since it brings new findings about creative writing user interfaces.

6 CONCLUSIONS AND FUTURE WORK

Because of today's diversity of possible technological ways to write, creative writing is a constant activity in many sectors and professions in the modern world.

In this paper we presented a novel evaluation approach that addresses the study of creative writing dimensions and evaluates how participants write using different user interfaces. We described an experience that analyses the impact of different creative writing interfaces on the satisfaction levels of participants.

This paper also presented an overview of the creative writing dimensions compared to the Technology Acceptance Model (TAM). We compared Microsoft Word (our baseline), a calming and relaxing user interface (OmmWriter), a very popular tool among professional writers (Scrivener) and a minimalistic and focused tool (Ulysses).

From a satisfaction perspective, our results suggest that for the Evolution and Haven dimensions OmmWritter was the most satisfying tool, as perceived by the users. From an efficiency perspective of creative writing, we could not find any effect that impaired or accelerated the process of writing.

In this study, we could identify some design implications for creative writing user interfaces. For instance, explicitly notifying the user of errors or exceptions that are relevant and of interest to the user through a clear feature of self-correction; feedback helps the writing process and keeping the user in the flow of his writing. Background environments and full-screen mode are important in this type of tools because they allow users to be concentrated and to be focused in the writing process.

When experiencing a moment of writer's block (or some inability to write) they can have all needed options to restart their writing. This can be made possible with the use of writing prompts or with the simplicity of a background soundtrack, which can trigger the thoughts and inspiration of users for writing or during writing. There are many aspects of this study that remain open for future investigation such as our results about creativity.

Measuring creativity is an important approach that will lead us to different impacts of specific creative writing tools. These tools can have features to increase the creativity of writers and also contribute to unblock writer's block. In future work, we think it is important to intensify the research on designing user interfaces that support creative writing and build novel tools that can be used by several people. Moreover, it will be interesting to develop new techniques to measure the creativity of the creative writing process.

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