Collaborative Writing: Online Versus Frontal

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Students in higher education, most frequently, use the frontal approach while being asked to collaborate on a writing assignment. However, the difficulty in collaborative writing using conventional technologies such as pen and paper, board or computer is the limited ability to view the work of your peers during the process (Baeker, Glass, Mitchell, & Posner, 1994).

The aim of this study was to examine the quality of an online synchronized collaboratively written academic assignment by graduate students. We used the GROOVE tools to facilitate this study. The products of the online synchronized collaboratively written assignments were compared with similar products produced in a frontal and collaborative face-to-face approach. The study examined the academic quality of the written products achieved with both collaborative methods – online versus frontal.

The qualities of the written papers were examined with an instrument called the Cognitive Level and Quality Writing Assessment (CLAQWA) (Flateby & Metzger, 2001). The instrument defines the parameters of the quality of an academic paper, which reflect the writing skills based on Bloom's taxonomy (1954). The findings of this study indicate that collaborative writing in a peer-to-peer (P2P) synchronized online environment could produce a paper of a higher quality than that produced in a P2P frontal face-to-face (F2F) environment.

Collaborative writing is widely practiced in business and academia settings. Ede and Lunsford (1990) found that subjects from varied and different areas stated that writing is *important* or *very important* for them in carrying-out successful assignments. They found that most of the writing, even at the early stage of the Internet (Net) in the 1990s, was done primarily in a collaborative manner.

The typology of every collaborative writing task (McGrath, 1984) is described in early literature as an intellective group assignment, whose main interest is finding a solution to a problem by locating the correct answer or agreed-upon formula for a defined problem. However, since then, to the best of our knowledge, no guidance was developed to address the problems that arise in the collaborative writing process. This situation has turned the process of collaborative writing into a complex task.

On the other hand, the literature dealing with the individual writer describes a large number of textual possibilities open for the individual as he or she writes. One can find in the literature numerous detailed processes and stages an individual can follow to improve his or her writing. These processes present the writer with many ideas to improve his goals, conviction, structure, and so forth (Sharples, 1993).

Collaborative writing, all the more so, generally increases the writers degree of complexity. Indeed, Galegher and Kraurt (1994) saw the process of collaborative writing as a kind of negotiation in which the peers in the group discuss the significance of the facts in the hope of arriving at a general agreement about a suitable solution to the problem at hand. However, besides general description of the nature of collaborative writing we did not find an elaborated suite of tools to better enhance the quality of a collaborative face-to-face or online synchronized writing assignment demanded from a group of students.

The current study aimed at zooming-in on the processes involved in collaborative writing using a synchronized online tool named GROOVE. Using this process, the aim was to identify patterns or characteristics embedded in online collaborative writing that might be different or unique compared to those used in face-to-face collaborative writing. This article describes the technology that facilitated the peer-to-peer online writing, presents the fine-tuning process we have employed to make use of the parameters as developed in the measuring tool – the CLAQWA, as well as the results of the experiment we have developed in order to test whether online or F2F collaborating writing is producing a better product – an academic paper of a higher quality.

COLLABORATIVE WRITING

Writing is a complex process in which the writer makes a variety of textual choices, which change during the various phases of the writing process. The definition of collaborative writing is not clear in the literature, but clearly depends on the different subject matters employing it. Generally speaking, however, one can say that in collaborative writing the writer combines the complexity of the individual writing processes and the collaborative processes, which increases the complexity of the different components of

the collaborative endeavor. The complexity of collaborative writing assumes greater proportions as a result of the need to reach a coherent written product, which is agreed upon by all members of the group (Sharples, 1993; Sapp & Simon, 2005). Negotiations take place in the collaborative writing process regarding the significance of facts and brainstorming takes place until a coherent solution to the problem is accepted by all the peers (Galegher & Kraut, 1994; Baecker, Glass, Mitchell, & Posner, 1994).

Posner and Baecker (1992) described the writing strategies involved in collaborative writing. They divided them into four categories: (a) tasks, (b) activities, (c) text control, and (d) writing strategy and found that there are groups which blend a number of strategies during the process of collaborative writing.

1. Tasks – Each group member has an assignment which raises his status in the group. The following tasks are expressed in collaborative writing: the writer, the advisor, the editor, and the proofreader.

2. Activities – A broad range of activities take place in collaborative writing, such as brainstorming, initial planning, final editing, and proofreading.

3. Text control – A broad range of text control methods are employed, such as the centralized method, in which one member controls the text throughout the writing process; the collaborative process, in which each member has equal access to the text at all times; the conservative method, in which one member has control of the text from time to time, but the control moves from member to member, so that all members have control at some point during the process; the independent method, in which each member works separately on a specific part of the text throughout the process.

4. Writing strategy – The group formulates the text in different ways during the collaborative writing process, for example: a single writer, separate writers, and writing together.

Similarly, collaborative writing probably includes different styles which are influenced by the nature of the assignment and by the personalities of the group members. Accordingly we can assume why it has been so difficult to develop technology-based environments with tools that could support these processes, strategies, and styles.

Technology-Based Collaborative Writing

Over the last decade, a number of researchers have examined various aspects of collaborative writing (Posner & Baecker, 1992; Chen, 1997; Sjoerd, 1995; Galegher & Kraut, 1994; Cerratto & Rodriquez, 2002) in order to develop computerized tools to support the complex nature of collaborative writing. They examined the nature of collaborative writing on a computer in

comparison to that of pen and paper and found a great difference between the two forms. The findings show that pen and paper writing is generally more linear, its initial stage is brainstorming and progresses with the crystallizing of an idea. Thereafter, comes a stage in which a first draft is written, which is followed by a variety of different versions.

On the other hand, these studies indicate that computerized collaborative writing is more integrative and coherent. The findings indicate that when the group members write down their ideas while creating a first draft they tend to be faster in reaching a compromise on their positions and their opinions. As a result, the group solidifies and formulates its document earlier than do groups which collaborate face-to-face by pen and paper writing (Goldberg, Russell, & Cook, 2003).

Online Writing Environments

Computerized writing environments that were developed to date can be put into four main categories: (a) E-mail back and forth messages; (b) written discussions through the Instant Messengers programs (IMs), such as ICQ; (c) joint schedule coordination through online calendars; and (d) shared editing tools, such as GROOVE (Sjoerd, 1995, Chen, 1997). E-mail is still considered to be the most widespread asynchronous collaborative way of writing. Its efficiency expresses itself primarily when two or three colleagues want to edit some text. However, when more colleagues join in to do some editing tasks, the collaborative writing process becomes cumbersome, mainly because of the difficulty to follow all the changes made.

Collaborative writing technologies of the fourth category are the most challenging to develop. The most difficult feature is text control that could enable a large group of participants to view and edit simultaneously large bodies of text. With this challenge in mind, the GROOVE has been designed and developed (Udell, 2000). The program that can be downloaded and installed generates a shared space which serves as a private online work environment to which colleagues are invited to share information. The shared space enables all the online participants, among other shared tools, to process and edit text in an interactive, synchronic way. Following is a brief description of the inner working of shared spaces.

GROOVE

The Groove's online work environment offers broad possibilities to collaborate in a range of applications and on different synchronous levels. The environment is based on the concept of a virtual computer, which is open to participants for a given assignment. They can all carry out the assignment together or, if they wish, each one can add or erase material at his/her leisure in such a way that all the participants will be able to identify who added or erased

which material, and at what time. There are many collaborative possibilities, and Groove's developers (www.groove.net) are continuing to improve the environment according to the feedback they receive from users. The possibilities include sending private or general messages, adding files, and sending e-mail messages. The documents are saved in a shared space, where each participant has equal control over the text, and can enter it at his/her own time to make changes, even if he/she isn't connected to the Net. The files are updated in the shared space when the participant goes online. At that point everyone in the group can see the changes he/she has made and can add comments and corrections of their own. The program makes a repository available for collaborative materials. It also makes it possible to conduct a discussion or brainstorming session between the colleagues in real time, when all of them are editing their materials with the help of a number of tools. One is by using a chat tool, in which conversation is saved as discussion minutes. Another is a microphone that facilitates auditory conversations while working on a document. Above all, it shares Microsoft Office tools which make it possible to do synchronic and asynchronic editing of Excel, Word, and Power Point screens.

The Groove environment also enables collaborative activities, including peer surfing on the Net, where all colleagues can lead the others in group browsing, building a library of favorites, and building a joint reservoir of relevant sources for the group's work.
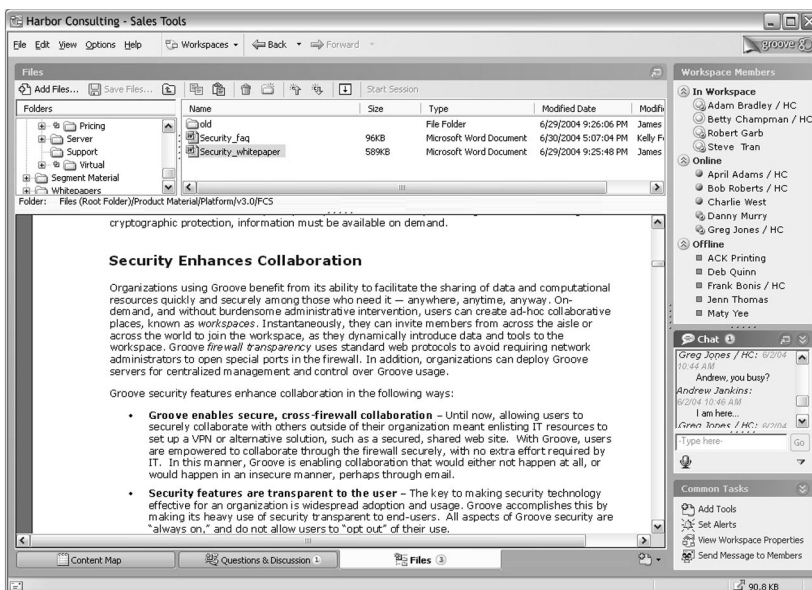
Figure 1. A typical screen of Groove

In this study we examined the quality of the collaborative written product, which was drafted by peers with the help of the collaborative virtual space that Groove enabled. We compared it to a written product, which was drafted and edited in a face-to-face setting. We examined the quality of an academic paper as being drafted by graduate students.

RESEARCH TOOLS

We tested the quality of a written assignment with the help of the tool, Cognitive Level and Quality Writing Assessment Instrument (CLAQWA). The tool was developed by Flateby and Metzger (2001), who report that it helps them evaluate academic written products and instruct students in writing courses. The tool details the necessary criteria for high quality writing and is divided into two scales:

1. **The scale for measuring writing quality.** This scale examines writing skills, and is divided into six parameters which detail the 21 writing skills demanded. According to those parameters the writer is guided on exactly how to draft a coherent written product to be well organized and clear to the reader. The quality of the written product is measured according to these skills.

2. **The scale for evaluating cognitive level.** The second scale was built in such a way that the cognitive level of the written product can be evaluated in accordance with the demands of the assignment, and according to four levels of writing: (a) knowledgeable, (b) comprehensible, (c) applicable, and (d) analytical.

Defining the goal of the assignment determines the value of each parameter and its importance to the written product. The two evaluation scales enable the instrument to serve as an instruction tool, as well. They allow the teacher to locate weak points in the way the student writes and guide him/her in improving written skills and raising their level.

In addition to being an instrument for instruction and evaluation, the CLAQWA can serve as an analytical scale solely for evaluation and grading, with no need for instruction or for guidance defined in advance. In such a situation each parameter receives a grade in accordance with the demands which are defined at the time when the assignment is given.

PARTICIPANTS

To examine the variables of this study – peer-to-peer (P2P) online collaborative writing versus face-to-face (F2F) collaborative writing – we selected peers whose writing level were assumed to be high, and whose experience in Information & Communications Technology (ICT) was also

above average. The participants' characteristics were as follows:

- the subjects were graduate students in ICT and Education;
- they participated in a graduate course the subject of which was the Future of ICT in Education;
- they were students exempted from a basic course in multimedia (MM) on the basis of an exam, which tested their advanced knowledge in a variety of MM tools;
- the language used for the assignment was their mother-tongue;
- all the students used their personal computers at home;
- the hardware and software demands were high enough to enable the subjects to install the Groove program with as few problems as possible;
- all the students had broadband access at home;
- all the students were highly skilled in the use of e-mail. Most of the coordination done with all the groups was carried out through e-mail;
- the students chose their peers voluntarily;
- each group consisted of 2-3 students; and
- the same members were in both collaborative writing groups – online P2P and F2F.

To determine if the online environment affected the quality of writing, we had each group prepare two articles, one F2F and one online. Half of the groups began to write their first assignment F2F and then online, while the second half vice versa.

The groups negotiated their writing process in similar ways. They both received background materials to read. They were asked to browse for other relevant materials either from the internet or from other offline resources and share them with their peers through their assigned framework – online P2P or F2F. They were asked then to negotiate its relevancy and discuss the correct strategy and main idea for their writing assignments. After doing so, they were constructed to draft their articles together.

Table 1
Participants

	Students	Groups
Face-to-face groups	21	10
Online groups	21	10
Total	**42**	**20**

PARAMETERS

For the purpose of this study we tested the quality of the papers according to the first scale of the CLAQWA instrument only. The authors (Flateby & Metzger, 2001) of the tool claim the two scales can be used separately since they are not entangled. The first scale is built of the following six parameters: (a) quality of the task, (b) integrity of the structure, (c) appropriateness of the language to the target population, (d) conclusions and focus, (e) grammar and technical editing, and (f) miscellaneous. In these six parameters there are 21 writing skills which were the independent variables we examined. In this study, as opposed to the original procedure of the instrument, we quantified the evaluation of the judges. Each item received a maximum of five points and a minimum of one point. An irrelevant item was coded as zero points (Table 2).

To verify that no distortion of the results was subjectively embedded in the grading process, we asked a second examiner to test two papers of one group randomly chosen to verify the researchers' objectivity in assigning fair grades. One paper was written in F2F collaboration, and the other in collaboration using the Groove program. No significant differences were found in the six categories which measured the quality of the academic assignment. The six categories that were measured were as follows:

1. *Quality of the assignment*

Quality of the assignment: The students in this study were told to write a paper, which presents a future technology to a defined audience, describing it, explaining its possible applications, defining its current stage of development, and presenting its advantages and disadvantages.

Table 2
Example of a Grading Page Which the Examiners
Filled Out for Each Paper They Read

1. Quality Parameter						
5 **Very** **relevant**	**4**	**3**	**2**	**1** **Slightly** **relevant**	**0** **Irrelevant**	**1. The quality of** **the assignment**
						The paper satisfies the demands of the assignment
						The paper has a central idea
						The paper's target audience is addressed
						1.4 The writers' intention is clear

Central idea: The central idea must relate directly or indirectly to the future technology that was chosen.

Target audience: In this study the target audience was defined as the readers of an electronics magazine devoted to the topics of future technologies and their impact on social processes. This e-zine is delivered monthly to a mailing-list of technology oriented people interested in issues of future technologies.

The writers' intention: In line with the topic and the goals, the writers must explain, present, analyze, compare, and convince the reader about the pro or cons of the technology they have chosen to write about.

2. *Structural integrity*

Opening: The students were told to write a preface which briefly and clearly presents the topics discussed in the paper.

Quantity of items: The number of conjunctions, expressions, phrases, sentences, and paragraphs in each paper were counted.

Transitions between paragraphs: The number of paragraph transitions was counted which made the central ideas cohesive, clear, and smooth.

Summary: Each paper was examined to see if there was a summary of some kind, and what extent it contributed to the clarification of the paper's message.

3. *Contextual language and audience appropriateness*

The choice of words for the reading audience: The style and choice of words, and its connection to the content were examined to see to what degree they were appropriate to the target audience of those for whom the paper was written.

The degree of clarity of ideas: The clarity in which the ideas were formulated and the way in which they were presented in the text was evaluated.

A worthy and/or varied sentence structure: We examined the sentence structure according to grammatical measures as well as the variety of sentences used to describe the idea.

Point of view: We examined the writers' point of view, the degree of their objectivity or subjectivity, and their attitude toward the central topic.

4. *Consistence in reasoning and focus*

Conclusions: This measure belongs to the high cognitive level of the writing, and generally stands out at the end of the paper. There are writers who reach conclusions at the end of a paragraph and sum up with a subtopic, which supports the central idea presented in the paper.

Number of facts for the development of the central idea: The ideas which supported and developed the paper's central theme were counted. The facts were counted regardless of their quality.

The quality of the facts which develop the central idea: The general picture which stems from the facts, was evaluated according to a number of parameters. First, the qualities of the facts were evaluated. Second, the way in which they supported the presentation of the central idea was evaluated. Finally, we evaluated the kind of description used, and the degree to which each fact was developed in relation to the central idea.

5. *Grammar mechanics of standard editing*
Sentence structure: Short, noncomplex sentences are considered to be of a lower cognitive level than complex sentences rich in conjunctions and phrases. Therefore, conjunctions and phrases were counted.

Paragraphing errors (mechanical): The number of times spelling mistakes and typographical errors appeared were also counted.

6. *Miscellaneous*
Originality: The level of originality on which the topic of the paper is presented was evaluated, as well as the general impression of originality in the choice of topic.

Sources: We counted the sources of information on which the paper is based, for example, quotes and references, as is expected in academic writing.

Intellectual maturity: On this parameter the examiner is required to give a general grade based on his or her impression of the paper's intellectual maturity, general impression, and his or her impression of all the parameters of writing as a whole.

Other special criteria of the assignment: The last measure was a count of the quantity and quality of the links to additional resources provided by the writers, such as the number of illustrations which helped make for clear concretization of the article.

GRADING METHOD

The original instrument (CLAQWA) did not include a quantitative grading method for evaluation of the items in each parameter. For that reason we decided it would be the correct thing to do to develop a grading system for the purpose of this study, which would enable us to make a clear and simple comparison of the collaboratively written products which were organized online, as opposed to those organized F2F. Thus, every item was evaluated

equally, with the help of five points, as shown in Table 1. The total number of criteria in collaborative writing in the Groove program was 21, so that the highest score a student could receive was 105 points, or 100%, as opposed to F2F collaborative writing, which had 20 criteria and therefore a maximum score of 100 points, or 100%.

Results

1. *Quality of the assignment*

The research hypothesis was that students who manage a collaborative process of writing of an academic paper through Groove will produce a written product of higher quality than that produced by a F2F collaborative writing (Table 3).

The results indicate that a paper drafted through Groove led to a product of a higher quality in all the four items measured. We can attribute these findings to several reasons:

- questions such as choice of words and expressions in the context of the central idea are sharpened in the online collaborative process of writing;
- the need, on one hand, to be coherent, and on the other to be concise, creates a complex process in the choices of the writers in the online environment; and
- the writers online are able to see the changes made in the text, and to relate simultaneously to the comments and ideas of their colleagues,

Table 3

Mean and Standard Deviation of the Items in the Parameter of the "Quality of the Assignment" – Online Versus F2F Collaborative Writing

T(P)	F2F Collaborative writing		Online Collaborative writing		1. Quality of the assignment
	SD	Mean	SD	Mean	
2.47*	1.11	3.25	0.85	4.40	The paper satisfies the demands of the assignment
2.06*	1.53	3.30	0.83	4.45	The paper has a central idea
3.53**	1.55	3.00	0.43	4.75	The paper's target audience is addressed
2.85*	1.47	2.90	0.84	4.40	1.4 The writers' intention is clear
$P<0.001$*** $P<0.01$** $P<0.05$*					

therefore creating the need to be clear and concise. Writing in the Groove program requires each participant to track the changes made by the colleague whose turn it is to be editor, so that following the changes as they are made, it becomes possible for each colleague to focus on the written content; something which enables the adding-on of comments, correction of mistakes, improvement of formulation, as well as other changes.

It is important to clarify that each student in both groups – online versus F2F – were required to be prepared and well versed in the materials on which the groups were asked to write a paper.

2. *Structural integrity*

The second hypothesis was that students who conducted collaborative writing with the help of the Groove program would produce a more focused and clearer written product, with greater structural integrity than the written products of the F2F group (Table 4).

The results indicate that writing with the Groove program requires the writers to be more focused on their assignment, and significantly reduces the possibility of dealing with matters which are not connected with its carrying-out. While observing the work of the F2F groups in class, one could distinguish between the groups in which some of the students were working on the assignment, while others were busy with nonrelated issues that did not contribute to its completion. It is important to point out that the work in the shared online space demanded different rules and norms from those opera-

Table 4

Mean and Standard Deviation of the Items in the Parameter of
"Structural-Integrity"

T(P)	F2F Collaborative writing		Online Collaborative writing		2. Structural Integrity
	SD	Mean	SD	Mean	
*2.15	1.67	2.75	1.16	4.05	2.1 Degree of support of the central idea by the opening paragraph
*2.30	1.18	3.00	0.88	4.15	2.2 The way conjunctions, sentences and expressions are used
1.30	1.80	3.05	1.26	4.10	2.3 Transitions between paragraphs
*2.65	1.70	2.45	1.00	4.25	2.4 Way of summing up the topic
$P<0.001$*** $P<0.01$** $P<0.05$*					

tive in a frontal meeting. The online group organizes its own norms of operation, for example: Who leads the editing, when to request permission to edit, meeting deadlines, and so forth.

3. *Matching language to the target audience*

The third hypothesis was that students who conducted collaborative writing within the Groove program would produce written products which were clearer and more appropriate to their target audience than those produced by collaborative face to face writing (Table 5).

The students in this study were required to match the language of their written product to fit an audience of academic readers interested in future technologies. They were, therefore, asked to choose words and sentences appropriate to an audience of this sort. Similarly, they were asked to develop their central idea so that it would clearly represent their points of view. The results indicate that the online products matched the language level of the target audience more closely, and the clarity of the ideas was on a higher level than that of the face-to-face products.

4. *Conclusions and focus*

The fourth hypothesis was that students who conducted their collaborative writing within the Groove program would produce more focused written products, and that their conclusions would be better supported by their central idea, and would be more precise and clearer than the collaboratively written products conducted face-to-face (Table 6).

Table 5
Mean and Standard Deviation of the Items in the Parameter of
"Matching Language to Target Audience"

T(P)	F2F Collaborative writing		Online Collaborative writing		3. Matching language to target audience
	SD	Mean	SD	Mean	
4.62**	0.80	3.45	0.42	4.75	3.1 Choice of word matching target audience
2.82*	1.62	2.70	0.69	4.40	3.2 Clarity and comprehensibility of ideas
3.33**	1.16	3.30	0.42	4.70	3.3 Variety and appropriate
4.32**	1.32	2.95	0.35	4.75	3.4 Clarity of point of view
$P<0.001$*** $P<0.01$** $P<0.05$*					

Table 6
Mean and Standard Deviation of the Items in the Parameter of
"Conclusions and Focus"

T(P)	F2F Collaborative writing		Online Collaborative writing		4. Conclusions & focus
	SD	Mean	SD	Mean	
3.16* tral idea	1.63	2.40	0.68	4.45	4.1 Reaching conclusions supporting the cen-
2.61*	1.27	3.00	0.81	4.40	4.2 Quality of details for developing the central idea
3.44**	1.25	3.35	0.35	4.75	4.3 Quantity of details for developing the central idea
*P<0.001*** P<0.01** P<0.05**					

The central idea is the heart of any written product. The quality and quantity of the details brought forth in the article to support the central idea help to develop the central idea, to focus and clarify it, and make it possible to arrive at more accurate conclusions. One can see from the findings of our study that collaborative writing using the Groove program had a significantly higher score in these parameters than did collaborative writing carried out-face-to face.

5. *Grammar and standard editing*

The fifth hypothesis was that students who conducted their collaborative writing within the Groove program would produce a written product on higher grammatical and linguistic levels (Table 7).

Table 7
Mean and Standard Deviation of the Items in the Parameter of
"Grammar and Standard Editing"

T(P)	F2F Collaborative writing		Online Collaborative writing		5. Grammar & standard editing
	SD	Mean	SD	Mean	
0.17	0.65	4.40	0.67	4.35	5.1 Sentence structure from a grammatical point of view
1.50	1.33	3.70	0.65	4.41	5.2 Sentence structure from a mechanical point of view
*P<0.001*** P<0.01** P<0.05**					

Table 8
Mean and Standard Deviation of the Items in the Parameter of
"Miscellaneous"

T(P)	F2F Collaborative writing		Online Collaborative writing		5. Miscellaneous
	SD	Mean	SD	Mean	
6.00***	0.94	3.00	0.50	4.60	6.1 Originality
3.07*	1.63	1.00	2.04	3.70	6.2 Sources and quotes
8.18***	0.71	3.25	0.35	4.80	6.3 Intellectual maturity
---	---	---	2.01	3.70	6.4 Additional criteria
$P<0.001$*** $P<0.01$** $P<0.05$*					

These results can be attributed to the criteria used in choosing the students in this study. All the students were graduate students who have demonstrated through their studies, above average cognitive skills, as well as above average abilities in using their native language.

The absence of differences in the parameters of grammar and language indicates homogeneity in the language characteristics of the participants in this study – a point which underlines and strengthens the fact that differences were measured in the other parameters of this study.

6. *Miscellaneous*

The last point we examined was that which dealt with the things defined as miscellaneous in the Groove environment. Here, also, the results reflect what we found in the parameters we reviewed above. We found that online collaborative writing generates a product of higher quality than a product of collaborative writing done face-to-face (Table 8).

SUMMARY OF RESULTS

The results of this study reveal that in most of the parameters the products of collaborative writing using the Groove program were of a higher quality than the collaborative writing managed face-to-face. This is despite the technical glitches which accompanied the process of successfully installing and smoothly running the Groove application in a variety of home computers with a variety of hardware capabilities and operating systems configurations. Nonetheless, no significant differences were found in the parameters that tested transitions between paragraphs (item 2.3), quantity of items (item 4.3), grammar (item 5.4) or paragraphing (item 5.2). This clear-

ly indicates the homogeneity within the research populations and it suggests further reliability to the other measures. Very clear differences, however, were found in the items of intellectual maturity (item 6.3) and originality (item 6.1), which might suggest that the online experiences have generated the best out of the same students.

Discussion

The findings of this study indicate that the products of collaborative writing managed through the Groove synchronized environment are of significantly higher quality than the products of collaborative writing managed face-to-face. Most of the research done to date, to the best of our knowledge, that examined the quality of collaborative writing has not verified the depth of the written product as we have intended to do in this study. The results of most of these studies (Cerrato & Rodriquez, 2002; Galegher & Kraut, 1994) pointed out that in the process of collaborative writing the colleagues advance in three significant stages: The brainstorming stage, the negotiating stage of the text components, and the crystallization and formulation stage of the actual writing. It appears that in an online collaborative writing experience, these stages are managed more efficiently and quickly than in a face-to-face collaborative writing experience. It seems that the technology enables all the colleagues to see the text at the same time, to read it, and to take an active part in the process of writing and editing the assignment. It appears that this advantage gives the colleagues the possibility of creating a more focused text, and to reach more firmly based conclusions without the need of wearying negotiation. When the writing is synchronized online, the writers search for solutions which are acceptable to all the group's members without exception. They tend to write many drafts, more than in F2F, and look for the most fitting and accepted draft, which promises a coherent result (Mc Garth, 1984; Galegher & Kraut, 1994).

The measure in which the difference was the most significant was the item "summary" in the second parameter – structural integrity (item 2.4). This reflects similar findings in the literature. Studies which focused on collaborative writing styles found that people using the computer for writing (in an asynchronous manner such as fetching drafts through e-mail) produce many more drafts until an agreed upon draft is achieved. As a result, they produce a document with a higher level of structural integrity (Goldberg, Russell, & Cook, 2003). The literature about collaborative writing to date, to the best of our knowledge, has not addressed the "summary" as an important component in the cohesiveness of the collaborative product. It may be assumed that in writing many drafts, and searching for an accepted version of a draft, the writers are more careful in writing all the parts of the article, including the summary. It is possible that there is a correlation between writing a few drafts and the degree of care in writing the summary.

In this study we did not examine the process of adopting the technology employed. Nonetheless, it would appear that the study provided a surprising revelation. Various studies that examined the adaptation of new technologies found that the participants invested a great deal of effort and time in getting acquainted with the new tools. As a result, the products were often of lesser quality (Cerrato & Rodriguez, 2002). The participants in various studies who had to learn how to use new tools and accustom themselves to new and unfamiliar norms of work invested much time in learning the technology and less in using it to carry out the assignment. These studies found that adopting a new technology is usually accompanied by difficulties and by antagonism to the new tool, and sometimes it damages the quality of the product (Levitt & Mahowland, 2002).

However, in our study, even though we introduced a new tool and the process of adopting it was accompanied by similar difficulties reflecting the installation of a hardware demanding program on a variety of desktop configurations. The results indicate that a relatively better quality of writing was achieved in comparison to other studies in which a new technology was adopted (Levitt & Mahowald, 2002). This can be related to the advantages especially inherent in Groove – its interesting concept of collaboration and its clear interface, and primarily because of the technologically advanced background of the participants in this specific study.

CONCLUDING NOTE

It should have been expected that the written products of collaborative writing managed face-to-face will always be of better quality than what a synthetic environment can make possible. A considerable number of people still hold the opinion that technology will never be able to surpass the level of achievement of collaborative writing in which personal, unobstructed human contact is the environment in which the work is better done. This study investigated the issue on which there is a serious argument still going on among educators. The technologies, which are constantly being developed provide possibilities, which have as yet not been considered, and the findings of the current study suggest that it is still not clear what the advantages of the technology will be and whether it will be smarter and simple. This study should give educators a reason to claim that technology can bring us a potential greater than we have ever imagined.

References

Bloom, B. S. (1954). *Taxonomy of educational objectives: The classification of educational goals, handbook 1: Cognitive domain.* New York: McKay.

Chen, C. (1997). Writing with collaborative hypertext: Analysis and modeling. *Journal of American Society for Information Science, 48*(11), 1046-1066.

Cerratto, T., & Rodriguez, H. (2002). Studies of computer supported collaborative writing implications for system design. In K. Schmidt (Ed.) *Cooperative system design* (pp. 139-154). Amsterdam: IOS Press.

Ede, L., & Lunsford, A. (1990). *Singular text plural authors: Perspectives on collaborative writing.* Carbondale, IL: Southern Illinois University Press.

Flateby, T. L., & Metzger, E. (2001). *Cognitive level and quality writing assessment instrument.* Retrieved March 20, 2007, from http://usfweb2.usf.edu/eval/claqwa/

Galegher, J., & Kraut, R. E. (1994). Computer-mediated communication for intellectual teamwork: An experiment in group writing. *Information System Research, 5*(2), 110-138.

Goldberg, A., Russell, M., & Cook, A. (2003). The effect of computers on student writing: A meta-analysis of studies from 1992 to 2002. *Journal of Technology Learning and Assessment (JTLA), 2* (1), 1-52. Retrieved March 20, 2007 from http://escholarship.bc.edu/jtla/vol2/1/

Levitt, M., & Mahowald, R. P. (2002). *There should be more to collaboration than e-mail.* An IDC white paper. Retrieved March 20, 2007, from http://www.groove.net/pdf/idc-collaboration.pdf

McGrath, J. E. (1984). A typology of tasks. In R.M. Baecker (Ed.), *Readings in groupware and computer-supported cooperative work, assisting human-human collaboration* (pp. 165-168). Englewood Cliffs, NJ: Morgan Kaufmann 165-168.

Posner, I. R., & Baecker, R. M. (1992). How people write together. *Proceedings of the 25th Hawaii International Conference on System Sciences, IV,* (pp. 127-138). Retrieved March 20, 2007 from http://kmdi.utoronto.ca/rmb/papers/D26.pdf

Sapp, D.A., & Simon, J. (2005). Comparing grades in online and face-to-face writing courses: Interpersonal accountability and institutional commitment. *Computers and Composition, 22*(4) 471-489.

Sharples, M., Goodlet, J. S., Beck, E. E., Wood, C. C., Easterbrook, S. M., & Plowman, L. (1993). Research issues in the study of computer supported collaborative writing. In M. Sharples (Ed.), *Computer supported collaborative writing* (pp. 9-28). London: Springer-Verlag.

Sjoerd, M. (1995). *Human-computer interaction in a computer supported collaborative writing environment.* Extract from Co-writing, look, and feel! Unpublished master's thesis, Tilburg University, The Netherlands.

Udell, J. (2000, October). *How Ray Ozzie got his Groove back.* Retrieved March 20, 2007, from http://www.openp2p.com/pub/a/p2p/2000/10/24/ozzie_interview.html

Note

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