Evaluating the Use of Groupware Technologies in Support of Collaborative Learning in an ESP Tertiary Education Course

Aekaterini Mavri[1(✉)] and Stavroula Hadjiconstantinou[2]

[1] Cyprus Interaction Lab, Department of Multimedia and Graphic Arts, Cyprus University of Technology, 30 Archbishop Kyprianou Str. 3036, Limassol, Cyprus
aekaterini.mavri@cut.ac.cy
[2] Language Centre, Department of Multimedia and Graphic Arts, Cyprus University of Technology, 30 Archbishop Kyprianou Str. 3036, Limassol, Cyprus
s.hadjiconstantinou@cut.ac.cy

Abstract. ESP (English for specific purposes) refers to English teaching and learning with a strong emphasis on discipline-specific competencies and skills. Collaboration provides key benefits in ESP education, in terms of stronger linguistic gains and better written artefacts. Dedicated learning platforms as well as knowledge management and social networking tools, have become central in supporting collaboration in educational settings, yet sufficient evidence of their in-depth contribution and usability, with regards to ESP, is limited.

This study seeks to evaluate the perceived usability of two web-based collaborative learning and productivity platforms: (a) Moodle Elgg and (b) Google Drive, Docs & Hangouts, as well as investigate their distinct pedagogical impact on the students' perceived learning.

Results indicate that the affordances of each tool are accountable for the type and extend of activities performed within them, and - consequently – the respective learning outcomes achieved. Significant differences were recorded between the tools and the outcomes render Google Drive as a more appropriate option than Moodle Elgg for the ESP requirements in this study.

Keywords: Collaborative learning · Groupware · Usability · Courseware
Shared workspaces

1 Introduction

The present study seeks to evaluate the usability and suitability of two online collaborative learning and productivity platforms, as well as investigate their pedagogical impact in terms of the students' perceived learning outcomes within the context of an ESP (English for specific purposes) course in higher education. ESP refers to English teaching and learning with a strong emphasis on discipline-specific competencies and skills, whether these relate to the particular field of studies or workplace setting [1]. It seeks to motivate learners to self-direct their studies according to their needs and

P. Zaphiris and A. Ioannou (Eds.): LCT 2018, LNCS 10924, pp. 446–465, 2018.
https://doi.org/10.1007/978-3-319-91743-6_33

goals, through purpose-related, in-and-out of class activities, which are methodically planned by educators and instructional designers, as part of a learner-centered approach.

Over the past few years, higher education has generated a great demand for technological tools that can sustain such a shift, from the traditional "teacher-centered" to more student-oriented, "inquiry-based" pedagogy [2]. According to this, learners are expected to take control of their knowledge management, through information capturing, sharing and transferring, as well as develop work artefacts in collaboration with their peers. Collaborative learning, through the use of dedicated, web-based educational platforms has proven to benefit learners in terms of enhanced knowledge acquisition and better interpersonal skills development [2]. Students are able to maximize their learning and reach higher accomplishments, by sharing perspectives and through collective knowledge scaffolding [3]. Collaboration, in the context of English as a foreign Language has been shown to steer motivation and active student participation, benefit learners in achieving a "better vocabulary gain" [4] and enable them to produce better written constructs [5].

In support of collaborative learning, inclusive web-based Course Management Systems (CMS) and Learning Management Systems (LMS), such as Blackboard and Moodle, have emerged over the last two decades [6] and became central for the dissemination of learning materials, student collaboration (embedded wikis and forums), and assessment. Moreover, there is increasing interest in the use of commercial knowledge-management, productivity, blogging and social networking products such as DropBox, Google Docs, WordPress and Facebook, in order to cater for such educational practices [7] as well as benefit from the enhanced communicative features provided [8].

However, sufficient evidence about these tools' role and contribution in pedagogical practices as well as their level of usability, when compared to traditional LMSs, for foreign language education and especially ESP, is limited. We do not currently know how the particular user activities, behaviors and interactions, based on the capabilities and behavior of different environments, may impact the students' experience and their specific knowledge outcomes within this context.

This study incorporates two types of web applications, Moodle, a prevalent traditional e-learning platform and Google Drive, a commercial groupware product, in an undergraduate ESP course. In doing so it seeks to investigate their distinct implications on student experience and learning performance. More specifically, two groups of students are asked to use either Moodle Elgg, Moodle's social learning platform or a combination of Google's Drive, Docs and Hangouts to collectively gather, organize material and collaborate in co-authoring an article on a pre-assigned topic. We asked students to (a) evaluate the perceived usability and suitability of the tools in performing required collaborative activities within the context of ESP and (b) report on the perceived pedagogical impact of these tools on their knowledge development outcomes in regards to linguistic competencies, critical thinking and collaborative article writing.

The next section begins with an overview of studies concerning relate to educational approaches followed by usability evaluation guidelines and practices. Then we proceed by an outline of the design and research methodology used in the study. The analysis section then looks at the two main areas of research interest, the usability and

suitability of the tools for this study, as well as their impact on the students' learning performance, followed by an overview and discussion of the findings, as well as a final report of the study's results, limitations and future work prospects.

2 Related Work

2.1 English for Specific Purposes (ESP) Approach

The term English for Specific Purposes (ESP) has been in use since at least the mid-1980s to describe a learner-centered branch of ESL/EFL (English as a Second/Foreign Language) that caters for the study- or work-related needs of individuals which are not properly attended to by General English [9]. It can be characterized, amongst other things, by curriculum development based on the target-situation needs and wants of stakeholders, by a focus on specialized vocabulary and authentic materials as well by as a strong emphasis on learner autonomy [10]. Self-direction is sustained through specially-designed purpose-related activities in the classroom, in which learners, aware of the demands placed on them, assume responsibility for their learning. From an instructional point of view, the analysis of needs of learners in specific contexts especially in higher education is a key process of the ESP approach and so educators and course designers always make decisions on content, material and activities based on these needs.

In line with the principles behind the ESP approach, the courses offered to the students in tertiary education are especially designed based on those skills that are considered essential for individuals in each discipline. Language competence, critical thinking and ICT skills are among the most important. The English for Media and Communication Studies course - under investigation in this study - is organized around the kinds of tasks that students in the areas of Communication and Media would be expected to perform as part of their future academic or professional engagements.

2.2 Critical Media Literacy Skills

Periodic evaluation of the course including detailed needs analysis has highlighted a certain type of skills, directly related to the field of Communication and particularly important for future professionals in this field, which could have been more adequately covered in the curriculum as they could both facilitate and benefit from linguistic development. Among these were Critical media literacy skills, highlighted for their importance in empowering learners to effectively perform and excel in Communication, Media and Information infused digital contexts. Critical Media Literacy, refers to learners' everyday literacy practices in the 21st century, and more specifically the immense influence of Mass Media and popular culture in the everyday comportment of younger generations. Critical Media Literacies in this sense would include the sets of language and skills required for participating in such digitally mediated contexts. These might include the ability to search vast online databases, retrieve and process large quantities of information, communicate online with other people in various places and

for different purposes, collaborate through online platforms with the purpose of sharing or constructing knowledge through the creation of multimedia texts [11].

Students at tertiary education and especially learners in the fields of Communication and the Media - need to be endorsed with these types of skills in order to cope with the abundance of information they receive and which they need to process and manipulate for various purposes. As future Media people, then and as information mediating agents these students need to develop sophisticated skills of individual and collective 'text' creation using their own selection of materials from a variety of sources, and this goes beyond decoding texts, or understanding them, to the more demanding processes of re constructing and synthesizing information to accommodate a vast range of online texts.

2.3 Social Constructivism and Collaborative Learning

This study has been borrowing from Vygotskian theory or social constructivism, an approach to learning and teaching that emphasizes not only individual learners but also the social and material environment with which they interact in the course of their development [12]. A second fundamental feature of Vygotskian stresses the role of artifacts that are shaped and mastered in activity and interaction with others. Belonging to a community seems to increase learner's self-confidence making the learning experience easier, more pleasant and motivating for most participants in a course [13–15].

Transferring these considerations to the context of the present study, called for a reconceptualization of the curriculum, methodology and activities to include collaboration at various levels, between communities of learners with shared interests. Harasim defines online collaborative learning as "a learning process where two or more people work together to create meaning, explore a topic, or improve skills [7]. Consequently, an important characteristic of the activities was that they were organized and supported in ways that enabled learners to draw on multiple sources of assistance (peers, technology, and instructor) in creating their artifacts and in developing the necessary skills and competencies in the process.

2.4 Technology Enhanced Learning

In support of the development of skills and competencies and of course the collaborative requirements of the curriculum, a number of ICT tools have been integrated into various components of the course to serve a number of purposes over the last few years.

Initial attempts were based on a number of factors. Among these were student's previous experience with technology, affordances of the various tools as well as the academic and professional needs and collaboration requirements these tools would be facilitating Technology employed to accommodate such needs has highlighted strengths and weaknesses related to the various linguistic, contextual and communicative demands placed on the learners and has led to the need for a more detailed investigation of the perceived effect of specific tools on critical media literacy development and collaboration.

The question of how students interact at and with the computer has been addressed in a number of studies [16, 22] the type of software and the tasks teachers set for students had a large effect on the type and quality of student interaction with each other when working in pairs or small groups. In general, "software that requires a minimum of verbal interaction generates very little, while having students write a joint report or otherwise produce something collaboratively results in a substantial amount of interaction" [23].

Moreover, there is recognition that group size depends on the scope, duration, and complexity of the task. The learning group, however, needs to be small enough to enable students to participate fully and to build group cohesion [24, 25]. Bean (2011) asserts a group size of five may be optimal for many learning situations because larger groups may dilute the experience for the learner [26].

2.5 Usability of Collaborative Learning Platforms

Tools that can assist in the development of the abovementioned skills and competencies are widely available today, and depending on context and functionality, come in various labels: collaboration software [27], computer supported cooperative work systems [28], e-learning landscapes or platforms [29, 30] or real time distributed groupware [31]. Groupware is a term initially defined as the "intentional group processes plus software to support them" [32]. The latter will be used or the purposes of this paper.

In assessing such tools' effectiveness, amongst others, researchers and analysts draw from a set of predefined criteria for usability evaluation purposes. Fundamental usability metrics include a product's learnability - how easily users learn to perform tasks, efficiency - how fast users can perform tasks, memorability - how proficient returning users are after a period of inactivity, errors - the amount of errors and ways to recover, and satisfaction - how pleasant the experience is in performing desired tasks [33]. Furthermore, there is well-documented methodology for conducting usability evaluations on digital products – involving users in controlled and not-controlled experiments, field studies, formatively and/or predictively, such as heuristic evaluation [34]. However, these alone may not be sufficient for the evaluation of groupware, as they tend to focus on single-user applications. In fact, Baker, Greenberg and Gutwin mention that although commercial real-time groupware has become widely available over the recent years, it is under-utilized due to serious issues, which can go undetected from the scope of individual-user usability evaluation models [31].

Research attempts to answer this problem, by identifying the main components of collaboration – namely context, support, tasks, interaction processes, teams, individuals and overarching factors (psychological factors, trust, incentives, experience) and suggests these as a foundation to support, evaluate and improve systems for collaborative, co-located and distributed work [35]. More elaborate frameworks have emerged in the process, which attempt to augment the existing, more generic usability guidelines [36–38] where groupware is concerned; a set of adapted heuristics, directed towards the mechanics of "teamwork", rather than the single-user "taskwork". They derive from face-to-face collaboration, and evolve to fit the particularities of virtual collaboration,

focusing on the crucial activities, tasks and processes within this context, namely communication, planning, monitoring, assistance, coordination and protection [31].

The above considerations guide the research objectives set by the present study and consequently inform the design of activities, the selection of supporting tools and the thematic data requirements and guidelines upon which analysis is conducted and conclusions are inferred.

3 Study and Methodology

3.1 Participants

The study recruited second-year students of the department of Communication and Internet Studies, part of the faculty of Communication and Media Studies at the Cyprus University of Technology. A total of twenty-eight students (sixteen male and twenty-one female students) took part in the two-week study, after agreeing to participate. The students' English language proficiency was of an intermediate level. Students had prior knowledge and adequate experience with the groupware tools they were instructed to use.

3.2 Procedure and Materials

The study involved firstly the use of Elgg, Moodle's learning-oriented social networking application which combines features of file repositories, e-portfolios and weblogging to form a "personal learning landscape" [29]. For the purpose of this research, tools providing similar functionality to Elgg, from Google's Productivity Suite [39] were also employed: Google Drive, Docs and Hangouts. Although distinct through different features (interface, behavior, synchronous/asynchronous editing, communication and version control), yet both tools facilitate information-structuring and management (folders, documents), sharing, communication, and collaborative writing of artefacts. These tools will be referred to as Moodle Elgg and Google Drive throughout the course of this paper.

Based on the program structure, students were naturally sampled into two independent groups, A and B. Group A (twelve students) was instructed to work with Moodle Elgg and group B (sixteen students) with Google Drive. The instructor formed several, mixed-ability teams of students within each group. Both the team and instructor had access to each team's work-folder on both tools. An initial hands-on session was performed to inform students about various tool technicalities and ensure that they were fully familiar with utilizing tool functionality for the purposes of the assignment.

The assignment required students to attend a lecture on the subject of "Concepts in Communication", in which a number of important concepts in the area of Communication were discussed and related to personal experiences. Simulating a real life situation, students - in teams of five- as members of an editorial board for an online magazine- were asked to first take notes from the lecture and then use these and other related material to collaboratively write a short article (around 200 words) discussing

one of the concepts using the same approach - (personal) examples from real life. All activities could be performed both in-and-out of classroom, on documents in their shared online folders and by communication through Google's Hangouts or Moodle Elgg's blogging tool.

Drafts of the article were submitted at specific times during the completion process so that the instructor could provide corrective feedback. The final artefact should have the structure and format of an online article as it would appear on the University's student website. The assignment was part of student's summative assessment scheme.

3.3 Data Collection and Analysis

Following completion of the assignment, students were asked to participate in an online survey consisting of twenty-two close-ended questions as five-point Likert scales, rating matrices and multiple choice forms, as well as, open-ended responses – as supplementary commentary. The survey enquired about subject-driven activities that, amongst others, have been classified into three key areas which are characteristic of online collaboration for educational purposes: (a) information structuring and sharing (b) collaborative learning and writing and (c) knowledge building and management [40].

Although the two activities, 'Document/folder/notes management' and 'Sharing material' might appear similar, they are distant in the sense that 'documents, folders and notes management' involves primarily the structuring of resource taxonomies (i.e. folder-and-file hierarchies) whereas 'sharing material' presupposes the existence of such an infrastructure, in order to take place.

Table 1. Specific activities and classifications

Information structuring and sharing	1. Collecting material in various formats 2. Document/folder/notes management
Collaborative learning and writing	3. Collaboration with team members for work material processing 4. Exchanging feedback and comments on artefact development 5. Communication/chat for coordination purposes 6. 'Like' functionality
Knowledge building and management	7. Studying text and audiovisual material 8. Sharing material

Survey Monkey was used for the data collection with regards to the above dimensions and activity items. The close-ended results were quantitatively analyzed using SPSS (Version 23.0.0.0). Contingent to the type of question and based on the small data set size, non-parametric, exact statistical tests were conducted to compare the two groups.

Open-ended data was qualitatively analyzed using nVivo (Version 11.0.0.317). Initial codes were recorded by two researchers who worked separately, using an inductive thematic analysis approach [41], until saturation of codes and themes was reached. Next, the researchers jointly refined and finalized the data structure into a total

of two major categories and nine thematic groups and proceeded with further individual coding cycles, achieving an inter-rater agreement result of k = 0,9 based on Cohen's Kappa coefficient measure. This constitutes as an 'almost perfect agreement', according to Viera and Garrett [42].

4 Results

Results from survey were classified based on the research objectives, in two major thematic categories:

1. Usability: tool affordances, functionality, suitability and user experience within the scope of the assignment.
2. Context-specific (Language) collaborative learning: tool support for collaborative English learning and writing and the perceived impact on student learning outcomes.

4.1 Tool Usability, Tool Affordances and User Experience

Through the study participant assessment was collected in regards to the usability and the degree of suitability in performing specific activities.

According to adopted usability metrics (single and group interaction) [31, 33, 35], we were looking into the following areas:

(a) Ease of use: the level of ease by which learners perform tasks
(b) Tool suitability: suitability of the tool in facilitating various learning tasks?
(c) Error incidence and recovery: the occurrence of errors and how easy it was for learners to recover from them through the support of the system
(d) Time to learn: how fast users learn how to perform tasks using the tool
(e) User experience: how pleasant was the experience is in performing desired collaborative learning tasks

Ease of Use. Participants were asked to rate separate activities facilitated by the tool and by amalgamation of these ratings, generic usability evaluations were concluded. The rating options ranged from 1 to 5, with 1 being Very Bad and 5 Very Good.

The totals suggest that Google Drive (N = 16, M = 4,1, SD = 0,01) was overall perceived as more usable compared to Moodle Elgg (N = 12, M = 3,5, SD = 0,3), within the context of this study. Statistical tests were performed to examine the exact relationships between all rated activities, amongst the two groups. Significant differences were detected in two activities: (a) Using the tools to 'Collect material in various formats' (p = 0.026 by Fisher's exact test) and (b) Using the tools to 'Study textual or audiovisual material' (p = 0.026 by Fisher's exact test). These are discussed below.

The results from the two groups coincided as far as the three top-most preferred options were concerned (Table 3). 'Sharing material' was the easiest activity to perform for Moodle Elgg users, followed by 'Collaborating with team members in work material processing' and then 'Document/folder/notes management'. Although in different order, Google Drive users also elected the same easiest activities, namely

Table 2. Easiest collaborative activities supported by the two tools -

Activities	Moodle Elgg				Google Drive			
	Rank	Median	Mean	SD	Rank	Median	Mean	SD
Document/folder/Notes management	3	4	3,5	1	1	4,5	4,2	1
Sharing material	1	4	4	0,8	2	4,5	4,1	1
Collaborating with team members for work material processing	2	4	3,7	0,9	3	4,5	4	1,3
1 = Very Bad - 5 = Very Good usability								

'Document/folder/notes management' and 'Sharing material' as first and second-best. The differences, lay with the remaining activities which although received equal usability ratings in both tools, were generally higher in Google Drive, than Moodle Elgg (Moodle Elgg: $M < 4$, Google Drive: $M > 4$) (Table 2).

It was anticipated for Google Drive to best support the creation and management of documents, folders and notes for users, as it primarily is a file storage and synchronization service that seamlessly integrates Google Docs. Moodle Elgg, on the other hand, an education-centric social networking tool, presents far less sophisticated file-repository capabilities bearing distinct limitations outlined in the following sections.

As mentioned above, '|Collecting materials in various formats' and 'Studying text and audiovisual material' were significantly lower in usability scores for Moodle Elgg than for Google Drive. As next section (Tool suitability) explains, this result coincides with feedback concerning Moodle Elgg's suitability for collecting, managing and studying material in various forms (i.e. text, imagery, video, audio). Due to a technical glitch of the software release, the 'Embed content' option in the Files repository, did not allow for a thumbnail preview - a typically useful feature in image-filtering and selection, especially when traversing large image file volumes [43]. File embedding, also available in Google Drive ('Insert' menu), came with an additional file preview tool, which enabled easier file selection. However, aside from the filtering issue, problems in Moodle Elgg mostly fixated on within-document image manipulation (moving or resizing). Evidently, this forced students to abandon their efforts and leave images unaltered.

Tool Suitability. The groupware tools were not consistently evaluated in terms of their suitability in performing various activities (Table 4) within the scope of the lesson - the two most contradictory being the 'Communication/chat for coordination purposes' and the 'Like' option. An analysis of the four most suitable and the two less suitable activities, per tool, follows. We remind the reader that low scores indicate positive suitability in the following Sects. (0% = Most Suitable, 100% = Most Unsuitable).

Communication/Chat for Coordination Purposes. Despite the fact Moodle Elgg is a primarily social networking learning tool, the majority of its users found it not fitting for communication and chat whereas, this very feature was perceived as most suitable in Google Suite. The relation between the two group proportions was validated using a

Fisher's exact test and provided significant differences between the two (Moodle Elgg: 66,6%, Google Drive: 7,6%, $p = 0.004$).

This was an expected finding; while the Moodle platform offers a set of e-tools, namely forum, email and online chat, as part of its communication platform, Elgg, however, provides only weblogging activities instead – which were evidently under-exploited in this study. Typically, a weblog or forum allows for communication through asynchronous posts and replies, rather than real time messaging. Although generally seen as more structured, in that conversations involve a single threated, archived and searchable topic [44], they are typically asynchronous, slower-paced and require additional user actions than instant chat. They are thus limited in enabling users to become truly engaged into the discussion process, by projecting themselves "socially and emotionally as real people" [45], since they lack immediacy.

On the contrary, Google Hangouts, seamlessly paired with Google Drive - allows for more direct and flexible forms of dialogue between logged-in users. These outcomes are congruent with past findings that substantiate the valuable contribution of instant communication for collaborative learning, aside of its ability to encourage better peer relationships and social interactions outside of classroom [31, 46]. Students do not only deem this important, but also expect its direct incorporation into their e-learning environments.

'Like' Functionality. Apart from communication issues, significant suitability results were contradictory for the 'Like' functionality, with almost two thirds (61,5%) of Google Drive group members asserting that the tool was inapt for such an option, as opposed to a mere 11,1% in the case of Moodle ($p = 0.020$ by Fisher's exact test). Results are not surprising as Moodle's Elgg offers a 'Like' button embedded in its blogging tool. On the other hand, although Google users were advised to reward someone by text – similar to the 'like' button, whenever they wished, they failed to do so.

Studying Text and Audiovisual Material. Interestingly, 'Studying text & audiovisual material' was deemed as another less suitable activity for both groups (Moodle Elgg: 44,4% - Google Drive: 30.7%), despite the difference in percentages. This also agrees with user ratings regarding Moodle Elgg's ease-of-use from previous section.

Exchanging Feedback and Comments on Artefact Development. An examination of Google Doc's revision history, showed a complete lack of suggestions and comments, and justifies the participants' negative assessment of this activity as the second less suitable. Although students were informed and prompted to switch to the in-document 'Suggesting' mode, it appears that they have used the 'Editing' mode to make direct changes instead, hence the lack of constructive feedback. Blau and Caspi explain that it is common, amongst collaborators, to prefer offering and receiving productive suggestions, rather than seeing their work being modified by others [5]. In fact, Raman et al. propose that educators could establish corresponding grading schemes to motivate students to post comments rather than intrusive arbitrary edits, promoting a more considerate and effective form of online collaboration [47]. The activity was also found unsuitable in Moodle Elgg, albeit, in significantly lower ratings than Google Docs.

Document/Folder/Notes Management. Overall, although in varied proportions, both groups were in agreement, in jointly rating 'Document/folder/Notes management', as

their most suitable feature. Previous work, investigating online collaboration in design education, also indicates that students attribute the autonomy to create and populate shared online repositories with relevant material, as highly useful, facilitating better design processes as well as enhanced learning outcomes [48]. This is an illustrative example of how tools and systems can generate or enable and shape different interactions within them, and how these interactions can positively impact the students' overall learning process [49].

Table 3. Weighted averages and ranks of tool unsuitability for various activities

The tools were ranked as suitable for the following activities:	Moodle Elgg		Google Drive		Sig.
	Rank		Rank		
Document/folder/Notes management	**1**	0%	**1**	7,7%	1
Sharing material	3	22,2%	3	23%	0.963
Collaborating with team members for work material processing	**2**	11,1%	**2**	15,4%	0.779
Studying text & audiovisual material	4	44,4%	4	30,7%	0.521
Exchanging feedback and comments on artefact development	3	22,3%	4	30,7%	0.665
'Like' option	**2**	11,1%	5	61,5%	0.020
Communication (chat) and coordination purposes	5	66,6%	**1**	7,6%	0.004
0% = Most Suitable - 100% = Most Unsuitable					

Error Incidence and Recovery. Feedback in regards to the perceived amount, type and recovery from errors, a dichotomous question, was equally positive and negative in the case of Moodle Elgg. In contrast, the vast majority of Google Drive users reported not facing any problems with the tool. By employing a Fisher's exact test, we were able to conclude on significant differences between the two groups (p = 0,023).

These results agree with outcomes from the "Ease of Use" section, in performing various activities, as far as Google Drive is concerned. Users rated the tool's usability as 'Good to Very Good' on average.

On the contrary, although Moodle Elgg was generally assessed as of mostly 'Fair to Good' usability level, users reported on encountering several problems - irresoluble in certain cases. Issues related mainly to loss of orientation, poor navigation and problematic interaction with the interface. Participants reportedly felt that they found it '*difficult to comprehend how to use the tool*', that '*it was confusing*' *and* '*in some cases*', '*the state and presentation of the site was chaotic*'. They were also unable to 'locate the tools' and 'work with imported images'.

According to usability principles, users typically expect to understand the way a system works, navigate it and perform tasks within it, preferably without prior training [33]. In contrast, Moodle evaluations expose a series of usability issues which also evolve around bad layout, poor navigation, unattractive interface design, confusing information structure, duplicate elements and inconsistent visual graphics such as symbols and icons [30].

Moreover, in accordance to other findings (Tool Suitability section) the tool's limitation in providing necessary means for effective team communication was heavily criticized. Finally, users employed unorthodox error recovery methods according to usability heuristics (that is, native system support for automatic error recovery) [50, 51]. These were: technical support phone calls, instructor's assistance and giving up on their image manipulation goals altogether.

Time to Learn. The time required in learning how to use the tool for collaborating in module activities was perceived as normal for participants in both groups A (N = 12, M = 2,59, SD = 0,84) and B (N = 16, M = 1,57, SD = 0,5) based on an ordinal scale of 1 to 5, with 1 being Very Short and 5 being Very Long. No statistical differences were detected between the two tools.

User Experience. The perceived experience in using the tool to complete the assignment was considered to be 'Neutral to Pleasant' for Moodle Elgg (N = 12, M = 2,26, SD = 0,59) and 'Pleasant' for Google Drive (N = 16, M = 1,57, SD = 0,5) users respectively. On a scale from 1 to 5, with 1 being Very Pleasant and 5 being Very Unpleasant, the groups had significant statistical differences between them by Fisher's exact test (p = 0,04).

The user experience results agree and reflect the sum of others, such as usability and suitability evaluations. Conforming to previous studies, the overall outcomes indicate a clear predominance of Google Drive versus Moodle Elgg, in positive user-experience in performing online collaborative tasks [3, 29, 30]. The biggest concerns, in regards to Moodle Elgg, derive largely from interface design issues: poor presentation and layout and 'lack of finish', conspicuous properties that were found insufficient by users, through comparisons to similar, more effective tools (i.e. Flickr, in regards to image management functionality). In agreement to this study's outcomes, Google Drive & Docs have been recurrently linked to 'enjoyment' from a user-experience perspective, due to the user-friendly layout and an overall ease-of-use [2].

4.2 Context-Specific Language Learning Outcomes

This section analyzes the role and contribution of the two tools for the development of context-specific outcomes: linguistic and related competencies, critical thinking, learning English and producing written artefacts in English through collective effort.

Development of Linguistic and Other Competencies. The entirety of responses in both groups selected the capability to '5. Exchange feedback and comments on artefact development', rendering it as essential for developing linguistic competencies and skills (Table 4). As previously stated, feedback and suggestions are preferred rather than directly editing others people's work, in collective work, especially when content semantics are modified [5]. Direct alterations are tolerable only on the language level (i.e. grammar and spelling corrections) or when "adding rather than deleting sentences". Although, as previously stated, students did not utilize the in-document suggestion tools, alternative (external) communication tools were employed as they were deemed important for the development of linguistic skills.

The fact that group B (Google drive) rated '7. Communication/chat for coordination purposes' as highly important, a view not shared by group A – also coincides with previous outcomes, denoting the lack of instant messaging as one of Moodle Elgg's main disadvantages.

Groups A and B agreed in rating '1. File/folder/note management' as the second most important activity, equally with '3. Team collaboration' only in Google Drive. The importance of student-induced information and resource structuring is highlighted in related literature [52]. This emphasizes that it is actually necessary for learners to organize information as well as knowledge (concepts and ideas) themselves, in order to achieve true competency and expertise in a specific subject.

Participants in this study also justified that 'Team collaboration' was central in this context, in that it "can improve their writing skills" and that "consulting others was much easier in this way". In fact, related research concludes that working and communicating through online collaborative environments, versus single-user desktop applications (i.e. Microsoft Word) encourages the creation of longer and better-written artefacts [3, 53].

Finally, both groups agreed that the '6. Like' functionality is the least suitable feature for supporting the development of 'linguistic and other competencies'.

From an overview perspective, we are able to report on significant statistical differences in regards to the negative evaluations (Moodle Elgg: 50% - Google Drive: 12,5% - $p = 0.03$ by Fisher's exact test) indicating that students perceived Google Drive as by far, a more efficient tool in supporting the development of 'linguistic and other competencies' within the context of this study.

Table 4. Top-most positive and negative preferences for tool activities supporting the *development of linguistic and other competencies*

Activities assisting in: The development of linguistic and other competencies?	Positive preferences		Negative preferences	
	Moodle Elgg	Google Drive	Moodle Elgg	Google Drive
	5	5, 7	6, 4	6
	1	1, 3	7, 2	4

1. Document/Folder/Notes management **2.** Sharing material **3.** Collaboration with team members for work material processing **4.** Studying text & audiovisual material **5.** Exchanging feedback and comments on artefact development **6.** "Like" functionality **7.** Communication/chat for coordination purposes

Development of Critical Thinking. In accordance to the previous variable (Linguistic and other competencies section), the topmost activities in support of critical thinking development were 'Exchanging feedback and comments on artefact development' and '1. File/folder/note management' for both groups unanimously (Table 5).

Google users also deemed '3. Collaboration with team members' and, expectedly, '7. Chat/communication' as the next two preferred variables for critical thinking. The majority of the Google group, were nonetheless consistent with previous evaluations in downgrading the 'Like' facility as not important for this ability. In general, suggesting,

feedback, communication and collaboration amongst peers are themes that have been found central in promoting critical thinking abilities. This relies in the fact that it is nearly impossible for one person to have all the knowledge and competencies required to achieve highly sophisticated tasks, requires critical thinking processes, without the help of others [54, 55].

In conclusion, there were no significant statistical differences recorded between the positive and negative feedback from the two groups, in relevance to critical thinking development.

Table 5. Top-most positive and negative preferences for tool activities supporting the *development of critical thinking*

Activities assisting in: The development of Critical thinking	Positive preferences		Negative preferences	
	Moodle Elgg	Google Drive	Moodle Elgg	Google Drive
	1, 5	3, 5	6, 4	6
	–	1, 7	–	4

1. Document/Folder/Notes management **2.** Sharing material **3.** Collaboration with team members for work material processing **4.** Studying text & audiovisual material **5.** Exchanging feedback and comments on artefact development **6.** "Like" functionality **7.** Communication/ chat for coordination purposes

Learning English. Results were - to some extent - subversive in examining this variable – especially in the case of Moodle Elgg users, indicating that the 'Study of audiovisual material' was considered primary in supporting the learning of English language (Table 6). This was rated as the second most important activity for Google users, following their previous consistent selection of three activities, namely, 'File/Folder/Notes management', 'Exchanging feedback and comments on artefact development' and 'Collaboration with team members'.

Evaluations from both groups were again, in agreement in denoting the 'Like' option, as not supportive of Learning English activity.

Table 6. Most positive and negative preferences for activities that contribute to *learning English*

Activities assisting in: Learning English	Positive preferences		Negative preferences	
	Moodle Elgg	Google Drive	Moodle Elgg	Google Drive
	4	1, 3, 5	6	6
	1	4	–	–

1. Document/Folder/Notes management **2.** Sharing material **3.** Collaboration with team members for work material processing **4.** Studying text & audiovisual material **5.** Exchanging feedback and comments on artefact development **6.** "Like" functionality **7.** Communication/ chat for coordination purposes

Collaboration in the Development of Written Artefacts in English. Participant evaluations were confidently positive (Moodle Elgg: 91.67%, Google Drive: 81.2%) in regards to the assistive role of both tools in collective article-writing within the context of ESP. Qualitative feedback produced themes relating to – primarily - time flexibility and remote collaboration and secondly, problem-solving support. The fact that students could work together or independently, regardless of time and location constraints, was thought of as exceptionally useful in the study: "*...we don't all need to be in the same place for working on the assignment*", "*...we could edit the article at any time*" and "*... because it was easy to use... a very good application for co-op with my team for instant results in a document...*" were some of the responses from the survey. This agrees with multiple studies that also illustrate these tools' synchronous/asynchronous collaboration and communication potential as favorable by learners [56, 57].

Moreover, rapid collective problem-solving, through corrections and suggestions from the team, in real-time, can evidently help overcome challenges of traditional educational settings; one of these being the increased number of students versus limited instructional support in higher education [58]. As a participant explained, "*other people from my team could help me anytime in case I had trouble doing something...*". Evidently, the lack of timely support may cultivate bad time-management behavior, such as procrastination and extended completion times, consequently leading to overall poor learning outcomes for students [59].

The relation between the two groups in for this activity, showed no significant differences. These results suggest that producing a written artefact collectively is perceived as generally well-supported by online collaborative platforms, regardless of the tool used.

5 Discussion

This study was conducted with the aims to (a) Evaluate usability and suitability factors for two groupware products – Moodle Elgg and Google Drive and (b) Investigate the effect of these tools through various activities, on the perceived student learning outcomes within the scope of ESP in tertiary education.

Based on the findings we are able to infer that outcomes from research aim **a** were mostly related - either positively or negatively - to activities that fall under the '*Information collection, structuring and sharing*' and '*Knowledge building and management*' categories (Table 1), while outcomes from research aim **b** were more associated with activities involving '*Collaborative learning and writing*' followed by '*Knowledge building and management*'.

With regards to the *usability* and *tool affordances* evaluation results, Google Drive was overall perceived as a significantly better option than Moodle Elgg as far as ease of use, error incidence and user experience were concerned (Table 7).

Google Drive, primarily a file storage service, offering seamless document-management integration, justifiably received higher usability scores where 'document, folder and notes management' activities were concerned. Equally, the activity of 'sharing material' was rated as the top-most usable facility for Moodle Elgg. This also agrees with earlier research indicating that a wiki-based environment– similar to

Table 7. Top-most positive and negative preferences for easily supported activities based on *tool affordances*, *usability* and *suitability* evaluations

Tool usability and suitability in relation to specific activities	Positive preferences		Negative preferences	
	Moodle Elgg	Google Drive	Moodle Elgg	Google Drive
	2, 1	1, 2	8, 7	4, 6

1. Document/Folder/Notes management **2.** Sharing material **3.** Collaboration with team members for work material processing **4.** Studying text & audiovisual material **5.** Exchanging feedback and comments on artefact development **6.** "Like" functionality **7.** Communication/chat for coordination purposes **8.** Collecting material in various formats (Q1 only)

Moodle Elgg - (interlinked webpages) constitutes a very appropriate means for information sharing, particularly in the early stages of learning [52].

With respect to the tools' *suitability* in facilitating various key activities in this context, outcomes were contradictory, mainly in terms of communication as well as attribution and acknowledgement purposes. In regards to communication, while Google Hangouts was evidently utilized constructively and rated as the top-most suitable option, Elgg's asynchronous blog-posting service was negatively received. Conversely, based on the latter's social networking nature, functionality such as the 'Like' option was principally favored and employed by group members, which was not the case for Google Drive. Aside from these disparities, the tools were consistently assessed for 'studying text and audiovisual material', as the second worst suitable activity, agreeing with the usability evaluation results. Based on responses, this was largely due to lack of direct manipulation (moving, resizing) issues with the images, rather than the textual elements within the documents.

Participant response for activities regarding context-specific - *language learning* - outcomes, such as the development of '*linguistic skills*' and '*critical thinking competencies*', '*learning English*' and '*producing written artefacts collaboratively*', show consistent acceptance for both groupware products.

Overall, students considered the 'exchange of feedback' and 'comments on the written artefact' as primary for the development of such skills. Apart from rapid problem-solving activity, reciprocal feedback lies at the heart of effective knowledge construction and the building of specific competencies, necessary for achieving sophisticated field-centric tasks [54]. Agreeing with usability outcomes, creating and maintaining 'Online documents, folders' and notes' followed as fundamental, from a context-specific (language learning) perspective. Similarly, learners also considered the 'study of audiovisual material' and 'collaboration with team members for work material processing' as essential, while (by marginal difference) 'communication and chat for coordination purpose's as equally important in the case of Google Drive use only (Table 8).

In the case of *linguistic and other competencies development*, Google Drive was perceived as, by far a more efficient tool for performing related activities. Additionally, responses concerning the role of Google Drive's collaboration and feedback facilities

Table 8. Top-most positive and negative preferences for activities supporting *general context-specific (language learning) outcomes*

Tool evaluation in regards to activities assisting in: The development of linguistic and other competencies, critical thinking and learning English	Positive preferences		Negative preferences	
	Moodle Elgg	Google Drive	Moodle Elgg	Google Drive
	5, 1, 4	5, 1, 3	6	6

1. Document/Folder/Notes management **2.** Sharing material **3.** Collaboration with team members for work material processing **4.** Studying text & audiovisual material **5.** Exchanging feedback and comments on artefact development **6.** "Like" functionality **7.** Communication/chat for coordination purposes **8.** Collecting material in various formats (Q1 only)

for the development of context-specific (language learning) competencies, appear to be more consistent and less dispersed, compared to those on Moodle Elgg.

Based on the findings we are able to infer that outcomes from research aim a were mostly related - either positively or negatively - to activities that fall under the 'Information collection, structuring and sharing' and 'Knowledge building and management' categories (Tables 10 and 11), while outcomes from research aim b were more associated with activities involving 'Collaborative learning and writing' followed by 'Knowledge building and management' (Tables 10 and 12).

6 Conclusion

This study examines the usability and suitability of Moodle Elg and Google Drive as technologies that can support collaborative learning processes within the context of an undergraduate ESP course, as well as investigate the pedagogical impact on the participants' perceived learning outcomes.

With regards to the tool affordances, usability and suitability evaluation results, Google Drive is perceived as a significantly better option to Moodle Elgg as far as ease of use, error incidence and user experience are concerned. The three easiest activity areas are the 'creation and management of folder, files and notes', 'sharing material', and 'collaborating with team members for work material processing'. In regards to tool suitability evaluation, outcomes indicate that Google Drive is most suitable for communication purposes (instant chat) and 'document management' facilities. Results relating to the role of specific activities in context-specific (Language learning) outcomes, mainly involve the 'exchange of feedback and comments on written artefacts' and the 'management of folders, documents and notes' for the purposes of the lesson, while attribution features ('Like' option) were not deemed important by learners, from this perspective.

This study is limited by the small participant sample and the context of research in terms of subject specificity (ESP) and therefore lacks an adequate level of generalizability to the larger population.

References

1. Byram, M.: Routledge Encyclopedia of Language Teaching and Learning. Psychology Press, London (2017)
2. Chu, S.K.W., Kennedy, D., Mak, Y.K.: MediaWiki and Google Docs as online collaboration tools for group project co-construction. In: Proceedings of the 2009 International Conference on Knowledge Management (2009)
3. Zhou, W., Simpson, E., Domizi, D.P.: Google Docs in an out-of-class collaborative writing activity. Int. J. Teach. Learn. High. Educ. **24**(3), 359–375 (2012)
4. Liu, S.H.-J., Lan, Y.-J.: Social constructivist approach to web-based EFL learning: collaboration, motivation, and perception on the use of Google Docs. Educ. Technol. Soc. **19**(1), 171–186 (2016)
5. Blau, I., Caspi, A.: What type of collaboration helps? Psychological ownership, perceived learning and outcome quality of collaboration using Google Docs. In: Proceedings of the Chais Conference on Instructional Technologies Research, vol. 12 (2009)
6. Bold, M.: Use of wikis in graduate course work. J. Interact. Learn. Res. **17**(1), 5 (2006)
7. Harasim, L.M.: Learning Networks: A Field Guide to Teaching and Learning Online. MIT Press, Cambridge (1995)
8. Forment, M.A., Guerrero, M.J.C., Mayol, E., Piguillem, J., Galanis, N., García-Peñalvo, F.J., González, M.Á.C.: Docs4Learning: getting Google Docs to work within the LMS with IMS BLTI. J. UCS **18**(11), 1483–1500 (2012)
9. Huchinson, T., Waters, A.: English for Specific Purposes: A Learning-Centered Approach. Cambridge University Press, Cambridge (1987)
10. Csizér, K., Kontra, E.H.: ELF, ESP, ENL and their effect on students' aims and beliefs: a structural equation model. System **40**(1), 1–10 (2012)
11. Hafner, C.A., Chik, A., Jones, R.H.: Engaging with digital literacies in TESOL. TESOL Q. **47**(4), 812–815 (2013)
12. Lee, C.D., Smagorinsky, P.: Vygotskian Perspectives on Literacy Research: Constructing Meaning Through Collaborative Inquiry. Cambridge University Press, Cambridge (2000)
13. Vygotsky, L.S.: Mind in Society: The Development of Higher Mental Process. Harvard University Press, Cambridge (1978)
14. Wenger, E.: Communities of practice: learning as a social system. Syst. Thinker **9**(5), 2–3 (1998)
15. Swan, K., Shea, P.: The development of virtual learning communities. In: Learning Together Online: Research on Asynchronous Learning Networks, pp. 239–260 (2005)
16. Abraham, R.G., Liou, H.-C.: Interaction generated by three computer programs: analysis of functions of spoken language. In: Computer-Assisted Language Learning: Research and Practice. Newbury House/Harper Row, New York (1991)
17. Dudley, A.: Communicative CALL: student interaction using non-EFL software. CÆLL J. **6**(3), 25–33 (1995)
18. Dziombak, C.E.: Searching for collaboration in the ESL computer lab and the ESL classroom. Diss. Abstr. Int. A Humanit. Soc. Sci. **51**(2296–A) (1991)
19. Levy, M., Hinckfuss, J.: Program design and student talk at computers. Comput. Assist. English Lang. Learn. J. **1**(4), 21–26 (1990)
20. Meskill, C.: ESL and multimedia: a study of the dynamics of paired student discourse. System **21**(3), 323–341 (1993)
21. Murillo, D.: Maximizing CALL effectiveness in the classroom. CÆLL J. **2**(2), 20–25 (1991)
22. Pujol, M.: ESL interactions around the computer. CÆLL J. **6**(4), 2–11 (1995)

23. Warschauer, M., Healey, D.: Computers and language learning: an overview. Lang. Teach. **31**(2), 57–71 (1998)
24. Barkley, E.F., Cross, K.P., Major, C.H.: Collaborative learning techniques: a handbook for college faculty. Wiley, Hoboken (2014)
25. Schellens, T., Valcke, M.: Fostering knowledge construction in university students through asynchronous discussion groups. Comput. Educ. **46**(4), 349–370 (2006)
26. Bean, J.C.: Engaging Ideas: the Professor's Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom. Wiley, Chichester (2011)
27. Klemm, W.R.: Benefits of Collaboration Software for On-Site Classes (1997)
28. Dekeyser, S., Watson, R.: Extending Google Docs to collaborate on research papers, vol. 23, p. 2008. University of Southern Queensland, Australia (2006)
29. Werdmuller, B., Tosh, D., Files, F., Free, P.: Elgg–A personal learning landscape. TESL-EJ **9**(2), 1–11 (2005)
30. Tee, S.S., Wook, T., Zainudin, S.: User testing for moodle application. Int. J. Softw. Eng. Its Appl. **7**(5), 243–252 (2013)
31. Baker, K., Greenberg, S., Gutwin, C.: Empirical development of a heuristic evaluation methodology for shared workspace groupware. In: Proceedings of the 2002 ACM Conference on Computer Supported Cooperative Work, pp. 96–105 (2002)
32. Johnson-Lenz, P., Johnson-Lenz, T.: Post-mechanistic groupware primitives: rhythms, boundaries and containers. Int. J. Man Mach. Stud. **34**(3), 395–417 (1991)
33. Nielsen, J.: Usability 101: Introduction to Usability. Nielsen Norman Group (2012). http://www.nngroup.com/articles/usability101introductiontousability
34. Nielsen, J., Molich, R.: Heuristic evaluation of user interfaces. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, pp. 249–256 (1990)
35. Patel, H., Pettitt, M., Wilson, J.R.: Factors of collaborative working: a framework for a collaboration model. Appl. Ergon. **43**(1), 1–26 (2012)
36. Crumlish, C., Malone, E.: Designing Social Interfaces: Principles, Patterns, and Practices for Improving the User Experience. O'Reilly Media Inc., Sebastopol (2009)
37. Luna-García, H., Mendoza-González, R., Vargas Martin, M., Muñoz-Arteaga, J., Álvarez-Rodríguez, F.J., Rodríguez-Martínez, L.C.: Validating design patterns for mobile groupware applications by expert users: a USAER case. Comput. Sist. **20**(2), 239–250 (2016)
38. Pinelle, D., Gutwin, C., Greenberg, S.: Task analysis for groupware usability evaluation: modeling shared-workspace tasks with the mechanics of collaboration. ACM Trans. Comput. Interact. **10**(4), 281–311 (2003)
39. Herrick, D.R.: Google this!: using Google apps for collaboration and productivity. In: Proceedings of the 37th Annual ACM SIGUCCS Fall Conference: Communication and Collaboration, pp. 55–64 (2009)
40. Chu, S.K.-W.: TWiki for knowledge building and management. Online Inf. Rev. **32**(6), 745–758 (2008)
41. Patton, M.Q.: Qualitative Evaluation and Research Methods. SAGE Publications Inc., Thousand Oaks (1990)
42. Viera, A.J., Garrett, J.M.: Understanding interobserver agreement: the kappa statistic. Fam. Med. **37**(5), 360–363 (2005)
43. Shneiderman, B.: Reflections on authoring, editing and managing hypertex (1998)
44. Farmer, R.: Instant messaging–collaborative tool or educator's nightmare. In: The North American Web-based Learning Conference (NAWeb 2003) (2003)
45. Garrison, D.R., Anderson, T., Archer, W.: Critical inquiry in a text-based environment: computer conferencing in higher education. Internet High. Educ. **2**(2), 87–105 (1999)

46. Nicholson, S.: Socialization in the 'virtual hallway': instant messaging in the asynchronous web-based distance education classroom. Internet High. Educ. **5**(4), 363–372 (2002)
47. Raman, M., Ryan, T., Olfman, L.: Designing knowledge management systems for teaching and learning with wiki technology. J. Inf. Syst. Educ. **16**(3), 311 (2005)
48. Bubaš, G., Orehovački, T., Kovačić, A.: E-learning with Web 2.0 tools: what can ('t) go wrong. In: 18th European University Information Systems (EUNIS) Congress-A 360° Perspective on IT/IS in Higher Education (2012)
49. Farmer, R.: Instant messaging: IM Online! RU? Educ. Rev. **40**(6), 49 (2005)
50. Preece, J.: Sociability and usability in online communities: determining and measuring success. Behav. Inf. Technol. **20**(5), 347–356 (2001)
51. Ardito, C., Costabile, M.F., De Marsico, M., Lanzilotti, R., Levialdi, S., Roselli, T., Rossano, V.: An approach to usability evaluation of e-learning applications. Univers. Access Inf. Soc. **4**(3), 270–283 (2006)
52. Nicol, D., Littlejohn, A., Grierson, H.: The importance of structuring information and resources within shared workspaces during collaborative design learning. Open Learn. J. Open Distance e-Learn. **20**(1), 31–49 (2005)
53. Apple, K.J., Reis-Bergan, M., Adams, A.H., Saunders, G.: Online tools to promote student collaboration. In: Getting connected: Best Practices for Technology Enhanced Teaching and Learning in High Education, pp. 239–252 (2011)
54. Wang, Q.: Using online shared workspaces to support group collaborative learning. Com put. Educ. **55**(3), 1270–1276 (2010)
55. Liaw, S.-S.: Investigating students' perceived satisfaction, behavioral intention, and effectiveness of e-learning: a case study of the Blackboard system. Comput. Educ. **51**(2), 864–873 (2008)
56. Emmer, E.T., Liu, M., Reimer, T.C.: Student perceptions of a collaborative online learning environment (2005)
57. Bower, M., Richards, D.: Collaborative learning: some possibilities and limitations for students and teachers. In: 23rd Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education: Whos Learning, pp. 79–89 (2006)
58. Lahtinen, E., Ala-Mutka, K., Järvinen, H.-M.: A study of the difficulties of novice programmers. In: Proceedings of the 10th Annual SIGCSE Conference on Innovation and Technology in Computer Science Education - ITiCSE 2005, p. 14 (2005)
59. Mavri, A., Loizides, F., Souleles, N.: A case study on using iPads to encourage collaborative learning in an undergraduate web development class. In: 1st International Conference on the use of iPads in Higher Education 2014, pp. 267–290 (2014)