Web 2.0 learning environments in vocational education: a study on the use of collaborative online tools in the Statistics module.

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ABSTRACT: The project we present in this paper intends to evaluate the potential of using collaborative online tools in the teaching and learning process on Mathematics in Vocational Education. Google Docs tool and its features as a form, text, spreadsheet and electronic presentation editor were used to teach a Statistics Module. The study involved students from the "Communication/Marketing, Public Relations and Publicity" course, corresponding to the 11th grade that, throughout the Statistics module, exploited the different features of this tool. The aims of the study were: i) to evaluate the strategy implications in the interaction dynamics' and students' cooperation, and ii) to ascertain if the experience changed the participants' perceptions concerning Mathematics, Statistic and the use of ICT in this curricular subject.

Keywords: Collaborative Work, Google Docs, Vocational Education, *Web* 2.0.

INTRODUCTION

Nowadays, education and learning are necessarily present in online learning. In less than twenty years, the Web has gained attention from all areas of knowledge, human and social relations, presenting today as the ideal environment for digital natives (Prensky, 2001; OECD, 2007). It is necessary to take advantage of the valuable resources that the World Wide Web provides us and to guide all participants in the process of teaching and learning to what is more current and interesting to young people, opening the school to the world because "A school that closes itself is not able to learn or to develop" (Guerra, 2001: 60).

It is essential to develop a pedagogy based on the interaction of collaborative processes by promoting student's autonomy in learning and thinking (Days, 2004). The online learning includes forms of communication, access and sharing of information, of participation in collaborative processes of learning and new knowledge construction.

The collaborative learning model goes further and requires the participation of all elements of the group, involving them throughout the process "in a coordinated and synchronous effort" (Dillenbourg et al., 1999).

From the need to motivate students to learn, carrying teaching methods to a new structure and to the introduction of new practices, the study that is presented below has been implemented in the academic year of 2008/2009, in a vocational course at level 3, equivalent to 11th grade, from a private school in the district of Vila Real. The purpose of this study was to provide students with an opportunity to create, through the collaborative tools of Google Docs, a work within the

Computational Statistics module, where the assessment of satisfaction of the school served as the basis for data collection.

WEB 2.0

The Web 2.0, a concept released by O'Reilly and MediaLive International at a brainstorming conference, means a changing role of the user on the Web. Initially, the network user had a passive role by merely reading several published content available to everyone: we were at the Web 1.0 generation. At present, the user has an active role in the production and publication of content that is available online given the opportunity to build knowledge.

Despite disagreements over the terms used - Web 1.0, Web 2.0 and even Web 3.0 - Web 2.0 is considered the most comprehensive because it makes available to the user a wide range of free tools, without him having the need to know programming languages. The Web 2.0 buzzword is *sharing*.

According to Tim O'Reilly, Web 2.0 is transforming the Web into a platform for work: services constantly updated that improve as people use and interconnect the various sources, which he calls the "architecture of participation" (O'Reilly, 2005).

The use of Web 2.0 has enabled teachers to develop activities using these tools based on models of active, collaborative and constructive learning (Lisboa, Bottentuit Junior & Coutinho, 2009).

According to Coutinho & Bottentuit Junior (2007), Web 2.0 tools can be classified into two categories:

- First category – includes applications that can only exist on the Internet and whose effectiveness increases with the number of registered users, for example: Google Docs & Spreadsheets, Wikipedia, del.icio.us, YouTube, Skype, eBay, Hi5, etc.

- Second category – includes applications that can run offline, but can bring great benefits if they are online: Picasa Photos, Google Maps, Mapquest, iTunes, etc.

The study that is presented in this paper has focused on the use of an online collaborative writing tool – Google Docs & Spreadsheets – in a group of students from vocational education, in order to study the dynamics of the interactions generated by the use of this environment, and its impact on performance and perceptions of students about Mathematics and Statistics.

VOCATIONAL EDUCATION

Vocational education appears with the perspective of responding to the inadequacies of education, focusing on skills development, aimed at a good integration into the labor market, as well as to answer the challenges of information and knowledge society.

The teaching of mathematics allows students to develop knowledge, skills and attitudes that allow them to learn a set of skills for an industry, profession or family of professions (ME, 2004).

The aim of Mathematics in vocational education is to give students "tools" that can assist them in solving problems, applying it to real situations and intrinsic to the specific training of each vocational course.

The use of technology in mathematics teaching encourages the development of essential skills for professional performance. Thus, they allow the representation of problems, relating the different aspects (graphical, numerical and algebraic), explore situations in a dynamic and fast way in the verification of results.

The teacher must be aware of the constant changes that occur in the educational system, to develop new methodologies that aim to contribute to the improvement of education. The presentation of problems and exercises of logical reasoning possess specific characteristics that allow students to develop self-esteem and confidence. A confident and motivated student develops skills with ease and seems to be active in all work proposed. However, achieving these objectives is time consuming and arduous.

Like mathematics, also the Information and Communication Technologies (ICTs) are inseparable from our everyday lives. ICT currently assume an important role in our lives especially in the teaching and learning process of our students. Its use in education is not simply about improving the traditional teaching. They assume a very important role in education, as they offer new experiences and new teaching practices. The results and the experience of the teacher demonstrate this: learning is strengthened by the use of diverse strategies allied to ICTs and facilitate the development of skills.

GOOGLE DOCS AND COLLABORATIVE LEARNING

Google Docs resulted from the union between Google Spreadsheets and Writely in October 2006 and is an online tool developed by Google, accessible from any browser.

For immediate access to these applications it is only necessary to create a Gmail account (http://gmail.com). Google Docs combines a word processor, a spreadsheet editor, a presentation editor, a form editor and, more recently, a drawing editor.

Applications are available for free, without having to install any software or occupy any space on the disk hardware.

In this context, the teacher has at his disposal a set of Web 2.0 tools for the development of skills, critical thinking and reflection - one of the aims of school education - which could bring benefits to the teaching and learning process. There are many teaching strategies and activities in which this tool can be used in the context of the classroom: storage and editing of texts, real-time collaboration, collective building of knowledge, exchange of ideas and projects. A whole range of activities that provide innovative educational practices, enhancing the integration of Information Technologies and Communication in the curriculum, making the teaching and learning process more stimulating and effective, and meeting the interests and the "habitat" of the students (Barroso & Coutinho, 2009).

Thus, the authors can share their documents in various formats with collaborators, who can view or edit the text, and if they have a Gmail account, they can even publish documents on the Web. The Goggle Docs records all reviews made by users, allowing, in an educational context, a control over what is published.

It is a useful tool for collaborative work, jobs are accessible from anywhere, free of physical barriers, and there is no risk of losing files.

The educational potential of the tools used in students activities, brings a new dimension to the educational process, through contact with other communities, encouraging the students to the concept of sharing knowledge that promotes collaborative work (Bellarmine, 2006).

Google Docs allows collaborative learning, where each element is responsible for the outcome of the group. For Pierre Lévy (1997), the new role of the educator is to help others to learn collaboratively, not only teaching and transmitting knowledge, where the teacher is guide and the student author, constructing and reconstructing the knowledge for themselves.

Google Docs enhances the interaction, collaboration, critical thinking, responsibility, mutual respect, trust and relationship in a team that need to be developed in students.

For Lisboa (2010, p. 60), "The concept of collaborative learning, with regard to teamwork, is not new, and it was not born with the advent of the Internet nor with the emergence of the WWW, by contrast, it is perhaps as old as the concept of informal education (...) the concept was already used by theorists and educators since the eighteenth century, but was in the '80s that gained importance and increased significance". In fact, with the spread of the ICT and the democratized access to Internet, collaborative learning has new contours and proportions, due to the emergence of software that enables on-line connection of people from different social contexts, facilitating the information dissemination and exchange of experiences. For Pinto (2009), the technologies themselves are not collaborative, but there is no doubt that they open a range of possibilities to be implemented on the Web, since people can integrate into communities and interact with each other. This logic of ideas, and according to Lisboa (2010, p. 61), "technology can facilitate this process by transcending to new contexts collaborative work situations, for example, in virtual communities or other social Web applications, where it is valued the role that each person plays in order to achieve a common goal."

METHOD

The learning project was presented to students at the beginning of the "Computational Statistics" module. The teaching of this module has proved useful, not only for its practical nature but also by the profile of the course. As the module "Statistics" had been taught on the previous school year, students had the basic knowledge and were already familiar with the vocabulary of Statistics.

The study aimed to assess the influence of the use of tools for collaborative writing in the dynamics of interaction and students` performance, particularly to know if Web 2.0 tools stimulate collaborative work and influence the perceptions of students about Mathematics and Statistics.

In the first session, the teacher asked all students to create a Google account, which is essential to the use of the applications of Google Docs. Then followed a short presentation of the tool. Students were given time to explore the tool both individually and in group, getting to know and test the resources and technical capabilities of it. The teacher designed a site for the release of information concerning the execution of the activity on Google Sites, from the Google application family (http://sites.google.com/site/matepm/).

Students were organized into groups of four elements, a total of five groups. The formation of the groups took into account pre-established criteria by the teacher in order to obtain homogeneous groups with regard to knowledge of mathematics (this distribution being based on prior knowledge that the teacher had from students, both at the cognitive and personality level) and physical resources, ensuring that in each of the groups existed at least a laptop with internet connection as suggested by Davis & Davis (2002). The groups have created websites using a tool from the Google family, Google Sites, where they have provided the final documents of the group work.

The proposed task was to design, on the Google Docs editor a form that assessed satisfaction levels in relation to school and that was filled by students, staff (teaching and non teaching staff) and directors. After the data collection, the groups proceeded to the organization and treatment using the editor of the spreadsheet in Google Docs.

Throughout the activity the teacher's role was that of mediator, facilitator and manager of the learning process, not restricted to the mere transmission of content.

The tasks proposed to the class had in common to use the collaborative features of Google Docs, involving the creation of a questionnaire in the form editor application, the organization of information in the spreadsheet, drawing up of a report using the word processor and, finally, the presentation of results, using the presentation editor. For its implementation, the completed questionnaires were divided into parts and distributed among the five groups. Thus, the analysis of the survey would result with the contribution of each and every one of the groups.

The pedagogical benefits of the applications of Google Docs are that all students of the group have access to documents anytime, from any connection to the Internet, encouraging collaborative writing and serving as a stimulus and motivation for the exploration of new tools.

Google Docs allows the use of the word editor, the spreadsheet editor and presentation. These collaborative editing applications can be restricted to the author / group or extended to all visitors / participants. Besides, it keeps a register of editing that allows monitoring all the work done. This allows the teacher to monitor the implementation of the work, which was the case in this study.

Students, despite never having worked with the tool, joined with some enthusiasm and even managed to create personal Web sites in Google Sites and shared work from other disciplines.

During the sessions, students were exchanging ideas and opinions, sharing information with other groups on the functionality of the tool.

Instruments for data collection

To assess the learning activity, two questionnaires have been designed from scratch, that were subjected to prior validation of content. (Coutinho, 2005). The initial questionnaire was administered in March 2009, the week before the beginning of Statistics module. For reasons beyond the control of the teacher, the final questionnaire was applied only in January 2010, which allowed an assessment of experience in deferred which, according to some authors, may give more reliable results (Coutinho, 2005). The initial questionnaire aimed to: i) characterize the subjects; ii) assess their computer

literacy; iii) to assess perceptions about group work and iv) to assess attitudes towards Mathematics and Statistics, as well as their connection with ICT.

The final questionnaire intended to assess the students' opinions about the collaborative work using the Google Docs and compare the changes occurred in the dimension iv) of the initial questionnaire.

The questionnaire included only closed response items. To assess the dimension iii), we used a Likert scale of degree of agreement with five points (1 = Strongly Disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = agree and 5 = Strongly Agree). The results for this scale are presented using the weighted average value obtained for each item.

To assess the extent iv) we used a semantic differential type scale (Osgood) with seven degrees and ten pairs of adjectives randomly ordered, and were presented from the positive to the negative pole. These pairs of adjectives were grouped around the following issues: familiarity, usefulness, quality and nature related to discipline / module /ICT. For the interpretation of results we consider that average scores below -1.50 would correspond to a weak presence of the assessed feature; average scores higher than 2.00 correspond to a strong presence of the feature; mean scores between -1.50 and 2, 00 correspond to a moderate presence of the feature.

DISCUSSION

The sample consisted of 20 students (9 girls and 11 boys) from the vocational course of "Communication/Marketing, Public Relations and Advertising", equivalent to the 11th grade, from a private school in the district of Vila Real. The average age of students was 18 years old.

With regard to perceptions about the use of computers and the Internet, students unanimously reported liking math classes where the computer is used in the teaching-learning process. All also agree that they learn more when the teacher uses the computer and the Internet. When asked to justify the options given, the students reported that they can always resort to "examples" on the Internet to help them, "to be more attentive", "most creative way to learn and engage more students", "lessons are more motivating" and even that "this is the future."

The students reported using computers in school work because they like working on the computer (55.6%) but only do it when necessary (27.8%). One student reported not feeling comfortable when using the computer and two students said they used it a few times. None of the students reported not using the computer, ask for help using the computer or who do not like to work on the computer.

Although the computer is a part of the daily lives of students, their use in educational settings is small and little explored. The word processor is used for the preparation of written works, many of them elementary. The worksheet is used only to do graphics, and students didn´t know, until then, the functions it contains that are extremely useful for teaching mathematics in general and Statistics in particular.

Of the 20 students in the class, 10 said they knew about Google Docs, but only 3 possessed Gmail accounts before the study, but did not use it and even ignored their access data.

According to data obtained in the final questionnaire, we found that the use of Google Docs was pleasant to 95% of the students and only 5% shown to have been indifferent to its use in Mathematics. All students stated that the completion of the work was exciting and, if they could choose, would use the tool again. Likewise, students did not experience major difficulties in the use of the multiple features of the tool (creating word documents, spreadsheets and electronic presentations): most of students found it easy (14 students), four students showed indifference and two students found it difficult.

When asked about the effects of the use of Google Docs in the learning of Mathematics, all agreed they were positive. Students would like to repeat the experience and have the opinion that most teachers should use online tools in the classroom.

However, they recognized that the conditions under which the study took place were not always the ideal: 28.6% reported difficulties in the Internet access and 25.6% said the access had been very

slow. This very fact has conditioned the study, repeatedly forcing a change of classroom. The students recurred, several times, to the personal mobile Internet.

The unavailability of the computer room was also a constraint. Other factors that, in the opinion of the students, conditioned the study were the absences of group members in the days of carrying out activities (17.1%) and also the fact that not all elements of the group had a computer. Students also indicated the difficulty caused by the lack of time for the completion of activities (5.7%) and difficulty in accessing the documents on Google Docs (8.7%).

With regard to collaborative work using Google Docs (Table I), most students considered that was motivating and stimulating ($\bar{x} = 4.35$), that it's a useful tool for future work ($\bar{x} = 4.30$) and that it contributed to the personal enrichment of elements in group ($\bar{x} = 4.35$). Considered that learning using online tools is in favor of personal training ($\bar{x} = 4.15$) but understand that this requires more responsibility on the part of each group member. Likewise, they understand that the work done in this way requires autonomy, either individually or in groups, in order that the construction of knowledge can occur ($\bar{x} = 4.15$). However, responses to the statement "We are able to work autonomously and rarely recurred to the trainer" were different, although 40% of students have claimed to agree with the statement and 5% fully agree. In fact, one student noted "Totally Disagree", 4 "Disagree" and 6 "Neither agree nor disagree." In our view, this data shows that most students did not show independence in performing the tasks and only a small group succeeded in doing it, perhaps because they were more attentive. Students clearly state that "The group work done was more than bringing together the parts of the work done by each of the elements of the group", obtaining the agreement of 75% of respondents and indifference by 25%. This can also be due to the fact that the students did not understand the concept implicit in the statement.

When asked if the way the work was done enriched individual work, including sharing of knowledge and interaction between elements of the group, students have no doubts in agreeing with the statement ($\bar{x} = 4.00$). Still, two students marked "Neither agree nor disagree," not having an opinion on this. The collaboration and interaction between elements of the group and its influence on the knowledge learned, was beneficial for students. However, it is important to note the active participation of the group elements (60%).

TABLE I. OPINION OF STUDENTS ON THE COLLABORATIVE WORK

Items	**%**			**Weighted average**
	Agree	Indifferent	Disagree	
All group members participated actively in work performance.	60	20	20	3,45
Sharing ideas with colleagues contributes to personal enrichment of the elements of the group.	100	0	0	4,35
We were able to work autonomously and rarely recurred to the trainer.	45	30	25	3,2
The responsibility was greater because the job required individual and group autonomy in the construction of knowledge.	90	10	0	4,15
The work has allowed me to interact and share ideas and knowledge with other group members, enriching our services.	90	0	10	4
The group work done was more than joining parts of the work performed by each of the elements of the group.	75	25	0	3,75
Collaboration with other elements of the group allowed me to raise knowledge of some disciplines and to learn, not only at the personal level, but also with the remaining group.	85	15	0	4

The students found the resources provided and presented by the trainer sufficient ($\bar{x} = 4.30$). As for the potential of the tool, they say that Google Docs is a useful tool for school work ($\bar{x} = 4.20$), despite some difficulties in working with Google Docs ($\bar{x} = 3.35$) (Table II). These difficulties may be

related to difficulties in accessing the Internet. The experience was rewarding for the students who found the work done online was stimulating and motivating ($\bar{x}$ = 4.35) and a possible to repeat in the future ($\bar{x}$ = 4.30).

TABLE II. STUDENTS' OPINION ON THE GOOGLE DOCS COLLABORATIVE TOOL

Items	%			Weighted average
	Agree	Indifferent	Disagree	
The work done online was stimulating and motivating.	90	10	0	4,35
It was a new experience that you can use in future works.	100	0	0	4,30
Google Docs is a useful tool for school work.	90	10	0	4,20
There were difficulties in working with Google Docs.	55	25	20	3,35

During the study sessions, the different groups shared information on how to work "better" with the online tool. This tool requires "strategies" so that the work can be performed without delay and without complication, and the more able students were sharing the discoveries made.

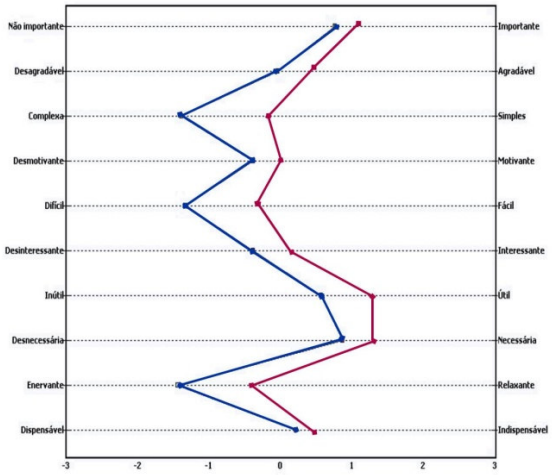
We wanted to know what perceptions students had on Statistics, and they responded unanimously that the Google Docs positively changed the perception of the discipline. The unanimous opinion continues to assert that it was interesting and enriching learning using the online tool.

However, when asked whether they preferred to have learned using the traditional method or using online tools, collaborative work, opinions disperse: 40% said they preferred the traditional method. From our perspective this view shows the anchor to traditional teaching does not seem easy to "disengage" in young people from this type of education, although they have liked and have considered the experience enriching. It seems that to leave the "comfort zone" is "too risky" for young people who deal with technology every day.

Using a semantic differential scale like the one used in the initial questionnaire, to characterize the subjects, and in the final questionnaire, allowed us to assess differences in the perceptions of students about Mathematics, Statistics and on the use of ICT in the discipline.

Thus, as regards to the perceptions of students about Mathematics before and after the educational experience, we found that the values improved in all dimensions considered (see Graph I). According to the students, this discipline is now simpler, motivating, easy, useful, necessary and relaxing, indicating that the strategy of teaching and learning has helped students of vocational education to develop more positive attitudes regarding this discipline.

GRAPH I. COMPARATIVE SEMANTIC DIFFERENTIAL OF STUDENTS PERCEPTIONS TOWARD MATHEMATICS



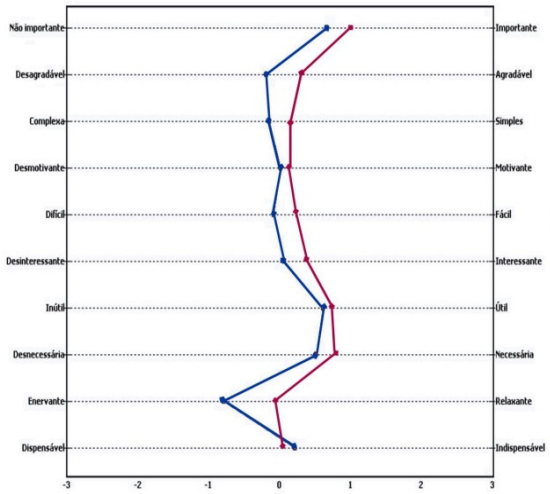
Initial Questionnaire

Final Questionnaire

The analysis of perceptions towards Statistics, modular unit, also shows that the relationship improves, even if in different degrees, in different aspects considered (see Graph II).

Statistics, as a field of study from Mathematics, has become moderately more important, much more pleasant and simple, slightly more motivating, easy, slightly more useful, necessary and far more relaxing. In all data the differences are not striking, just slight. Despite not having been asked to justify the choices, these findings can be explained due to the fact that work include the examination and treatment of data followed by interpretation of these data, in which students clearly had many difficulties.

GRAPH II. COMPARATIVE SEMANTIC DIFFERENTIAL OF STUDENTS PERCEPTIONS TOWARD STATISTICS



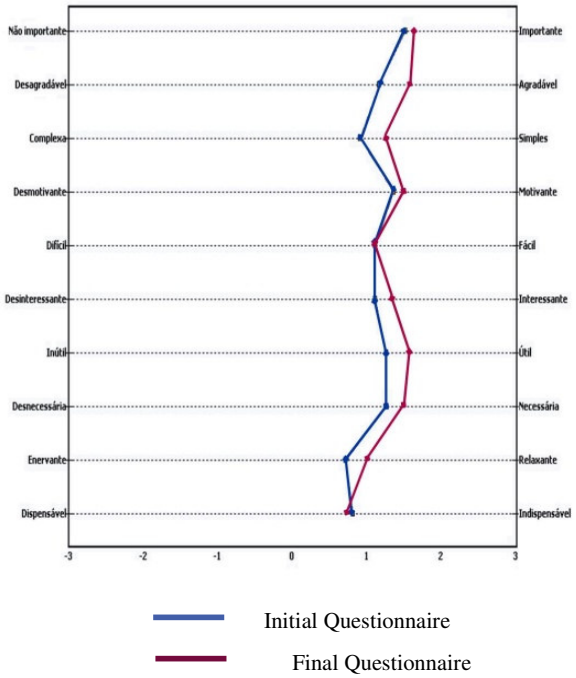
Initial Questionnaire

Final Questionnaire

The last question wanted to know how the students perceived the relationship between Mathematics and ICT, before and after the study.

By observing Graph III, we found that there were some minor qualitative improvements in almost all considered pairs of adjectives: it is important, pleasant, simple, motivating, interesting, useful, necessary and relaxing. However, two issues kept the same position before and after the study and were also the higher values on the three issues that took the form of semantic differential: easy and essential. This data clearly show how students gave importance to ICT in Mathematics, as a resource facilitator of learning.

GRAPH III. COMPARATIVE SEMANTIC DIFFERENTIAL OF PERCEPTIONS TOWARDS ICT AND MATHEMATICS



FINAL REMARKS

Web 2.0 tools, used in the context of vocational education, make available to teachers and students tools that promote collaborative learning, sharing and building knowledge beyond the development of the online socializing skills. However, it is a challenge for the teacher and students in what concerns their appropriate use in the classroom, either by the characteristics of the students, either by physical resources and ideal condition that not always exist in the school spaces and especially because it implies having to innovate in order to integrate ICT into the curriculum.

The experience presented shows that the use of a different teaching strategy was well accepted by students, although the logistical conditions were not ideal. The receptivity shown by students during the work, the interest with which they were involved in the project enabled the development of autonomy, confidence and taste for collaborative work that is positively reflected in a more positive attitude towards Mathematics and Statistics and the role that ICT plays in learning the discipline.

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