PEER INSTRUCTIONS AND USE OF TECHNOLOGICAL TOOLS. AN INNOVATIVE METHODOLOGY FOR THE DEVELOPMENT OF MEANINGFUL LEARNING

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ABSTRACT

In most of the pedagogical development experiences, the contents that students generate as a result of the course activities are not considered as a primary source of knowledge. Thus, students see their learning disadvantaged, when their intellectual outputs are not considered in the design of the learning activities. Today, the Web offers a wide range of resources and opportunities for the development of activities in a collaborative environment both to produce or spread the contents or to make them available. This article describes the experience of three groups of students from different programs, who based in applying a model of interaction among peers indistinctively assume consumer and producer knowledge roles, by incorporating authoring tools during their teaching process in a particular subject. Four levels can be distinguished for modeling the development of learning activities. Results show that 100% of the students assess positively the participation in their role as knowledge producers or consumers, accordingly to the four levels defined when using Web tools during their activities. Similarly, they recognize the potential of the instruction among peers associated with the use of Web tools as a contribution to their learning development.

KEYWORDS

Peer Learning, Education Technologies, Web Tools

1. INTRODUCTION

Up to date, classes are structured so that students act as knowledge receptors of what is transmitted by the teacher. Following this evidence, some investigations propose a change in this paradigm that consider a student as an authoring source of content in the coursing subject, which also allows the development of other skills and transverse competences, such as team work (McLoughlin & Lee, 2007; Gray et al., 2010).

In this context, Internet options to provide students the opportunities to create and publish contents that can be potentially used for their peers and their own consumption, is wide and diverse (Bennett, et al., 2012). This new way of understanding teaching, through the ICTs incorporation and authoring tools in the educational process, opens new possibilities to stimulate meaningful and collaborative learning among peers, one present aspect and hence means an alteration in the way of interaction amongst actors in the educational process (Rodriguez, Mendoza, 2014).

Educational institutions recognize the use of Internet promote interactions networks by allowing students to develop learnings from contents generated by the own students, and be considered as a primary learning source (Staines & Lauchs, 2013).

Instruction among peer using Web 2.0 authoring tools allows an active interaction beyond the traditional classroom. The use of these tools enables the promotion of creativity, and also encourages the interaction for achieving team work, both considered transcendental to the modern professional lifestyle. Lasri (2008) recognizes the importance of considering the participation of students in designing the learning activities, for example, when they interact with their peers inside and outside the classroom to promote their learnings.

This is the framework that supports the development of this research: "the knowledge or contents produced by students are not considered as primary source of knowledge", mainly because the traditional paradigm considers the teacher as the only person empowered to produce knowledge. The intervention

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shown is based on a model using Web 2.0 authoring tools which by relieving in the students the roles of producers and consumers of knowledge enhances the learning process. The model proposed here identifies four levels of interaction among peers for the production and consumption of knowledge, which are later described.

This article describes a case study of a group of students that act as knowledge producers, and when using learning resources generated by them self or by their peers as knowledge consumers. The aim of the experience is focused on promoting, among students from a higher education institution, the use of Web tools to produce knowledge. This knowledge is then lately made available to their peers and other group of students from different academic programs to be used in learning activities.

2. PRODUCTION AND CONSUMPTION OF KNOWLEDGE MODEL

Student's production of knowledge responds to a simple model. In this model (see Figure 1) the student produces contents by using tools from the Web 2.0.

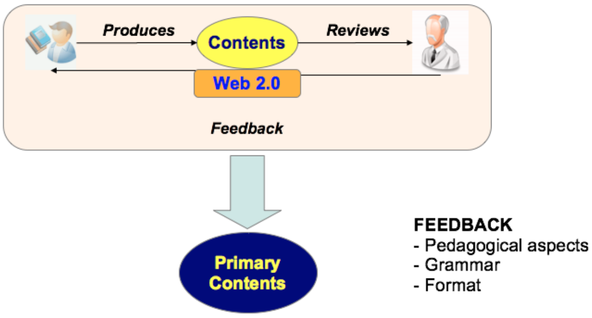

Figure 1. Knowledge Production Model

The content produced is reviewed by the teacher, who provides feedback to the student as often as necessary. Thus, as a product from this cycle, the primary content that is available to other students is obtained.

Consumption of knowledge model, was defined based on four interactions levels (see Figure 2).

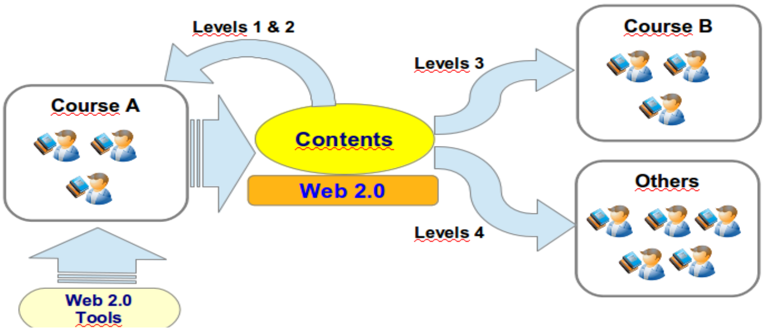

Figure 2. Levels of Consumption and Production of Knowledge

Level 1: Knowledge production level. Students assume the role of primary knowledge producers which is going to be used to promote their own learnings and can potentially use by their peers. At this level student autonomous working time is optimized, which allows the production of knowledge.

Level 2: Knowledge consumption level. Students consume the knowledge produced by their classmates. The value of the primary contents generated by the students is recognized when the teacher intentionally incorporates them in learning activities on a particular subject. The teacher, as a facilitator, generates the relevant activities that allow this level of consumption.

Level 3: Knowledge consumption level. The knowledge consumed is produced by students from other programs who attend equivalent courses. For this purpose, the courses involved have a related guidance but

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their curricula are different and therefore their learning context may have other approaches, even though the sequence of disciplinary subjects has common elements. This level must be deliberate by the teachers involved, for example through a Virtual Community of Practice generated for this propose.

Level 4: Knowledge consumption level. In this level the content produced by students is consumed by Web users, where massification of knowledge occurs transcending beyond the borders of the classroom. In this level a motivational aspect is highlighted, since the student can see that their knowledge production work is valued by external users. This is evidenced, for example by the number of visits count, comments posted and the amount of "likes" on the contents published on the Web, among other indicators.

3. METHODOLOGY

The present work describes an experience that involves different university programs, in which students use Web 2.0 tools to generate learning content, which are considered in their curricula and are potentially useful to their peers and Web users, as applicable.

The sample of participant consist in 51 students from all three programs, Pedagogy in Natural Science and Biology, Agronomy and Renewable Natural Resources Engineering careers (see Table 1). These three programs share a common initial formation subject incorporated into their curricula. In daily practice, there is no interaction between students from the different academic programs.

Table 1. Sample Composition

	Pedagogy in Natural Science and Biology	Agronomy	Renewable Natural Resourc Engineering
Numbers of Participants	18	14	19

All participating students from this experience are initially considered as potential actors in their roles as both producers and consumers of knowledge according to the levels described in the model.

For the purpose of this work, available Web tools were classified in the following categories: collaborative editing, mental maps, social networks, Web presenters, file sharing. In addition, for this experience, its use is complemented by linking an LMS Moodle (Learning Management System) which centralizes resources and activities for the student of the course. Criteria used for the selection of the tools were: accessibility, usability, gratuity and option for collaborative work in a synchronously and asynchronously way among users. Selected tools are shown in Table 2 and its use is specified given the context of this research.

Table 2. Selected Web 2.0 Tools and the Use Given in the Learning Process

Tool	**Collaborative Editing**	**Mental Maps Diagrams**	**Social Networks**	**Web Presenter**	**File Sharing**
Goear					X
Google Docs	X				
Dropbox	X				
Slideshare				X	
Dipity		X			
Cacoo		X			
Prezi				X	
Facebook			X		
Glogster	X				

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Based on Lasry's (2008) "Peer interactions", the experience for those students attending Organic Chemistry subject, consisted in the usage of some of these Web 2.0 tools for specific content authoring which became a learning input among students of the same course and students of equivalent courses. The selected tools for this work can embed objects on another platform. In this case, the products generated by the students were embedded within the LMS Moodle platform. Table 3 shows Web tools used by different students as producers and as consumers of knowledge.

Table 3. Authoring Tools According to Use and Career to Which Students Are Assigned

Program	**Tools**	**Use**
Agronomy	Google docs, Glogster Slideshar, Goear, Facebook	Produce Consume Produce and Consume
Renewable Natural Resources Engineering	Google docs Slideshare, Goear Facebook	Produce Consume Produce and Consume
Pedagogy in Natural Science and Biology	Dipity, Glogster Goear, Cacoo, Slideshare, Prezi, Dropbox	Produce Produce and Consume

Depending on the use of tools and according to what was stated in the description of the proposed model of use, a group of students assume the role of knowledge producers, whenever their materials can be used as primary source of content by themselves, by students from the same career and by students form other programs. The roles of consumers are recognized to other students from the same career or from another academic program, which use this material generated by their peers to benefit their own personal learning process. In general terms, the student's work was to select information, organize ideas, prepare presentations, and choose a broadcast medium for their peers, both physically and on-line, of a mandatory thematic content considered in the indicated subject.

As already noted, we worked with three programs of the same level, but with different educational contexts (Pedagogy in Natural Science and Biology, Agronomy and Renewable Natural Resources Engineering). For each program we worked with the Organic Chemistry subject, in a form that would cover the production and consumption levels, working in a common thematic content. Production and consumption of primary knowledge activities were assigned among the described students groups following the working model levels proposed in this work.

This experience gazed at the development of activities differentiated according to the role of producers and consumers of knowledge of students assigned to the different programs, but who share a common initial formation subject. The activities in each group and how they are integrated into the learning processes of the three programs are detailed below.

3.1 Pedagogy Students

For the Pedagogy in Natural Science and Biology program, levels 1, 2 and 4 of the described model were worked. Students using different Web 2.0 tools, produced learning products which were used as source of knowledge for themselves and by students of this program. Besides, it was found that many of the learning products generated, and published on the Web, were consumed by external people outside the institution (level4). Table 4 details each of the activities developed.

Table 4. Activities Developed by Pedagogy Students, Levels 1, 2 And 4

Activity	**Tool**	**Description**
Creating a presentation, and Web publication	SlideShare	Designing a presentation in power point format, with the topic "intermolecular attraction forces" which was uploaded to the SlideShare platform.
Timeline creation	Dipity	Development of the organic chemistry historical evolution, in timeline format.

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Podcast creation with nomenclature rules	Goear	Audio files were recorded based in nomenclature rules for aliphatic hydrocarbons, which were published in the Goear platform.
Graphic organizer creation	Cacoo	Mental maps graphic format were designed in, according to basic concepts of organic chemistry.
Poster creation for experimental results	Glogster	A collaborative report of experimental results was created in poster format according to organic chemistry functional groups.

3.2 Agronomy Students

Agronomy students, besides using the learning products generated by Pedagogy students (level 3), produced knowledge for themselves and their peers (levels 1 y 2). Table 5 details each of the activities developed.

Table 5. Activities Developed by Agronomy Students, Levels 1, 2 and 3

Activity	**Tool**	**Description**
Solving organic nomenclature exercises	Google Docs	This group uses pedagogy student's podcast to solve the exercises in a shared Google Docs spreadsheet. They work identifying and denominating chemical compounds applying nomenclature rules for organic compounds.
Presenting experimental work results	Glogster	After an experimental work in the organic compounds physical properties laboratory, students published their results in a poster crated in a collaborative way, in groups of three students. Each poster was published in Moodle to be used by all students.
Investigating and generating content to describe properties and characteristics of organic compounds	Slideshare	Students organized in pairs. They worked on an assigned topic to investigate and create a presentation that should be published on the Slideshare platform.
Learning biosafety rules for laboratory	Goear	A document with the laboratory biosafety rules was given to the students. They selected one of those rules and created a podcast later uploaded to Goear and published in Moodle.

3.3 Engineering Students

Natural Resources Engineering students used the learning products created by Pedagogy students, and also prepared learning products for personal consumption and for their peers. Table 6 resumes the activities developed by the Engineering students and the Web tools that were used, which stablished the production and consumption of knowledge at levels 1, 2 and 3.

Table 6. Activities Developed by Natural Resources Students, Levels 1, 2 and 3

Activity	**Tool**	**Description**
Fill multimedia template to recognize laboratory tools	Google Drive	Given a template prepared by the teacher and shared Google Slides, students worked on the development of this to describe laboratory instruments, depending on use and/or application.
Study and resolution of naming rules exercises of nomenclature for organic compounds denomination and formulation	Goear	Audio files created by Pedagogy students were embedded in Moodle so that Engineering students could listen repeatedly the naming rules, and lately apply these rules in resolving the organic compounds denomination and formulation exercises guides.
Organic compounds characterization	Google Drive	In a Google Docs shared document, students incorporated and/or collected from the web new bibliographical contributions that allow them to characterize chemical compounds according to observations of the experimental work.

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3.4 Evaluation

To perform an analysis of the model and their levels, a survey was made in Likert scale format (register 1 to 5), in which 5 is "strongly agree" and 1 is "strongly disagree". This instrument was randomly applied to students of the different participating programs. The questions were designed to show results from the four levels defined in the model. Table 7 shows the questions of this survey, classified depending on the definition in the proposed levels for the mentioned model.

Table 7. Survey to Assess Use and Satisfaction, According to Levels

1= Strongly disagree 2= Disagree 3= Undecided 4= Agree 5= Strongly agree

Level	Questions
1	1. The production of contents that were used by peers motivated me to create a good quality learning product.
1	2. The Web tools used to crate contents are important to develop my own learnings.
1	3. The activities implemented with these tools are motivating to develop learnings procedures.
1	4. The strategy of creating material for my consumption and for my peers', favors the development of learning.
2	5. The material produced by my peers contributed positively the process of the programmed activities in the subject.
2	6. Using contents created by my peers inspires distrust.
2	7. The production of learning content that will be used by my classmate favors my own learning in this discipline.
3	8. Using contents crated by pedagogy science students was useful to develop my own learnings.
3	9. The material developed by Pedagogy students is of a suitable quality for my subject requirements.
3	10. I appreciate positively using materials created by Pedagogy student.
3	11. Web 2.0 tools that Pedagogy students use are suitable to develop my learnings.
4	12. Learning contents that are visible on the Web are an important stimulus for developing my future professional skills.
4	13. Knowing that my content produced with Web 2.0 tools will be posted on the web motivates me to develop good quality material.

This tool was individually applied to each student through Google Form, using LMS Moodle platform to distribute it.

The data collected was systematize by using a simple mathematical model for its analysis and further discussion.

4. RESULTS

Tables 8 and 9 show the results of the survey applied, with the identification of the assessment of the experience in relation to the levels defined for their implementation.

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Table 8. Results of the Survey Question by Question. Data Mean According to Levels

	Level 1				**Level 2**			**Level 3**				**Level 4**	
Question>>	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Pedagogy	4,6	4,7	4,5	4,7	4,1	2,8	4,7	-	-	-	-	4,6	4,7
Agronomy	4,3	4,4	4,0	4,7	4,3	2,9	-	4,0	3,9	3,9	4,1	-	-
Engineering	-	4,3	-	-	-	-	-	3,9	4,0	4,2	3,9	-	-
Mean	4,5	4,5	4,3	4,7	4,2	2,8	4,7	3,9	4,0	4,1	4,1	4,6	4,7
	4,5				3,9			4,0				4,5	

Table 9. Results of the Survey. Overall Mean for Each Program According to Levels

	Level 1	**Level 2**	**Level 3**	**Level 4**
Pedagogy in Natural Sciences	4.6	4.4	-	4.7
Agronomy	4.4	4.3	4.0	-
Renewable Natural Resources Engineering	4.3	-	4.0	-
MEAN	**4.4**	**4.4**	**4.0**	**4.7**

It is noteworthy that for all levels activities were assessed positively (rank “agree” and “strongly agree”).

Level 1 (the student produces knowledge for self-use) was developed in all programs. Students assessed it very positively. 94% of the answers obtained values positively (score 4 or 5) being user and consumer of knowledge created by themselves. Besides, this shows that students assess positively the incorporation of Web tools to produce good quality content that promotes their own learning and peers’.

Like in the previous level, in level 2 (students consumed knowledge produced by peers from same course) the assessment from the students is positive. From this we can validate the model of knowledge production (Figure 1.), whenever students recognize the value of contents created by their peers. This content is made available to users throughout a teacher´s mediation, who intent their use to promote the learning of others.

In level 3 (students consumed knowledge produced by peers from other programs), Agronomy and Engineering programs consumed knowledge created by Pedagogy students. Students from these programs valued positively the contents crated by their peers from Pedagogy. The teacher´s intervention as mediator of the contents to students is outstanding, and the results enable to validate the model described for the purposes of this study.

In level 4 (contents created by students is consumed by external users from the Web) the instrument was applied only to pedagogy students. This level was positively valued, which shows the satisfaction of students, who were producers of knowledge, when observing that the contents of their authorship was consumed and valued by external users. Results show that content massification created by students, through the Web, reinforces their self-esteem and recognizes its value as knowledge producer.

Additionally, based on the obtained classifications from different courses it was possible to stablish that students achieved better grades compared to other semesters without this intervention.

Furthermore, development of transversal skills like team-work, autonomous learning and knowledge management is strengthened. This can be achieved with the use of technology due that most tools offer options that point to collaboration. For example, collaborative creation of conceptual maps with Cacoo, the creation of collaborative documents with Google Drive, or the creation of collaborative posters with Glogster, among other tools.

On the other hand, at general level, class dynamics and the personal motivation to face and assume their training successfully are strengthened. It was possible to value the quality of the knowledge created by the students based on comments, number of visits, amount of “likes”, among other indicators. This strategy enhances student motivation, because students can perceive that their contributions are valued by others. Besides, it motivates them to generate good quality products, knowing that they will be exposed to trial by others on the Internet.

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5. CONCLUSIONS

Throughout this study, we can confirm that the education among peers through the information and communication technologies is a useful tool that benefits and supports learning, and above all, motivates the student to produce good quality products. This is because there are dozens of tools for multiple use, available to teachers and students that are socially recognized and that incorporate social interactions elements like: collaboration, resource creation, share work, resource and experience feedback, and direct communication between people, among others. Therefore, it is possible today to take advantage of all these possibilities and highlight the role of the student as a producer of knowledge that will be used by their peers. Thus, training among peers using Web 2.0 authoring tools, allows an active interaction beyond the traditional classroom that helps to develop good quality learnings in different subjects such as chemical sciences and in areas like pedagogy and agronomy.

According to the results and considering the students' participation depending on different production and knowledge levels described in this article, it can be set that students from the three programs assess positively the proposed intervention according to the model of producers and consumers of knowledge in their different levels. Furthermore, it was possible to prove participation of students at all levels of producers and consumers of knowledge described. In this sense, the benefit on students is displayed, assuming both roles, producer and consumer. The role of producer allows them to incorporate, in the development of activities of a particular subject, the use of Web tools to strengthen their learning and to develop autonomy. On the other side, in their role of consumers, students showed satisfaction in the use of these strategies, assessing positively the knowledge produced by their peers.

The interaction among students, allowed the discussion of the issues discussed and the recognition of the contributions that each one of them could present independently to enhance their learnings. Moreover, this interaction allowed the detection of the best rated contents by the students themselves, identifying the most visited contents and those who were consulted more times. Thereby, students were able to recognize good quality job among their peers.

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