

ATIVIDADES EM PLATAFORMA WIKI PARA ENSINO SUPERIOR DE ENGENHARIA: A PERSPECTIVA DOS ALUNOS

ACTIVIDADES EN PLATAFORMA WIKI PARA ENSEÑANZA DE INGENIERÍA: LA PERSPECTIVA DE LOS ALUMNOS

ACTIVITIES-BASED ON WIKI PLATFORM FOR ENGINEERING HIGHER EDUCATION: STUDENTS' POINT OF VIEW

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RESUMO: A rápida evolução das Tecnologias da Informação e Comunicação (TICs) colaborou para o surgimento de uma nova geração de aprendizes que têm adotado os aparelhos móveis e as tecnologias Web 2.0 para busca de informação e comunicação. As ferramentas baseadas na Web 2.0, tais como os *blogs*, *wikis*, Facebook, Instagram, etc., oferecem grandes possibilidades para colaboração. Assim sendo, o principal objetivo desta pesquisa foi planejar uma atividade na plataforma *wiki* para a disciplina Estruturas de Concreto Armado do curso de Engenharia Civil com o propósito de responder às seguintes questões: (1) Como a colaboração poderia ser mensurada efetivamente em uma plataforma *wiki*? (2) Qual é a perspectiva dos alunos sobre a utilização da plataforma *wiki* para uma atividade colaborativa? A plataforma Wikispaces Classroom foi escolhida para a realização do projeto por ser adequada para tarefas educacionais colaborativas. Além disso, ela pode ser facilmente acessada em *tablets* e *smartphones*. As ações de 167 alunos do curso de Engenharia Civil foram monitoradas através das ferramentas estatísticas da plataforma Wikispaces. Todas as ações dos alunos foram analisadas e classificadas como baixo, médio ou alto nível de colaboração. No final do projeto 111 alunos responderam a um questionário e 10 participaram de uma entrevista informal onde expressaram a opinião deles sobre a plataforma, as atividades propostas e o relacionamento com seus colegas no ambiente online. Foi realizada uma análise estatística descritiva dos dados coletados na plataforma, questionários e entrevistas. Os resultados indicaram que a plataforma *wiki* é uma importante opção para o desenvolvimento de projetos e atividades colaborativas com o propósito de melhorar as seguintes habilidades dos alunos de engenharia: comunicação escrita, organização, colaboração e pensamento crítico.

PALAVRAS-CHAVE: Ensino de engenharia. Atividades em plataforma *wiki*. Colaboração em plataforma *wiki*.

RESUMEN: La rápida evolución de las Tecnologías de la Información y la Comunicación (TICs) colaboraron para el desarrollo de una nueva generación de estudiantes que están usando los recursos digitales para obtener información y comunicarse. Las herramientas basadas en la Web 2.0, como *blogs*, *wikis*, Facebook,

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Instagram, etc., ofrecen grandes posibilidades de colaboración. Así, el principal objetivo de esta investigación fue planear una actividad en la plataforma wiki para la disciplina Estructuras de Hormigón Armado del curso de Ingeniería Civil con el propósito de responder a las siguientes cuestiones: (1) ¿Cómo se puede utilizar efectivamente una plataforma wiki en una actividad de colaboración en línea? (2) ¿Cuál es la perspectiva de los alumnos sobre la utilización de la plataforma wiki para una actividad colaborativa? La plataforma Wikispaces Classroom fue elegida para la realización del proyecto porque es apropiada para actividades educativas colaborativas. Además, puede ser fácilmente accesible en tablets y smartphones. Las acciones de 167 alumnos del curso de ingeniería civil fueron monitoreadas con la ayuda de herramientas estadísticas de la plataforma Wikispaces. Todas las acciones de los alumnos fueron analizadas y clasificadas como bajo, mediano o alto nivel de colaboración. En el final del proyecto 111 alumnos respondieron a un cuestionario y 10 participaron de una entrevista informal en donde expresaron su opinión sobre la plataforma, las actividades y el compromiso de sus compañeros con el grupo no ambiente en línea. Fue realizada una análisis estadística descriptiva con los datos recogidos en la plataforma, cuestionarios y entrevistas. Los resultados indican que una plataforma wiki es una opción importante para el desarrollo de proyectos y actividades colaborativas con el propósito de mejorar las siguientes habilidades de los alumnos de ingeniería: comunicación escrita, organización, colaboración y el pensamiento crítico.

PALAVRAS CLAVE: Enseñanza de ingeniería. Actividades en la plataforma wiki. Colaboración en la plataforma wiki.

ABSTRACT: *The fast evolution of Information and Communication Technology (ICT) introduced a new generation of learners that have been adopted mobile devices and Web 2.0 technologies to get information and communicate. The Web 2.0-based tools, such as blogs, wikis, Facebook, Instagram, etc, offer huge possibilities for collaboration. In this way, the main purpose of this research was plan an activity on wiki platform for Reinforced Concrete discipline in Civil Engineering course and answer the questions: (1) How should collaboration be effectively measured on wiki platform? (2) What is the students' point of view about using wiki platform for a collaboration activity? Wikispaces Classroom platform was chosen for the project because it is a free social writing platform, suitable for collaborative learning. Furthermore it works on modern browsers, tablets, and smart phone. A total of 167 students of Civil Engineering course were monitored on Wikispaces® platform. All students' actions were analyzed and classified as low, medium or high level of collaboration. At the end of the project 111 students answered a questionnaire and 10 students participated of an informal interview where they expressed their opinion about the platform, the activities and the relationship with online peers. A descriptive statistical analysis of the data collected from the platform and the questionnaires answered by the students was performed. The results indicated that wiki platform is an important way to develop innovative activities and tasks for the purpose of to improve skills of engineering students such as: writing communication, organization, collaboration and critical thinking.*

KEYWORDS: Engineering education. Wiki-based activities. Collaboration on wiki platform.

Introduction

The expectations for the educational preparation of engineer are changing in the globalized and technological world. In order to attend the new demand of society and industry, there is a general consensus among researchers about the necessity to adopt methodologies that improve the skills and competences recommended for professionals of the 21st century, such as: problem solving, critical thinking, communication, collaboration, creativity, etc. (The Royal Academy of Engineering, 2007; The Royal Academy of Engineering, 2010; JAMES, 2014; KIM, 2015). The Royal Academy of Engineering (2007) constituted two committees composed of members of British universities and companies to address issues related to engineering education considering 21st century skills and the improvement of higher education engineering sector to meet industry needs for professional engineer. Important conclusions made by these teams are: (a) there is still much to do to improve students' perceptions in relation to their profession; (b) the universities need to ensure that the content of the courses taught reflects the real needs of the labor market; and (c) the engineering qualification system should focus on the importance of professionals' skills as the primary means of assessing student performance. Summarizing the report, the industry wants engineering graduates who have ability to apply theoretical knowledge to real industrial problems. They pointed some relevant attributes for professional engineer: theoretical understanding, creativity and innovation, team working, technical breadth and business skills. The reports also presented the set of skills that enable engineers work effectively: ability to communication and negotiation, collaboration and technological understanding.

Web 2.0 technologies that involve resources such as podcasts, photo and video sharing, instant messaging, among others, offer a high level of interactivity and communication between individuals as well as many possibilities for cooperation and collaboration (EBNER, KICKMEIER-RUST, HOLZINGER, 2008; SULISWORO, 2012; ABREU *et al.*, 2012; JAMES, 2014; MAY *et al.*, 2014; KIM, 2015). The wikis, one of the Web 2.0 technologies, can be used as a support tool for the teaching and learning process in order to improve 21st century skills such as critical thinking, reasoning and argumentation, information technology and communication, written communication, flexibility, adaptability, responsibility, collaboration, teamwork,

cooperation, negotiation and leadership (GOMES, SOUSA, 2013; WANG, 2014; KIM, 2015).

Although new methodologies that involve use of Web 2.0 technology are being investigated and adopted by professors in teaching and learning process in engineering education, the lecture-centered is the traditional approach in the teaching and learning process in higher education in Brazil. In this way, the main purposes of this research were plan an activity based on wiki platform to Reinforced Concrete discipline in Civil Engineering course to improve collaboration and written communication between students and, gather students point of view about the project and wiki platform.

Competences and Skills for 21st Century

According to the National Research Council (2012), 21st century skills have been defined as the knowledge and procedures that can be transferred or applied in new situations. Competences are related to the ability to meet complex demands through the mobilization of psychosocial resources, including skills and attitudes, in a specific context. The committee subdivided into three areas of competence: cognitive, intrapersonal and interpersonal. These domains distinctly represent human thought. The cognitive domain involves reason, problem solving, and memory, all related to reasoning. Intrapersonal is the affective domain that relates to emotion and feelings and includes self-control. Finally, the domain of interpersonal skills refers to how the individual expresses information to others and interprets messages received from other individuals, verbal or nonverbal, and responds appropriately. Over the last decade, many initiatives related to teaching and learning process have proposed outlined frameworks of 21st century skills that reflect the importance of them for professionals and industry (The Royal Academy of Engineering, 2007; National Research Council, 2012; ANANIADOU, CLARO, 2017). Despite of the diversity conceptual definitions about of 21st century skills and to some extent connote different skills and/or reflect different categorizations of the skills, collaboration, communication, digital literacy, problem solving, critical thinking, creativity, and team working are mentioned in the most of frameworks.

Vygotsky introduced the concept of Zone of Proximal Development (ZPD), defined as the “distance between the actual developmental level as determined by

independent problem-solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers” (VYGOTSKY, 1978). His social-cultural learning theory originally refers to expert-novice or teacher-student interactions but it has been applied to supportive behaviors by which students can help each other in the classroom or online platform (GUERRERO, VILLAMIL, 2000; LI, ZHU, 2013; CICONI, 2014; HADJERROUIT, 2014). Online platforms offer new opportunities to team working, for example, wiki platforms with high interactivity potential that enables users to create and edit online hypertexts easily (GOMES, SOUSA, 2013; WANG, 2014). In wiki platforms, editions and revisions can be made directly in the text and the changes can be synchronized or not. In the discussion page, students can communicate and argue about the specific subject and consequently they are encouraged to construct knowledge and develop critical thinking. In addition, previous research results demonstrated that wikis are also an efficient platform to measure collaboration, interactivity and written communication (HADJERROUIT, 2014; University of Delaware, 2008). Wiki platforms provide tools that enable professors to evaluate individually the student’s contribution level through history log and statistics resources. Despite the advantages of wiki platforms, students should be encouraged to collaborate with each other to make revisions on the text because most of learners are inclined to work independently of each other without peer support (WANG, 2014; HADJERROUIT, 2014).

Wikis and 21st Century Skills

Ward Cunningham in 1995 introduced the concept of wikis when created the first wiki website known as Wiki Wiki Web (Wiki-Wiki-Web® Website, 2017). The Hawaiian word for quick, wikiwiki, was the inspiration for the term wiki (EBNER, KICKMEIER-RUST, HOLZINGER, 2008; ABREU *et al.*, 2012). There are different platform freely available on the internet for creating wikis, such as: [MediaWiki](#), [TWiki](#), [DokuWiki](#) and [Wikispaces](#). MediaWiki®, TWiki®, and DokuWiki® are open source wiki software that is especially useful for web application and enterprise context. All of those three software mentioned before you must download the newest release from the corporation website, unpack and install/copy the files to your web space but some web server administration skill is necessary. In contrast, Wikispaces® is a free online

platform for education proposals that does not require download and installation tasks. Wikispaces® also provides a statistical report about the usage of the projects, i.e., pages accessed and date of access for all wiki project users. Most of wiki software/platform freely available can be applied for educational projects so educators should identify the features that are essential for the activity and depending on these features the best wiki software/platform might be chosen.

Abreu *et al.* (2012) conducted research with teachers and students who participated in online activities on the wiki platform. A total of 149 teachers and students (12 teachers and 137 students) answered the questionnaire available online; 50% of teachers chose the wiki platform as the best way to make content available to students and a small portion of professors (25%) would adopt the platform to evaluative activity. Considering students point of view, 63% reported that the wiki platform is best suited for collaborative activities compared to others, such as Google Docs, ShareLaTeX, etc. To check how a wiki platform could facilitate collaboration and promote foreign language learning, Wang (2014) applied online activities in the course of English as a foreign language. Their conclusions attest to the fact that this resource increased students' motivation to learn English, raising student confidence and promoting socio-constructivist initiatives. According to Gomes and Sousa (2013) the development of activities on wiki platforms can contribute greatly to teamwork processes, improving self-organization, integrity and transparency. The authors used a wiki platform for online activities of the Information Systems Management course to investigate the results of using this technology in the teaching and learning process.

Research Questions

Although Web 2.0 technologies can support teaching and learning process and improve students' 21st century skills providing to them opportunity to get control of your own learning process, there is a lack of report about how to apply wiki resource in engineering education. In this way, the following questions were addressed to explore the characteristics of wikis for improving the abilities and skills of students:

- (1) *How should collaboration be effectively measured on wiki platform?*
- (2) *What is the students' point of view about using wiki platform for an collaboration activity?*

Methodology

a) Participants

This research involved the participation of a total of 167 fourth year civil engineering students from two different universities. The group consisted of 98 males and 69 females. All of participants were enrolled in Reinforced Concrete Structures which is a compulsory discipline in Civil Engineering course. Participation in the wiki-based project was a complimentary part of the course as homework task. All students had experience with teamwork, but none of them were familiar with wiki-based collaborative writing.

b) Wiki Platform

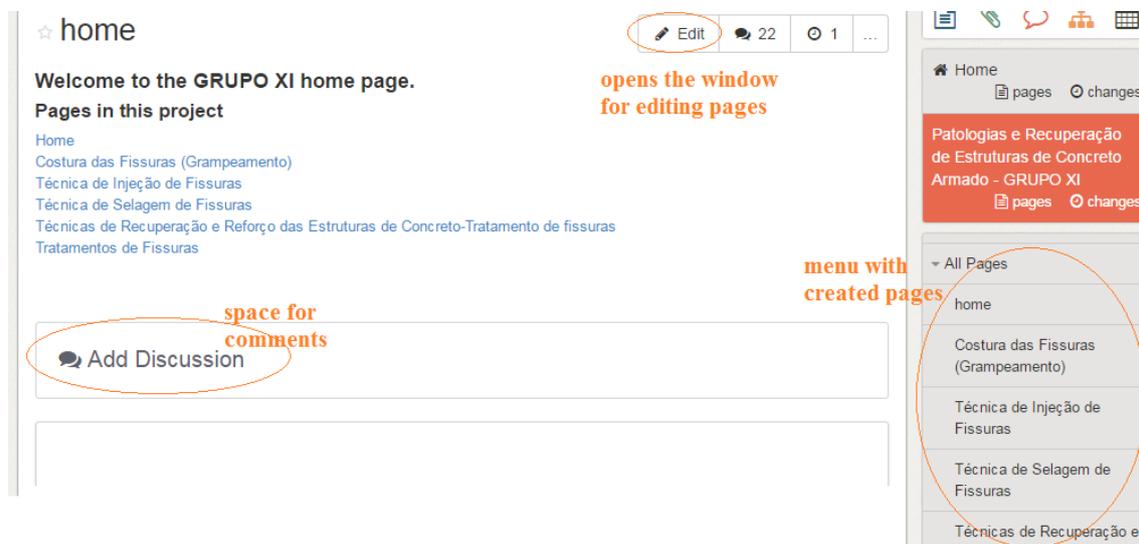
Wikis are classified as pure or authentic and hybrid. Both can be used in online activities such as brainstorming, team projects, support resources for meetings, list building, link collection, collective written content on the web, building group archives (University of Delaware, 2008). Hybrid wikis have two characteristics that becomes it much more appropriate for educational projects: (a) it is moderated by a specialist, i.e., the teacher administers all available resources including the schedule for the assignment of tasks; (b) the participants and all their actions are registered in the platform and can be monitored in real-time or analyzed later by the moderator. Wikispaces® Classroom platform was chosen because it is a social writing platform for education suitable for collaborative learning. Some important characteristics of this platform are: (a) students can use it easily, (b) teacher and students can communicate and work on writing projects alone or in teams, (c) it provides assessment tools that give teachers the power to measure student contribution and engagement in real-time; and (d) it is possible to implement a hybrid wiki. Furthermore it works on modern browsers, tablets, and smart phone. Figure 1 shows part of a team homepage composed by editing page, comments, menus and command icons.

c) Activities on Wikispaces® Platform

Wiki-based project was developed during 5 weeks. The first week of the project was reserved to introduce to students the main resources of Wikispaces platform. During this week they learned about the text editor and also about platform's main resources they need to edit and revise texts and communicate with peers. Next three weeks the teams should make the established tasks. Three tasks were timetabled: (1) bibliographic research, (2) pages implementation and, (3) peer review. Fifth week was reserved for professor's final feedback. The project was detailed on the web environment, i.e., all information about the team tasks, production of final online pages, and assessment were posted in home page of wiki-based project.

It was created 27 teams and for each team was chosen a subject of Reinforced Concrete Design. The students were randomly distributed into each team. Students worked together in order to create online pages in Wikispaces® platform about their respective topics. Students were provided with list of references with articles, books, and technical magazines available at university library. They were allowed to use additional resources such as internet information.

Fig. 1: Team homepage in Wikispaces platform.



Source: Printed screen of the Wikispace platform, author's collection, 2017.

d) Collaboration in the History Log and Comments Space

In the wiki platform, the actions of each member can be measured by number of accesses, permanence time and number of editions, revisions and comments. On revisions, for example, members can contribute to a wiki in many ways: add and

remove new content, restructure existing content, revise text grammar and sentences, etc. Based on Pfeil, Zaphiris, and Ang (2006) recommendations, editions were categorized into 2 actions: add information and delete information; revisions were categorized into 3 actions: format page, clarify or modify information and correct grammar and spelling. The comments were classified into 3 types of message: related to project and technical information, related to content or theme and message to clarify information. All actions' categories are explained in Table 1 whose also presents the three levels of collaboration considered in this research: low, medium and high.

Table 1: Collaboration level for editions, revisions and comments.

Category	Interaction		
	Action	Explanation	Collaboration Level
Edition	Add information	Add information related to the topic (text, link, video, etc.).	Medium
	Delete information	Delete information related to the topic (text, link, video, etc.).	Medium
Revision	Format page	Improve appearance, presentation or structure of the text or page (addition of space lines, sorting/moving of paragraphs or links and addition of subtitles in order to structure the content, bold/ italic/underlined text).	Low
	Clarify or modify information	Clarify existing information by adding or not new information (replace, insert or delete words or phrases to improve understanding of the text). Modify an existing information like an alteration of the linked URL, image, video or text.	High
	Correct grammar and spelling	Modify grammar (e.g., change of punctuation) and correct spelling mistakes (reversed letters or capital letter, spelling errors).	High
Comments	Send message about project or technical information	Write comments related to the activities' organization (deadlines, division of tasks, etc.) or related to how the platform works (how to insert images, how to format tables and texts, how to create a new page, etc.)	Low
	Send message about content	Write comments related to content (presentation of new information, suggestion of links)	Medium
	Send message to clarify information	Write comments clarifying or modifying information to improve understanding of content or pointing mistakes.	High

Source: Adapted from Pfeil, Zaphiris, and Ang (2006) and Hadjerrouit (2014).

e) Background Questionnaire

After the end of project, all students were invited responding a questionnaire which was developed to facilitate further investigation of online collaboration activities in wiki platforms. A printed questionnaire was delivered individually to each them. The questionnaire consists of 14 questions in the Likert scale, in 5 levels: (1) totally disagree, (2) disagree, (3) neutral, (4) agree, (5) totally agree. Next, the students' satisfaction level in terms of project organization, experience using the wiki platform, knowledge acquisition, self-behavior and peer-behavior were analyzed. Reliability and internal consistency of the questionnaire was verified by the Cronbach's alpha test whose value was 0.81.

Results

Thirteen students (7.8%) of the 167 students invited to participate in the wiki platform project did not perform any action, although they accessed the environment some times. In Table 2 are presented the numbers of actions related to edition, revision and comment by team and, Table 3 presents the amount of actions according to level of interaction for each team.

Table 2: Actions performed by team.

Team	Edition	Revision	Comment	Edition (%)	Revision (%)	Comment (%)
1	37	37	17	40.7	40.7	18.7
2	4	10	32	8.7	21.7	69.6
3	18	19	26	28.6	30.2	41.3
4	6	1	23	20.0	3.3	76.7
5	35	37	49	28.9	30.6	40.5
6	13	18	19	26.0	36.0	38.0
7	21	5	36	33.9	8.1	58.1
8	11	6	28	24.4	13.3	62.2
9	15	7	30	28.8	13.5	57.7
10	18	5	51	24.3	6.8	68.9
11	27	6	49	32.9	7.3	59.8
12	24	16	27	35.8	23.9	40.3
13	13	4	17	38.2	11.8	50.0
14	19	19	20	32.8	32.8	34.5
15	22	26	46	23.4	27.7	48.9
16	14	9	19	33.3	21.4	45.2

17	9	6	19	26.5	17.6	55.9
18	22	10	36	32.4	14.7	52.9
19	19	7	16	45.2	16.7	38.1
20	14	13	30	24.6	22.8	52.6
21	8	9	24	19.5	22.0	58.5
22	16	25	41	19.5	30.5	50.0
23	20	8	20	41.7	16.7	41.7
24	10	3	26	25.6	7.7	66.7
25	29	5	42	38.2	6.6	55.3
26	4	2	17	17.4	8.7	73.9
27	25	11	18	46.3	20.4	33.3
Total	473	324	778	30.0	20.6	49.4

Source: Prepared by author.

Table 3: Collaboration level by team.

Team	Low	Medium	High	Low (%)	Medium (%)	High (%)	Content Evaluation
1	39	40	12	42.9	44.0	13.2	10.0
2	28	11	7	60.9	23.9	15.2	7.0
3	25	27	11	39.7	42.9	17.5	9.0
4	17	10	3	56.7	33.3	10.0	4.0
5	57	44	20	47.1	36.4	16.5	10.0
6	8	32	10	16.0	64.0	20.0	10.0
7	20	41	1	32.3	66.1	1.6	5.0
8	13	27	5	28.9	60.0	11.1	10.0
9	31	17	4	59.6	32.7	7.7	5.0
10	22	39	13	29.7	52.7	17.6	10.0
11	37	41	4	45.1	50.0	4.9	10.0
12	27	29	11	40.3	43.3	16.4	10.0
13	17	17	0	50.0	50.0	0.0	5.0
14	20	24	14	34.5	41.4	24.1	7.5
15	39	37	18	41.5	39.4	19.1	10.0
16	14	21	7	33.3	50.0	16.7	10.0
17	11	12	11	32.4	35.3	32.4	2.5
18	32	31	5	47.1	45.6	7.4	7.5
19	14	26	2	33.3	61.9	4.8	5.0
20	28	21	8	49.1	36.8	14.0	7.5
21	29	11	1	70.7	26.8	2.4	5.0
22	37	29	16	45.1	35.4	19.5	10.0
23	19	23	6	39.6	47.9	12.5	10.0
24	19	16	4	48.7	41.0	10.3	5.0
25	26	41	9	34.2	53.9	11.8	7.5
26	11	10	2	47.8	43.5	8.7	2.5
27	17	29	8	31.5	53.7	14.8	10.0

Total	657	706	212	41.7	44.8	13.5	-
Mean	24.3	26.1	7.9	-	-	-	-

Source: Prepared by author.

a) Students' Final Score

For final grade was considered just medium and high level of collaboration and the follow aspects of the constructed pages: quality of the content, presentation and organization of them and bibliographic reference. Students' participation was an individual score and for it was separated 50% of final score. Content evaluation was a team score and for it was also separated 50% of final score. Content score was classified according to its range, such as: 1-2.4 (regular); 2.5-5.5 (good); 5.4-7.5 (very good) and; 7.4-10 (excellent).

b) Collaboration Analysis

There were 1575 actions performed by the participants, of which 473 (30.0%) were editions, 324 (20.6%) revisions and 778 (49.4%) comments, as show in Table 2. Most of actions performed were considered as medium level (44.8%), followed by low level actions (41.7%) and high level actions (13.5%), see Table3. In Table 3 are also presented the mean for low, medium and high level of collaboration.

The content of 16 (59.3%) teams was considered very good or excellent. Twelve teams (75.0%) of these groups intensively collaborated with peers; their percentage of collaborations' high level is above mean, as shown Table 3. Although their members did not collaborate effectively with their colleagues, the teams 3, 11, 16 and 23 had an excellent score attributed to the content pages. In these teams some of their members worked practically alone without sharing the tasks with their colleagues. In groups 3, 11, and 18 only 50% of team members performed editing and review actions, the other students limited themselves to comments.

c) Questionnaire Outcomes

Of the 167 participants, 111 (66.5%) answered the questionnaire. In Table 4 are presented all fifteen questions and the percentage of answers for each Likert scale of

each question. Although the majority of respondents (64.9%) indicated options 4 and 5 affirming that the platform has all the necessary resources for the development of the project, a huge number of them (46.0%) reported difficulty in using their available resources.

Of all respondents, 46.0% think the project contributed to improving their ability to written communication; 58.6% believe the project has contributed to the development of their collaboration skills; 69.4% agreed with the flexibility of the online platforms for the development of learning since they can choose the time and place to carry out the tasks. Regarding teacher feedback, 73.0% agreed that it was important for the development of tasks. A little bit more than half of participants, 56 (50.5%) considered the experience as positive and for 31.5% of participants the experience was considered indifferent. A total of 42.4% stated that they did not have difficulties working with peers in this online teamwork and 35.1% said they had some type of difficulty. All the students affirmed never to have participated of a project using a wiki platform and no activity realized totally online during the course of graduation, until that moment.

Table 4: Answers' percentage for each question.

Question	Responses' Frequency (%)				
	1	2	3	4	5
The Wikispaces platform has the necessary resources for the development of online activities.	0.9	9.9	24.3	53.2	11.7
I had no difficulty to use the platform tools once there is an online tutorial.	7.2	39.6	26.1	19.8	7.3
The time reserved to create pages was enough.	0	11.7	18.0	50.5	19.8
The time reserved to peer review pages was enough.	0	13.5	18.9	51.4	16.2
The wiki project helped me in developing skills for written communication.	3.6	17.1	33.3	39.6	6.4
The wiki project helped in developing my skill to collaborate in teamwork activities.	3.6	16.2	21.6	46.8	11.8
The teacher feedback supported me in the development of after further activities.	0	2.7	24.3	58.6	14.4
The peer feedback supported me in the development of after activities.	6.3	19.8	36.9	33.3	3.7
Performing activities in an online platform becomes easy the communication between the participants of the team and between the teams and the teacher.	16.2	33.3	29.7	18.9	1.9
The online activities facilitate students' participation in the proposed tasks.	23.4	54.1	18.9	3.6	0
Online activity is a flexible teaching and learning methodology because I can perform the tasks anytime and anywhere.	3.6	5.4	21.6	57.7	11.7

I prefer to use the time in the classroom to clarify doubts and to use online resources to studying and performing activities.	5.4	19.8	22.5	36.0	16.3
I had no difficulty working with my peers in this online project.	11.7	23.4	22.5	33.3	9.1
My experience in this wiki-based project was positive.	2.7	15.3	31.5	39.6	10.9
I have never participated in a project or activity based on wiki platform.	0	0	0	0	100

Source: Prepared by author.

d) Interview Outcomes

It was conducted an informal interview with 10 students that had participated effectively. They should answer just one question:

Which are the positives and negative points of Wikispaces' project?

The main students' reports about positive points were: (1) possibility to choose time and place to do the tasks; (2) possibility to visit pages of all groups after the end of the project; (3) students are encouraged to collaborate more; (4) spend more time in class clarifying doubts once that activities about the chosen topic was realized online. And the main negative points were: (1) difficulty to understand the platform, mainly the text editor; (2) some students do not answer the messages because they did not access the platform and; (3) some colleagues done the tasks in the last hour which harmed the well development of other students' tasks of team. Most of students (80%) related that wiki was a nice tool for collaboration work and file sharing despite of the negative points reported. Some students (30%) indicated preferences on using other platform because they think that it is difficult to execute some operations and commands on Wikispaces text editor such as inserting images and tables.

Final considerations

This work takes part of o research project whose the main objectives were explore the possibility of use wikis as pedagogical resource for online teamwork in engineering courses, observe the level of collaboration between students in a wiki platform and, identify the challenges of using wiki platforms in higher education. Here, it was presented the feedback from students regarding the project as a whole. In

addition, it was explained the methodology adopted for the assessment of the tasks performed. All 27 teams created digital learning material on Wikispaces platform about a specific subject of Reinforced Concrete discipline. Data were collected from statistic reports, questionnaire answers and informal interview and were analyzed to answer the research questions.

First Question: *How should collaboration be effectively measured on wiki platform?*

Measuring collaboration on wiki platforms for educational purposes only by counting the number of edits, revisions and comments is not enough to clearly state that there was collaboration. These parameters indicate student participation but do not determine the level of collaboration involved. To be more precise in the measurement of the collaboration of each individual it was necessary to categorize the actions identifying the types of possible collaborative actions and their classification into levels. The results demonstrated that the application of this methodology was efficient for classifying actions and determination of participation for each student in the three established levels.

Second Question: *What is the students' point of view about using wiki platform for a collaboration activity?*

Most of participants think that the online activities realized on wiki platform contributed to improve their skills to written communication and collaboration. In addition, many students considered the experience as positive. They confirmed the importance of teacher and peers feedback to successfully development of all established tasks. In both, interview and questionnaire, it was emphasized by participants the following challenges: difficult to use the platform tools and working together in a team once some peers did not do the tasks on time. However, all of them reported that it was the first time they participated in wiki platform based activities.

Some important points were noticed during the five weeks project. The first one is the difficulty of the students in collaborating with their peers. Although it was explained during the class the importance of actions classified as high level of collaboration, only 13.5% of total actions (1575) performed in wiki platform corresponded to this classification, see Table III. As suggestion, they should be more encouraged to working with peer instruction methodology to improve their ability to collaborating in higher level.

The second observation, and also quite important, is that although 46.8% of the students reported difficulty in using or applying Wikispaces available resources (Table IV) all of them have never participated in a online wiki-based project. To further decrease this percentage, a more detailed lesson on the platform and its resources is recommended.

And finally, according to Waycott *et al.* (2013) , the use of social technologies in higher education could introduce new tensions for students and teachers when (1) students make their work visible to others; (2) teachers challenge the rules and established practices associated with university assessment; and (3) teachers introduce new practices and pedagogical approaches. It is appropriate to students be comfortable with how they represents themselves in online environment so it is convenient to educate students about taking care when publishing their work on social medias. To minimize the impact of new approaches' implementation, professors should consider negotiating with university the rules for students' assessment and paying attention on pedagogical aspects related to online learning.

Despite of all challenges, wiki platform is an important way to develop innovative activities and tasks based on learner-centered approach (LCA) in online environment. Wiki-based project provides opportunity for learners to participate actively in their own learning process; pedagogical activities in online environment can contribute to pro-active and collaborative writing and furthermore, wikis can improve the teaching and learning process greatly once it can contribute to development of students' abilities and skills such as: written communication, organization, and critical thinking development.

Especially in engineering education, wiki-based activities can be used to support different projects like brainstorming, team project, and writing collective web content. It is important to clarify that the main idea behind this proposed approach is not to discard the traditional classroom teaching method, but to create complementary and innovative alternatives, which aid lectures to improve student's engagement.

REFERENCES

ABREU, P. et al. Effect of the usage of wikis on an educational context. **Computer Applications in Engineering Education**, v. 20, p. 646-65, 2012.
<<http://dx.doi.org/10.1002/cae.20434>>.

ANANIADOU, K.; CLARO, M. 21st Century skills and competences for new millennium learners in OECD countries. Organisation for Economic Cooperation and Development. **EDU Working paper** n. 41. Retrieved March 12, 2017 from: <[http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=EDU/WKP\(2009\)20&doclanguage=en](http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=EDU/WKP(2009)20&doclanguage=en)>.

CICCONI, M. Vygotsky meets technology: A reinvention of collaboration in the early childhood mathematics classroom. **Early Childhood Educ J**, v. 42, p. 57-65, 2014. <<http://dx.doi.org/10.1007/s10643-013-0582-9>>.

EBNER, M.; KICKMEIER-RUST, M.; HOLZINGER, A. Utilizing wiki-systems in higher education classes: a chance for universal access? **Universal Access in the Information Society**, v. 7, N. 4, p. 199-207, 2008. <<http://dx.doi.org/10.1007/s10209-008-0115-2>>.

GOMES, R.; SOUSA, L. Teaching and learning through wikis in higher education. **International Journal of Information and Education Technology**, v. 3, n. 6, p. 628-633, 2013. <<http://dx.doi.org/10.7763/IJiet.2013.V3.350>>.

GUERRERO, M. C. M. de; VILLAMIL, O. S. Activating the ZPD: Mutual scaffolding in L2 peer revision. **The Modern Language Journal**, v. 84, p. 51-68, 2000. <<http://dx.doi.org/10.1111/0026-7902.00052>>.

HADJERROUIT, S. Wiki as a collaborative writing tool in teacher education: Evaluation and suggestions for effective use. **Computers in Human Behavior**, v. 32, p. 301-312, 2014. <<http://dx.doi.org/10.1016/j.chb.2013.07.004>>.

JAMES, R. ICT's participatory potential in higher education collaborations: Reality or just talk. **British Journal of Educational Technology**, v. 45, n. 4, p. 557-570, 2014. <<http://dx.doi.org/10.1111/bjet.12060>>.

KIM, N. Critical thinking in wikibook creation with enhanced and minimal scaffolds. **Educational Technology Research and Development**, v. 63, p. 5-33, 2015. <<http://dx.doi.org/10.1007/s11423-014-9361-6>>.

LI, M.; ZHU, W. Patterns of computer-mediated interaction in small writing groups using wikis. **Computer Assisted Language Learning**, v. 26, n. 1, p. 61-82, 2013. <<http://dx.doi.org/10.1080/09588221.2011.631142>>.

MAY, D. et al. What students use - results of a survey on media use among engineering students. In: **Frontiers in Education Conference**, 2014, Madrid, Spain. IEEE Frontiers in Education Conference Proceedings, 2014. <<http://dx.doi.org/10.1109/FIE.2014.7044002>>.

National Research Council. Education for life and work: Developing transferable knowledge and skills in the 21st century. **Committee on Defining Deeper Learning and 21st Century Skills**, J.W. Pellegrino and M.L. Hilton, Editors. Washington, DC: The National Academies Press, 2012.

PFEIL, U.; ZAPHIRIS, P.; ANG, C. S. Cultural differences in collaborative authoring of Wikipedi". **Journal of Computer-Mediated Communication**, v. 12, n. 1, p. 88-113, 2006.

SULISWORO, D. Designing the online collaborative learning using the Wikispaces. **International Journal of Emerging Technologies in Learning**, v. 7, n. 1, p. 58-61, 2012.

The Royal Academy of Engineering. **Educating engineers for the 21st century**. London, UK: The Royal Academy of Engineering Press, 2007.

The Royal Academy of Engineering. **Engineering graduates for industry**. London, UK: The Royal Academy of Engineering Press, 2010.

University of Delaware. **Wikis in higher education**. Newark, DE: University of Delaware, IT-User Services, 2008. Retrieved March 12, 2017 from: <http://udel.edu/~mathieu/wiki/resources/2008-5-3_Wikis_in_Higher_Education_UD.pdf>.

VYGOTSKY, L. S. **Mind and society**: The development of higher mental processes. Cambridge: MA, Harvard University Press, 1978.

WANG, Y.-C. Using wikis to facilitate interaction and collaboration among EFL learners: A social constructivist approach to language teaching. **System**, v. 42, p. 383–390, 2014. <<http://dx.doi.org/10.1016/j.system.2014.01.007>>.

WAYCOTT, J. et al. Making students' work visible on the social web: A blessing or a curse? **Computers & Education Journal**, v. 68, p. 86-95, 2013. <<http://dx.doi.org/10.1016/j.compedu.2013.04.026>>

Wiki-Wiki-Web® Website. **Cunningham, Ward**, 1995. Retrieved April 2, 2017 from <<http://c2.com/cgi/wiki?WelcomeVisitors>>.

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