







## RESEARCH


Received: 07/06/2019 --- Accepted: 17/12/2019 --- Published: 15/06/2020


# VIRTUAL ENVIRONMENT E-EVALUATION AS A MANAGEMENT TOOL IN NUMEROUS GROUPS

*Entorno virtual e-evaluaciones como herramienta de gestión en grupos numerosos*

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## ABSTRACT

This article presents the development of a virtual environment of e-evaluations for the management of evaluations and monitoring of the academic performance of students in large groups, applied in a pilot test in the academic unit of mechatronic engineering of Sinaloa Polytechnic University, Mexico. The development of the virtual environment of e-evaluations consists in the use of the model-view-controller framework, CodeIgniter developed by EllisLab, at the same time Bootstrap, a framework developed within the Twitter company, was used with the aim of standardizing the tools that are used in the development of the front-end. The results obtained allow us to observe an increase in synchronous and asynchronous interaction between professor and student in a virtual environment of e-evaluations; for their part, the professors measured and observed a saving in the time allocated to carry out the evaluation in large groups. The evaluation was carried out through customized management of each of the students. On the other hand, the virtual environment involved the student in his own evaluation and feedback, the experience in the use of the virtual environment said by the students was positive since it allowed them to develop the evaluation in an interactive way in a shorter time. In conclusion, it was obtained that the virtual e-evaluations environment

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provides elements that promote the follow-up and monitoring of the evaluation results.

**KEYWORDS:** e-evaluation – virtual environment – numerous groups – web tools – distance education – evaluation – higher education – learning.

## **RESUMEN**

En este artículo se presenta el desarrollo de un entorno virtual de e-evaluaciones para la administración de evaluaciones y seguimiento del rendimiento académico de los estudiantes en grupos numerosos, aplicado en una prueba piloto en la unidad académica de ingeniería mecatrónica de la Universidad Politécnica de Sinaloa, México. El desarrollo del entorno virtual de e-evaluaciones consiste en el uso del framework de modelo-vista-controlador, CodeIgniter desarrollado por EllisLab, al mismo tiempo se utilizó Bootstrap un framework desarrollado dentro de la compañía Twitter con el objetivo de estandarizar las herramientas que se utilizan en el desarrollo del front-end. Los resultados obtenidos permiten observar un incremento en la interacción sincrónica y asincrónica entre docente y estudiante en un entorno virtual e-evaluaciones; por su parte de los docentes se midió y se observó un ahorro en el tiempo destinado a realizar la evaluación en grupos numerosos, se realizó la evaluación a través de una administración personalizada de cada uno de los estudiantes, por otro lado el entorno virtual hizo partícipe al estudiante de su propia evaluación y retroalimentación, la experiencia en el uso del entorno virtual dicha por los alumnos, fue positiva dado que les permitió desarrollar la evaluación de una manera interactiva en un menor tiempo. Como conclusión se obtuvo que el entorno virtual e-evaluaciones aporta elementos que promueve el seguimiento y monitoreo de los resultados de la evaluación.

**PALABRAS CLAVE:** e-evaluación – entorno virtual – grupos numerosos – herramientas web – educación a distancia – evaluación – educación superior – aprendizaje.

## **ENTORNO VIRTUAL, AVALIAÇÕES ONLINE COMO FERRAMENTA DE GESTÃO EM GRUPOS NUMEROSOS**

### **RESUMO**

Neste artigo se apresenta o desenvolvimento de um entorno virtual de avaliações online para a administração de avaliações e seguimento do rendimento académico dos alunos em grupos numerosos, aplicado numa prova piloto na unidade académica de engenharia mecatrônica da Universidade Politécnica de Sinaloa, México. O desenvolvimento do entorno virtual de avaliações online consiste no uso do framework do modelo-vista-controlador, CodeIgniter desenvolvido pelo EllisLab, ao mesmo tempo se utilizou Bootstrap um framework desenvolvido dentro da empresa Twitter com o objetivo de padronizar as ferramentas que se usam no

desenvolvimento do front-end. Os resultados obtidos permitem observar um incremento na interação síncrona e assíncrona entre professor e aluno em um ambiente virtual de avaliação online; por parte dos professores se mensurou e se observou uma economia no tempo destinado a fazer a avaliação em grupos numerosos, se executou a avaliação através de uma administração personalizada de cada um dos alunos, por outro lado o entorno virtual fez participar ao aluno da sua própria avaliação e retroalimentação, a experiência no uso do entorno virtual de acordo com os alunos, foi positiva dado que permitiu-lhes desenvolver a avaliação de forma interativa em um tempo mais curto. Como conclusão se obteve que o entorno virtual e as avaliações online aportam elementos que promovem o seguimento e monitoramento dos resultados da avaliação.

**PALAVRAS CHAVE:** avaliações online - entorno virtual - grupos numerosos - ferramentas web - educação a distância - avaliação - educação superior - aprendizado.

#### **How to cite the article:**

Espino Román, P., Olaguez Torres, E., López Hernández, R. A. & Vásquez Martínez C. R. (2020). Virtual environment e-evaluation as a management tool in numerous groups. [Entorno virtual e-evaluaciones como herramienta de gestión en grupos numerosos]. *Vivat Academia. Revista de Comunicación*, (151), 107-125.  
doi: <http://doi.org/10.15178/va.2020.151.107-125> Recovered from  
<http://www.vivatacademia.net/index.php/vivat/article/view/1201>

## **1. INTRODUCTION**

Both in Mexico and globally, political agendas have more participation in issues related to education, where it is reflected that coverage of education predominates. In the National Development Plan (2013-2018) of the government of the republic in Mexico, it established, in one of its lines of action, to achieve coverage of higher education by at least 40% by 2018 (González, 2015). Regarding coverage of higher education, the National Association of Universities and Institutions of Higher Education (ANUIES) has proposed the goal of increasing coverage by 60 percent in the 2021-2022 cycle, that is, an enrollment of 5 million 840 thousand students, therefore, enrollment should increase 257,000 each year. In total, enrollment increases more than 2 million 570 thousand additional to those registered in the 2011-2012 cycle (Arias et al, 2013). In the 2016-2017 school year, in higher education, according to the Ministry of Public Education (2017) and based on the report presented by the Organization for Economic Cooperation and Development (OECD) indicates that, in the 2016-2017 school year, it increased with a total coverage of 5.2 percentage points, from 32.1% to 37.3%.

In the particular case of the State of Sinaloa, Mexico, the coverage of higher education is located in the first place at the national level with 43% this in the 2015-2016 school year according to statistics from the Ministry of Public Education (2016).

Sinaloa Polytechnic University, Mexico, in recent years has had a considerable increase in enrollment according to the Upsin Statistical Agenda (2017). In relation to the aforementioned, Sinaloa Polytechnic University, in the 2017-2018 school year, with the Mechatronics Engineering educational program registering the highest enrollment. Since the beginning of the Educational Institution in the 2005-2006 school year, Mechatronics Engineering registered a total enrollment of 70 students as compared to the 2017-2018 school year, which registers a total of 654 students who are enrolled, representing a percentage increase of 934% over 12 years.

In such a way that having the determination to meet the goal set in the coverage of higher education in Higher Education Institutions (HEI) has notably caused the effect of overpopulation in groups, generating that each time the groups are more numerous. Aguerrondo (2008) points out that the large number of students in the classrooms is generated by the desire to have a high coverage of education and this results in having to make a significant change in the teaching-learning proposals and produces a deterioration in the educational quality. Several studies have detected that a factor that definitely affects the academic performance of students is the numerous classrooms. Gutiérrez (2000) show in their study that, due to the large number of students per group, there is little or no exchange of didactic experiences between professors and students.

On the other hand, Mendoza (2013) mentions that a factor that plays an important role in numerous classrooms is infrastructure since, if there is not enough space, it is difficult to teach classes and develop abilities and skills in students. Causing professors to tend to focus more on discipline control and student-professor interaction is limited to lack of communication and little time to carry out individual evaluations by the professor (Rocha, 2017; Fondón *et al.*, 2010). Furthermore, as Rodríguez and Díaz (2015) and Sobrados (2016) point out, for the professor to have large groups in the classroom, it lies in the excessive workload that is specified in: distributing and collecting tasks, tests, monitoring and tutoring, correcting, grading and eliciting feedback on student work. As has been pointed out, the increase in large groups entails a great challenge for professors as their workload multiplies, so strategies must be established to facilitate this work, especially the introduction of mass evaluation and feedback procedures. A factor that constitutes the problem of this piece of research. Which deserved an academic exercise in search of didactic strategy in the optimization of management of the evaluation process in groups with a permanent overcrowding of students.

There are various strategies that support the use of virtual learning environments as an option to serve the largest number of students, virtual environments consist in an educational space hosted on the web and made up of a set of computer tools that enable didactic interaction (Salinas, 2011). Cuesta and Alegre (2011), point out that virtual learning environments are presented as a really useful tool when addressing the challenge of continuous assessment in large groups. Lara (2001) indicates that it is a teaching-learning environment based on telematic applications, in which computing and communication systems interact. Virtual environments offer a viable

alternative to evaluate academic individual and group performance, by facilitating the registration and processing of data, to be used as reliable evidence in the evaluation process (Cano and Hernández, 2009). A virtual environment has the advantage that it becomes a space for the transmission of information, since professors provide students with documents, readings and links (Santibáñez, 2010). Virtual learning environments contribute a totally new form of educational technology by offering the availability of various strategies to promote complex learning through the use and linking of information and communication technologies (ICT) such as blogs, discussion forums, social networks, chats and virtual learning environments (Martínez *et. al.*, 2013 and Murrieta, 2016).

An alternative to virtual environments is the use of an e-assessment platform that allows online professor-student interaction. E-evaluations are understood as any electronic evaluation process in which ICT are used for the presentation of activities, evaluation tasks and the recording of responses (Chiva *et al.*, 2013; Rodríguez *et al.*, 2011). Bretones (2008) describes them as a continuous evaluation where the student participates in his own evaluation. The e-evaluation has become a core aspect for universities that develop their educational programs under online environments (Hernández *et al.* 2018). E-evaluations are an increasingly important component of online courses (Wambui *et al.*, 2014; Espino *et al.*, 2019). Offering various benefits for both the student and the professor. Among those that stand out to have control of the evaluations in the students, it generates friendly learning environments, it provides immediate feedback as compared to traditional evaluations, which helps improve the level of learning (Alruwais *et al.*, 2018, Ridgway *et al.*, 2004, Osuji, 2012), it is easy to use, improves academic performance, increases student motivation (Eljinini M. and Alsamara S., 2012, Gilbert *et al.*, 2011, Marriott, 2009).

Additionally, it helps students who are in remote areas to learn and evaluate in their different locations and to do it at any time, which provides flexibility to students when doing their evaluations (Williams and Wong, 2009, Kikelomo, 2010). It encourages the development of professional competencies in students and promotes prospective feedback (Ion *et al.*, 2013). With respect to professors, the use of e-evaluations will save the professor time, the electronic evaluation helps the professor to improve the quality of the feedback for the students (Sorensen, 2013 and Osuji, 2012), makes it possible to track the performance of the students, reduce the burden to evaluate a large number of students, the same that is sought to attack and contribute via this study (Ellaway and Masters, 2008 and Nicol, 2007).

## 2. OBJECTIVES

Thus, the project consisted in the design and implementation of a virtual learning environment through the use of e-evaluations based on web tools, which contributes to the solution to the problem of evaluating and monitoring student performance in large groups. Its main function will be to support the learning process by promoting that the evaluations and academic monitoring of students can be continuously monitored during the development of their academic training, contributing to

management of the evaluations applied to the students. To evaluate the use of the virtual learning environment based on e-evaluations as a technological alternative, this study is limited to the academic unit of mechatronic engineering of Sinaloa Polytechnic University, Mexico, particularly in the subject of maintenance and industrial safety, this subject is currently composed of five groups with at least 40 students each. This experience was carried out in the 2018-2019 school year. To determine the impact obtained from the virtual environment design, a questionnaire was carried out that measures the degree of satisfaction of both students and professors considering usability, accessibility and operation.

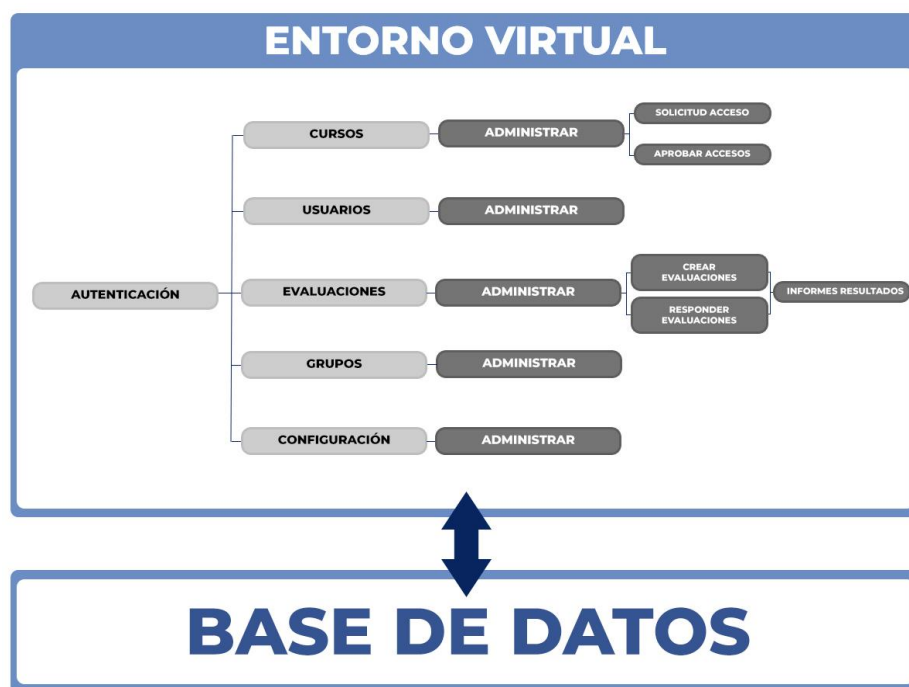
### 3. METHODOLOGY

There is a large number of technology platforms on the market today designed to carry out a virtual distance teaching-learning environment, such as: Blackboard, Convene, Embanet, eCollege.com, IntraLearn, Symposium, TopClass, WebCT, TheLearning Manager, WebMentor, Lotus LearningSpace, or LUVIT, (Llorente, 2006). For this reason, the purpose of this article is to develop and implement a virtual platform for self-evaluation within the same educational institution called Virtual Environment e-evaluations (EVEE), developed by a multidisciplinary team at Sinaloa Polytechnic University, Mexico.

The design of the EVEE environment is based on the use of web tools, since they have various advantages, among which are: Facilitating collaborative and remote work can be used by several users at the same time and can also be hosted on a server; the applications developed are dynamic, attractive and interactive. EVEE help both the professor and the student in the preparation and response of electronic assessments in an easy and simple way. Therefore, the following design specifications should be taken into account, such as: User management (in their different roles as administrator, professor, students); required educational resources (presentations, bibliographies, information resources); Training activities, enrollment, control and monitoring of the evaluation process, generation of reports of results.

For this, Bootstrap, a framework developed within the Twitter Company with the aim of standardizing the tools used in the development of the front-end, was used. Bootstrap consists of a set of CSS libraries responsible for styling the interfaces of web applications, as well as various JavaScript components that are based on the jQuery JavaScript library, which allow the interface design to be fast, easy and dynamic, offering various advantages such as responsive web design. The virtual environment consists in the use of CodeIgniter developed by EllisLab, it is a rapid open source software development framework used in dynamic web applications with PHP. CodeIgniter contains several libraries that encourage the development of web applications in a specific way, allowing the different scripts to be classified, as well as having a clean and organized code, facilitating the creation and maintenance of the code. It implements the development process known as the Model View Controller (MVC), which is an application programming standard.

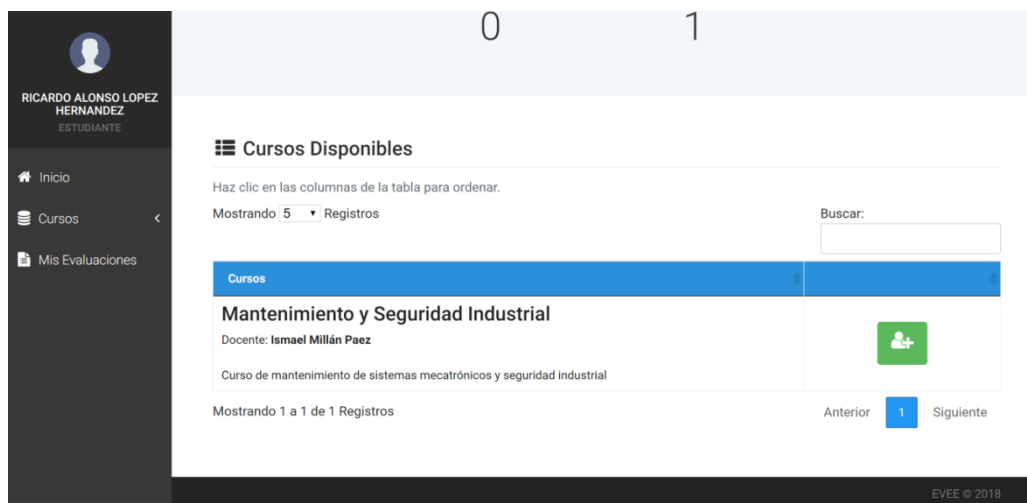
Regarding the composition of the platform, there are 5 main modules, which are shown in Figure 1, which are: courses, configuration, groups, users and evaluations, the access of each of them has the limitation that certain modules are not available for all levels of access (administrator, professor and student).



*Figura 1:* platform component diagram.

**Source:** self-made.

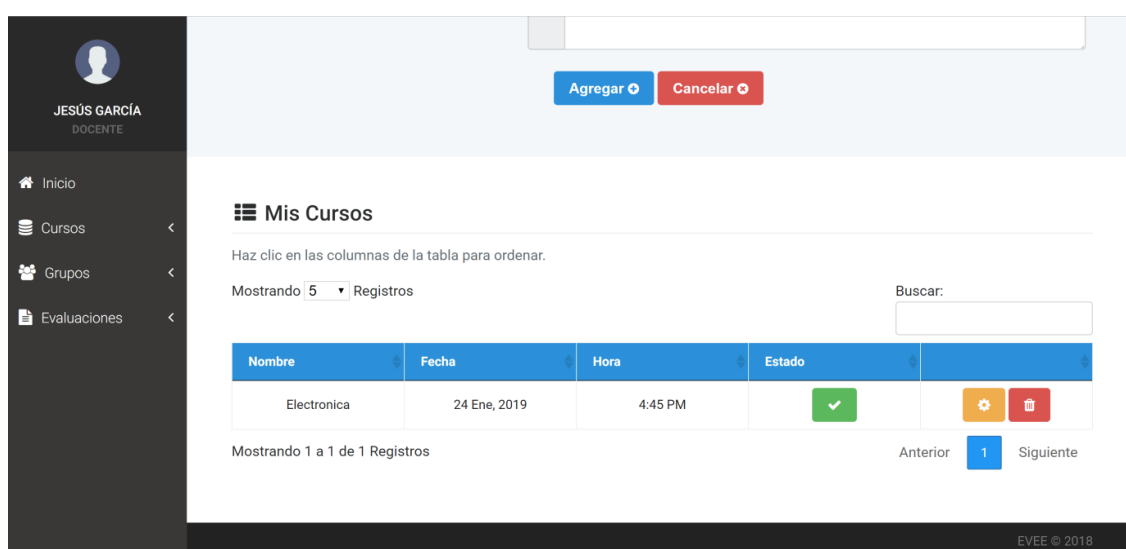
The virtual environment e-evaluations (EVEE) favors the continuous evaluation of students in large groups. EVEE allows users to select the evaluation instrument, such as: multiple choice; development questions (open); false and true; solving problems with procedure and result, similar to a development question, only the answer is numerical and a margin of error is allowed. In addition, it is possible to add images, recommend readings, consultation resources, support material and with the ability for students to receive files in PDF, Word, Excel, PowerPoint. The questions can be selected to be random or fixed, as well as the options can be random. EVEE makes it possible to automatically display the results of the students in the virtual environment and / or download a report in PDF format for each student, enabling continuous assessment. In general, the virtual environment has a front panel with a simple and easy-to-use interface, since the objective is to provide the student and the professor with a friendly and intuitive design. The first step to enter the EVEE virtual environment is to access the electronic page [www.seyfermaq.com/evee](http://www.seyfermaq.com/evee), both professors and students can generate access to the platform by completing a form to enroll, the system generates a username and password, which allows you to access the administration panel. In figure 2, the main module for the student evaluation process is shown. In this section, students are monitored during the course in each of the subjects.



**Figure 2:** student course administration section.

**Source:** self-made.

Once the course, units and groups have been registered, the EVEE platform allows the professor to create an evaluation for their students depending on the learning unit to be evaluated. For the evaluation record, enter “Title” which consists in assigning a name to the evaluation, select the “Course” to be evaluated, as well as the “learning unit” and in turn select the group of students that the evaluation will be available, you have the option of selecting the start and end time of the evaluation, as well as the date range in which the evaluation will be available. The professor creates the evaluation procedure for his students by selecting the evaluation instrument between random or fixed questions, quantitatively and qualitatively assesses the students with marks and comments on the activities carried out, the results are displayed within the same virtual environment and/or imports the notes of the questionnaires / evaluations carried out for downloading a report in PDF format, see figure 3.

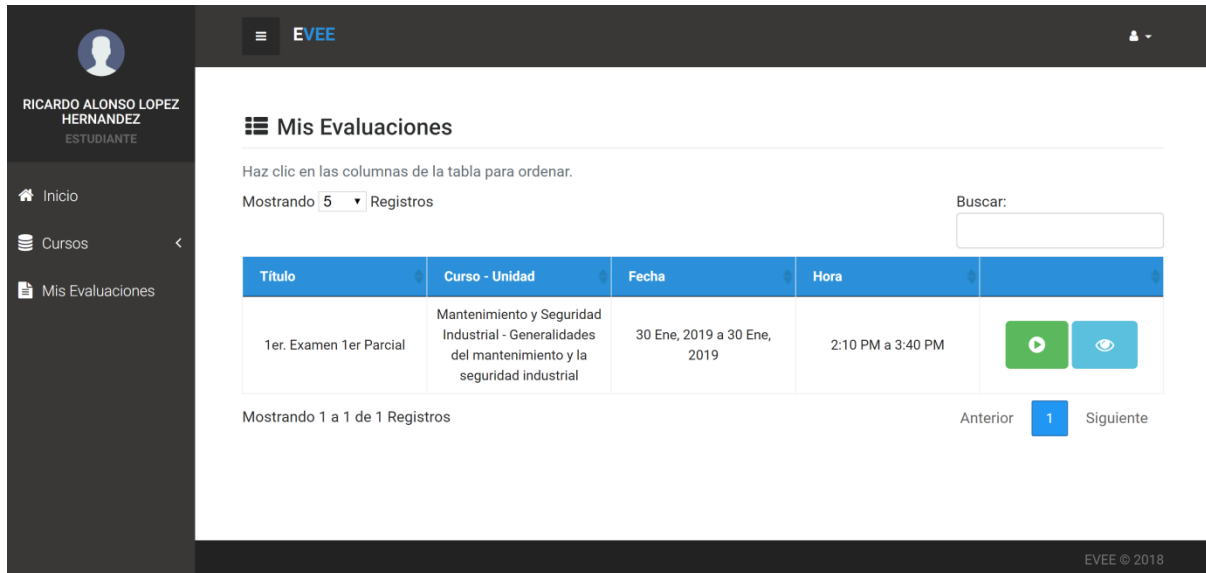


**Figure 3:** teacher course administration section.

**Source:** self-made.



In “My Evaluations” section, the student can consult the evaluations that are available to answer or consult the results of the evaluations that have already been completed. For each available evaluation, there are two options, one is to access the evaluation and the second option is to visualize the results once the evaluation has been completed, see figure 4, figure 5 shows the results obtained by the student and feedback from unaccepted responses.



*Figure 4:* professor course administration section.

**Source:** self-made.

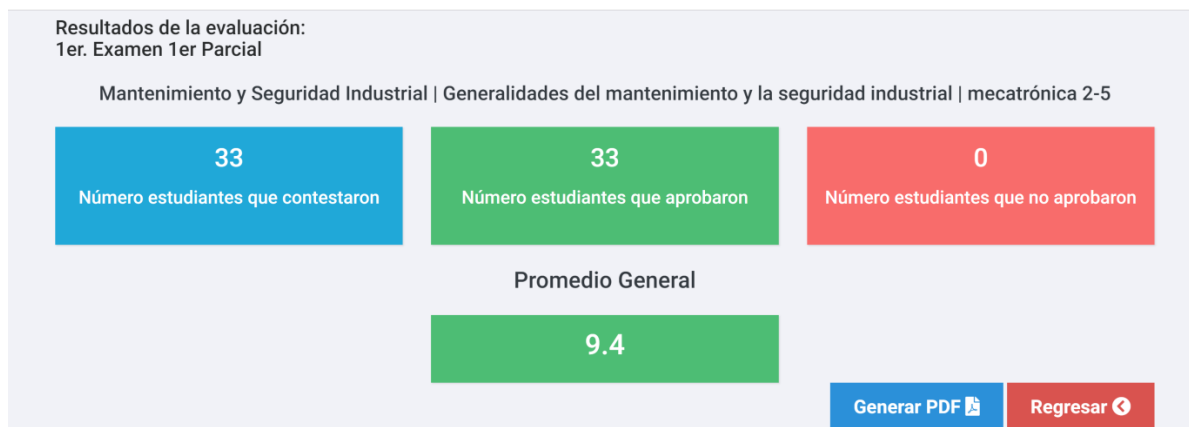


*Figure 5:* section the results of the evaluation presented by the students.

**Source:** self-made.

Once the students conclude and finish the evaluation, professors can obtain a general report of the evaluation, figure 6 shows the general data of the evaluation, the number of students who answered the evaluation, the number of students who

passed the activity, the number of students who did not pass, as well as the general average of the group in the evaluation, the platform shows the results within the same application in addition to allowing the import of the evaluation results in a PDF file.



*Figure 6:* screen of the results of an evaluation presented to professors.

**Source:** self-made.

#### 4. RESULTS

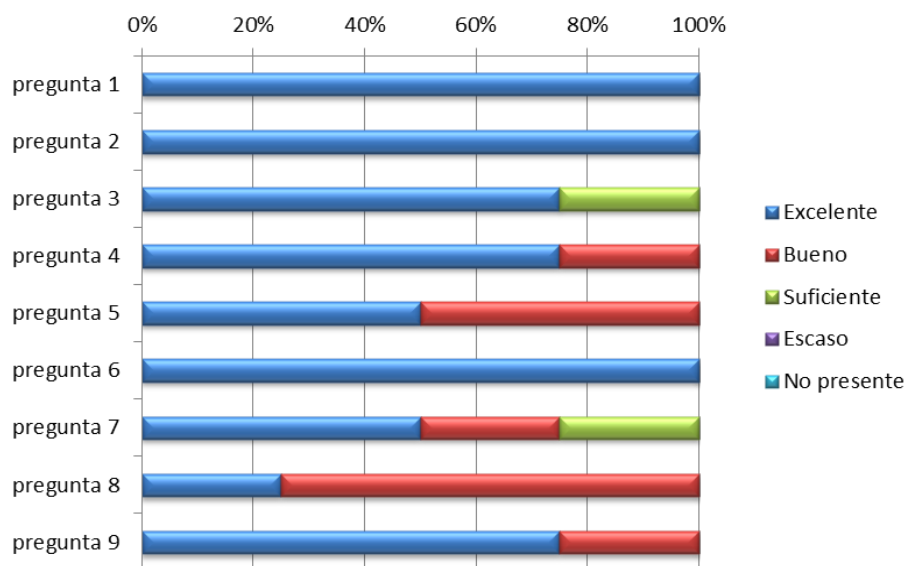
In order to evaluate the use of the EVEC virtual platform, it was necessary to carry out a questionnaire as a collection instrument that was applied to professors and students to determine: usability, accessibility and operation. This study describes the data obtained in the descriptive analysis consisting of the use of measures of central tendency and frequencies for classifying data on the subject of work and determining the scope of the objectives set at the beginning of this process. The questionnaire was sent to professors and students through the use of the Google tool "Google Forms", which allows the survey to be sent and information to be collected easily and efficiently.

a) -Evaluation by professors of the EVEC virtual platform:

A group of 31 professors was selected who represent 100% of professors who teach 15 or more hours a week in the academic unit of mechatronic engineering, 60% out of which are male and 40% female. The age range was between 23 to 55 years. In the type of contractual appointment of professors, 77% corresponds to Full Time Professor and 23% to Subject professors. According to the results of the survey applied to professors, the use of the platform resulted in a novel and innovative experience for professors; they were asked: Does the design of the user interface allow flexible arrangement of access and navigation? 100% of professors considered the design of the user interface "Excellent", that is, access and registration to the virtual platform did not pose any problems for it.

Regarding the structure of the interface, are they organized in a consistent way, for example, courses, evaluations, student monitoring, learning units with the following sections: introduction, contents, resources, tasks and evaluation? 100% of professors evaluated it as "Excellent". Do the contents have a well-defined linear and hierarchical structure? 75% of professors considered it "Excellent". They were asked, "Does content design allow interactivity through autonomous navigation?", 75% evaluated it as "Excellent", while 25% considered it "Good".

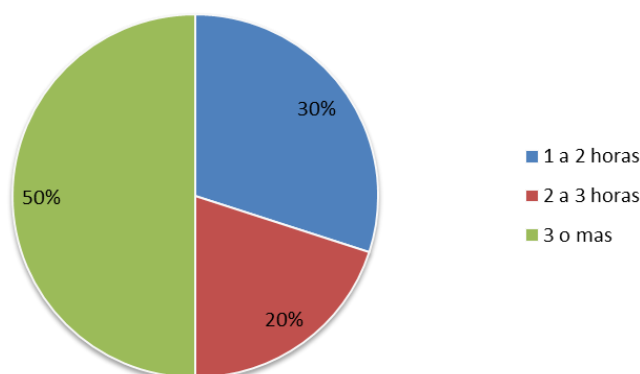
Is the language used for content development adequate? "Excellent" with 50% and "Good" with 50%. 100% of professors considered it "Excellent" that the virtual platform allows access from any browser: Internet Explorer, Mozilla Firefox, Google Chrome. 50% indicated that the information provided on the professor's profile was "Excellent", followed by 25% who considered it "Good" and "Sufficient". Given the possibility that the platform makes it possible to establish deadlines for activities to be carried out by students, 25% selected "Excellent" and another 75% indicated "Good". The EVEE virtual platform provides professor with a wide variety of options to select an assessment instrument for their students, so they were asked: Do the assessment tools available on the virtual platform favor continuous assessment in large groups? Considered it "Excellent" followed by "Good" with 25%. In figure 7 the concentrate of answers to question 1 to 9 is shown.



**Figure 7:** answers provided by professor from question 1 to 9.

**Source:** self-made.

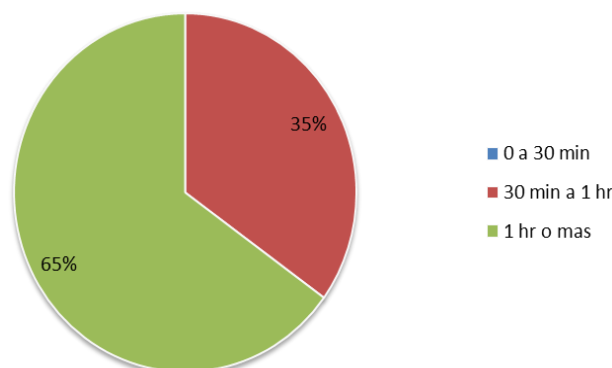
In addition, professor were asked: how much time do you allocate to traditionally evaluate an exam in a group of 40 students or more? The response of "3 or more hours" being more frequently among professor with 50%, followed by 30% from "1 to 2 hours", and less frequently from "2 to 3 hours" with the 20%, see figure 8.



**Figure 8:** Answers to the question: How much time do you allocate to traditionally evaluate an exam in a group of 40 students or more?

**Source:** self-made.

Finally, professor were asked, based on their experience, what is the average time it takes for a student to take an exam in the traditional way? The most frequent response was "1 hour or more" with 65%, while "30 minutes to 1 hour" obtained 35% and the response "0 to 30 minutes" had no mention, see figure 9 .



**Figure 9:** answers what is the average time it takes for a student to take an exam in the traditional way?

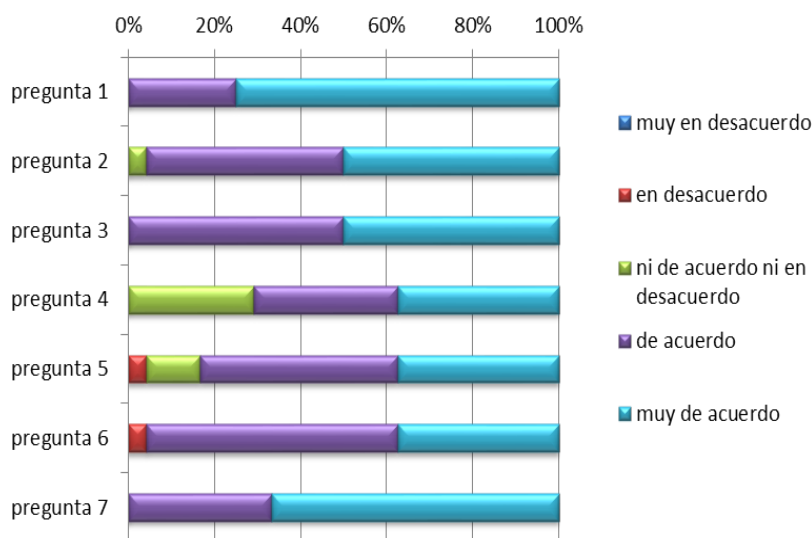
**Source:** self-made.

#### b) - Evaluation of the use of the EVEE virtual platform by students:

The instrument to evaluate the use of the EVEE virtual platform applied to students was used the one presented by Nass *et al.* (2017) in his research work. A group of 40 students from the second four-month period industrial maintenance and safety subject of the academic unit of mechatronic engineering was selected, represented by 70% male and 30% female, with an age range of 18 to 23 years. The scale adopted for the evaluation is as follows: strongly disagree, disagree, neither

agree nor disagree, agree, strongly agree. According to the results of the questionnaire, the EVEC virtual platform is a great experience and a great help for students. 75% of students considered they “Very agree” in the presentation of the platform while 25% considered they were “In agreement” with it.

Regarding the interactivity and navigation in the prototype, the evaluations make it easier and more entertaining for 50% of the students to “Strongly Agree” while 45.8% “Agree” and only 4.2% mention “Neither agree nor disagree”. The main menu and links are guides in navigation within the prototype. 50% mentioned “Strongly agree” while the remaining 50% “Agree”. Regarding the fact that if they would like the platform to include a greater amount of content, 37.5% “Strongly agree”, 33.3% opted for mentioning that they “Agree” while 29.2% “Neither agree nor disagree”. About whether this virtual platform makes the contents acquire an excellent degree of clarity, 45.8% of the students “Agree”, 37.5% indicated that they “Strongly agree”, 12.5% “Neither agree nor disagree” and lastly, 4.2% “Disagree”. When asked if the material encourages student participation, 58.3% “Agree”, 37.5% “Strongly agree” and only 4.2% “Disagree”. And, finally, they were asked about their liking the way this platform encourages me to continue in my learning process. 66.7% “Strongly agree” while 33.3% mentioned “Agree”, figure 10 shows the response of the students.



**Figure 10:** answers provided by students.

**Source:** self-made.

From the results obtained in this piece of research, it can be deduced that the professors stated that the virtual environment of e-evaluations has a good structure to be able to create content, the design of the interface of the environment is intuitive, which makes it simple and easy to use; therefore, it facilitates navigation within it. They also highlight the portability of EVEC, due to its design and development, it can be used on mobile devices without any difficulty and without any type of alternate

download, the evaluation instruments that the virtual environment has are suitable for creating and applying evaluations. As for the students, it can be inferred that the use of EVEE was a good experience because it is a different alternative to be able to answer evaluations and obtain feedback instantly, in turn, the interactivity and navigation on the platform make evaluations easier and more entertaining. It was observed that, with the use of the EVEE virtual environment, the time allocated to evaluation by the professors was improved since, in a group of 40 students, the average time to obtain the evaluation of the entire group was 21 minutes, quite significant if compared to "3 or more hours" that the professors indicated previously.

## 5. DISCUSSION

The following conclusions were reached, considering that the platform is in process and constant development, so far it can be seen that: 1. The time factor in the application, development, evaluation and feedback of the evaluation process turned out to be a priority for professors, making efficient and strategic use with a higher margin for mass evaluation; 2. When referring to an optimization in the evaluation time, the professor has timely information for the appropriate interpretation and analysis of the learning process based on the responses and inferences of his students, providing tools to promote feedback and correct errors that promote slow or low understanding of a certain competence or discipline depending on the subject in progress; 3. The development of the platform with the characteristic of e-evaluations contributes elements of didactic support to the student, promoting self-taught learning and promoting feedback by the professor who determined the evaluation; 4. The platform is developed and has a friendly interface, this characteristic attributes certain reliability to the teaching and learning (student) users, providing an opportunity area for development in an application format that fulfills the same purpose as a support tool for the strengthening of teaching competences and the learning process in the student.

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