

## **GPA<sub>REDE</sub> – A automated evaluation system for web**

**L. A. C. da Costa, M. A. L. Silveira, G. J. Creus, S. R. K. Franco**

**CEMACOM (Center of Applied and Computational Mechanics) / Department of Education / UFRGS (Federal University of Rio Grande do Sul)**

### I – INTRODUCTION

Learning assessment is one of the most polemic aspects of the teaching/learning process. This work is the result of the collaboration of a professor and students of Civil and Electrical Engineering with a professor of Education. The objective is to reduce the traumatic characteristics of evaluation exams, and to increase their formative results.

In this paper we present GPA<sub>REDE</sub>, an evaluation and grading system managed through the web, that may be used together with traditional or on-line courses. It can be used for grading as well as for self-evaluation.

In Section II we present a theoretical framework based on constructivist principles and the ideas of constructivism specialized to the design of evaluation and grading tools. In Section III the system under implementation is shortly described.

### II. THEORETICAL FRAMEWORK

One of the first workers in constructivist theory was Jean Piaget, who developed a subject called genetic epistemology that describes the different cognitive stages through which a child passes while building up a model of the world<sup>1,2</sup>. This theory is very general and has, besides its pedagogical applications, biologic and psychological interfaces. In setting the present theoretical framework, we will focus on learning evaluation and its relations with the improvement of the teacher/student interaction, using constructivist principles.

#### A. Active Participation of the student

As we look into the history of epistemology, we can notice several positions and practices: empirism, apriorism and constructivism<sup>3</sup>. According to empirism, learning is mainly knowledge transmission, and the student a passive receptor. The teacher has the power that knowledge warrants. The essence of science lies in collecting ‘objective’ data which speak for themselves. In the aprioristic approach the emphasis is on the students, that, by their a priori knowledge, drive the learning activities.

The empirist approach was efficient in the industrial and pre-industrial ages, when access to information (i.e. books, periodicals) was difficult. Traditional classes were designed to transmit information from a professor to large classes.

Now, in the information society age, knowledge application and actualization have priority, as the knowledge evolution is very fast. Students must be trained into self learning, to assure constant evolution. They should learn how to transform information into knowledge.

According to constructivism, the main emphasis should be given to the process, i.e., to the knowledge evolution obtained in the learning activities. The knowledge is built up like a rising spiral by a iterative reconstruction. Of main importance are the relations established during the process.

In a learning process designed with the constructivist approach, the student active participation is the main key to success. This participation should not be limited to thinking about the learning subject. The student must also reflect about the way knowledge is built.

Computers and information technology can make constructivism learning applications easier. For example, a JavaScript code developed to teach visualization skills for a course in engineering graphics provides a great interactive learning experience. According to the author<sup>4</sup>, “the games, which walk the student through an increasing range of difficulty using different visualization techniques and puzzle formats, challenge the student to develop to a more advanced level of comprehension”. This is a representative example of the importance of the active participation of students, which receive an immediate feedback.

Another example is the Pearl Project (Practical Experimentation by Accessible Remote Learning), that “presents an opportunity to widen access to real experiments that might otherwise only be offered to those able to get to a suitably equipped laboratory”<sup>13</sup>. This project, lead by Open University, provides a wide range of student activities.

#### B. Student participation in the evaluation process.

As mentioned above, student self-reflection about cognitive evolution is important. One example of this reflection can be found in a question development about constructed concepts<sup>5</sup>, that run an experience dividing a class in two groups. Each group, with the assistance of the teacher, had to set up questions for the other group, thus building a positive participation environment, adequate to learning:

*“...the evaluation process should be democratic, clear, transparent and honest. It is impossible to develop a cooperative learning process using authoritarian evaluation. With the democratic approach, students must be involved in the decisions about evaluation content.”*

Other work shows that study groups<sup>6</sup> (with two students each) improve learning because frequently a student is better prepared to identify the doubts of his classmate than the professor.

### C. How technology can work with pedagogy

It is important to make clear the possible path to real pedagogical relations transformation. Web publication of books or traditional classes creates no new educational paradigm. That must rest on active pedagogy. Communication and information technology can be fundamental pedagogical auxiliaries in knowledge construction<sup>8</sup>.

An example of technology application is the Open University project developed by Massachusetts Institute of Technology<sup>9</sup>, that will publish in the web all the teacher didactical materials. As the author says:

*“by throwing millions of pages of precious professional output onto a Web site, MIT is not only opening itself to the word, it may be changing forever the way educational is delivered”.*

Still, this information must be transformed into knowledge.

In our proposal of evaluation using computational tools, self-evaluation becomes easier because the student increases his autonomy by the use of technology. The student becomes autonomous assuming the task of the teacher<sup>7</sup>: to recognize needs, to choose objectives, to select subject matters, designing the study plan, finding didactical materials and media, identifying complementary knowledge sources and directing, controlling and evaluating the learning process.

### D. Constructivist evaluation

Here we describe a pedagogical evaluation tool resting on the constructivist approach. In our proposal, we use computer tests in a web site. Test results and comments are included in the evaluation. It is important to list some precautions needed to prepare computer test questions<sup>10</sup>: to define clearly which skills or methods are to be tested, to avoid excessively detailed calculation and to provide adequate explanations.

One of the keys to a clear evaluation process is to consider all of the students work. Tests are just one of the possible evaluation means.<sup>11</sup> The development of student portfolios is important to make an evaluation resting on the constructivist paradigm. This is not a polemic question anymore. However, the practical viability of this process is still a question. To get the student reflection and comments about his own work it is necessary to provide adequate means of communication. Yet, it is basic to provide an integrated and cooperative learning environment, such that the students can reflect on their correct and incorrect answers and discuss questions and exercises developed by the teacher.

These discussions will make it possible to identify didactical situations that lead to knowledge, making possible the meta-cognitive modelling<sup>12</sup>.

Formative Evaluation must be an integrated process. The amount and diversity of evaluation instruments are the practical tools that make it possible the integration of the evaluation process with the teaching-learning process<sup>6</sup>, leading to a constructivist evaluation

proposal. In Section III we describe the tools developed in the evaluation system to obtain the Formative Evaluation.

### E – Webfolios

Self-evaluation and students comments included in portfolios are important for the evaluation process. As the GPA<sub>REDE</sub> is a system designed for the web, the public space to show students work will be called Webfolio.

*“A teaching-learning tool should provide to the student information that allows him to judge his work in progress. The access to a dossier where he can get information about texts read, activities developed and results obtained would allow the student to manage his learning activity.”<sup>8</sup>*

Here again we can identify elements mentioned in the theoretical framework . Student management of his own learning leads to an improvement of the action/reflection process. This is a great difference introduced by technology: it becomes easier to share files, to do on-line digital productions and to receive tutor orientations by Internet.

### III. GPA<sub>REDE</sub> – A AUTOMATED EVALUATION SYSTEM FOR THE WEB

GPA<sub>REDE</sub> is a test generator system that takes questions from a database and applies them through the web, allowing continuous student evaluation. It has been implemented using a Microsoft Access database, Microsoft Excel files and diverse picture, text and animation files. Figure 1-a shows the student home of the system, that gives a brief explanation of each item by clicking on the corresponding link in the left screen frame.

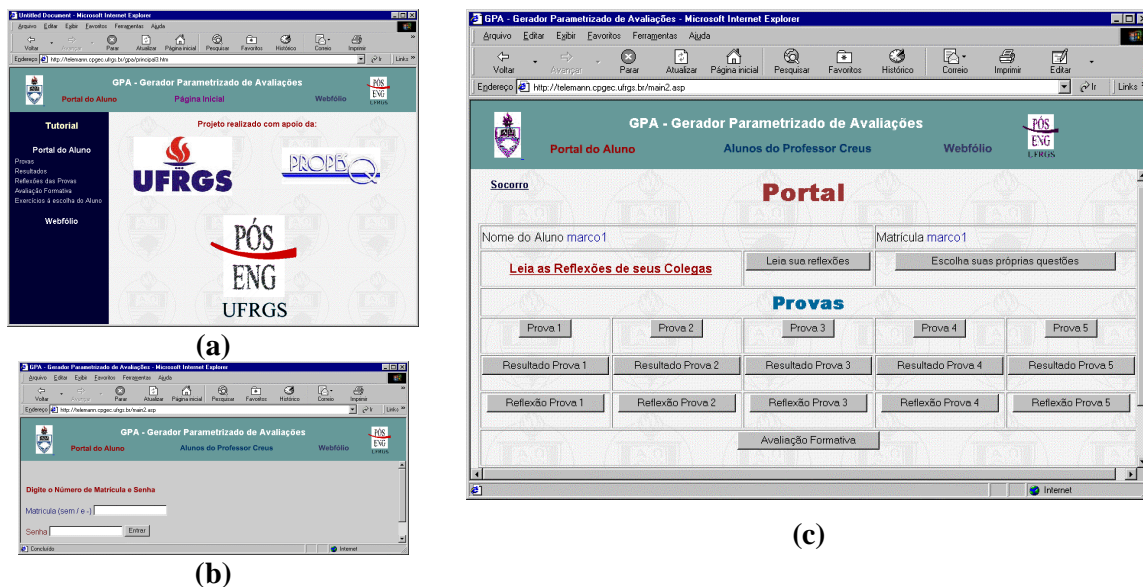


Figure 1. Initial screens: a) Home of the system for the student; b) Inserting registration number and password; c) Student Web Portal

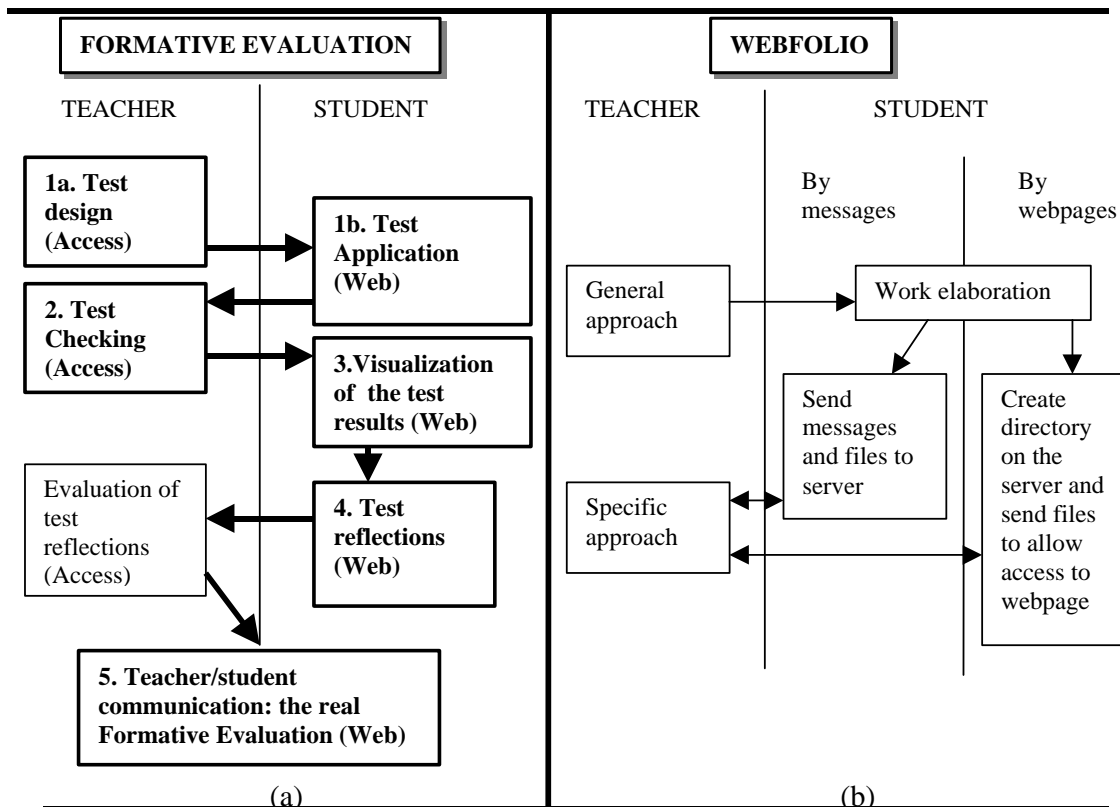


Figure 2. GPA<sub>REDE</sub> structure: a) Formative Evaluation steps; b) webfolio interactions

The system has two main parts: **Formative Evaluation** and **Webfolio**. Formative Evaluation is related to student evaluation and student/teacher communication; only teacher and student can access this information. The Webfolio is a public server space designed to show student work, ideas and opinions. This information can be accessed by any visitor. In Figure 2 the general structure of the system is shown.

#### A. Formative Evaluation Tools

The Formative Evaluation tools are (see Figure 2): test design and application, teacher test corrections, visualization of teacher test corrections by students, student reflection about each test and channel for student/tutor communication. They are described below.

##### 1. Test design and application

The questions are stored in a Microsoft Access database table, whose access is restricted to the teacher. One of the characteristics of the system is that it allows different formats of question files, such as text, pictures and movies. Once the questions are ready, the teacher can select the test questions by an automatic process. Before the test application, the teacher must make a student registration inserting name, registration number and password.

The test is applied through the Web. The student must insert his registration number and password (Figure 1-b), accessing the web portal, that is a web site with the questions (see Figure 1-c).

The teacher can introduce up to five different tests. Clicking in the test button will open a homepage with the first question of the chosen test. It shows one question at a time, as shown in Fig. 3.



Figure 3. Prova 3 : Test 3, selected by the student. Questão 1 de 7: Question 1 of 7.

The student can answer the question in one of two ways: sending an answer file or answering through a form.

## 2. Test correction by the teacher

To correct a test the teacher must select the test and then the student, one by one. Only the answered questions are shown. The teacher corrects successively all the questions and fills up the boxes with the corresponding grades and eventual comments, as shown in Figure 4

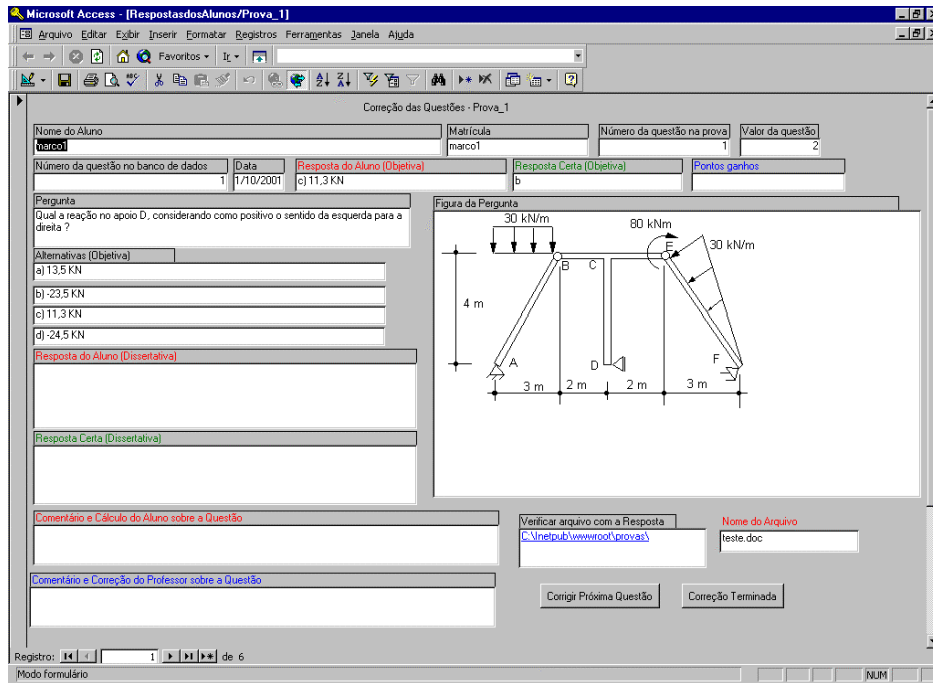


Figure 4. Comentário e correção do professor: teacher comments and test correction.

The software will calculate the final grades, which can be accessed by the students.

### 3. Visualization of the test results

Under each Test button, inside the Student Web Portal (Figure 1-c), there are the corresponding Test results buttons. For example, the *Prova1 (Test 1)* button allows to make test 1, and *Resultado Prova 1 (Result of Test 1)* button allows him to visualize the results of test 1, as like shown in Figure 5. Test results include the grade and comments on each question. Again, questions are shown one by one.

**Socorro** **Resultado da Prova 1** **Data da Prova 03/10/01**

Nome do Aluno	marco2	Questão número	1	Matricula	marco2
Pergunta	Qual a reação no apoio D, considerando como positivo o sentido da esquerda para a direita ?				
Resposta do Aluno (Múltipla Escolha)	b) -23,5 kN				
Resposta do Aluno (Dissertativa)					
Comentário e Cálculo do Aluno sobre a questão	Devido à forma como estão distribuídas as forças, chega-se a conclusão que a única resposta para o problema é esta alternativa				
Resposta Correta (Múltipla Escolha)	b				
Resposta Correta (Dissertativa)					
Valor da Questão	2	Pontos ganhos na questão	2		
Comentário do Professor sobre a Questão	Apesar de de ter sido um pouco impreciso o seu comentário, acredito que mereces levar todos os pontos nesta questão				
Nota da prova	4				

Diagrama de um sistema estrutural com uma viga horizontal BC de 4 m de altura e uma coluna vertical CD de 2 m de comprimento. Há um apoio móvel em D. Uma carga distribuída de 30 kN/m atua sobre a viga AB (3 m). Uma carga pontual de 80 kNm atua no ponto C. O eixo horizontal é positivo da esquerda para a direita.

Questão Anterior Próxima Questão

[Voltar à página principal](#)

Figure 5. Visualization of the test results

#### 4. Student comments on the tests.

After looking at the test results, the students can make comments. These comments are made in a page where the student must complete a small questionnaire, as shown in figure 6. The aim of these questions is to help the students to reflect about their own learning, to make searches in the web about test content, to self-evaluate and to design new questions related to the test. By this reflection a more meaningful communication among teacher and students can be obtained.

**GPA - Gerador Parametrizado de Avaliações**

Portal do Aluno Alunos do Professor Creus Webfólio

Reflexões da Prova 1 do Aluno: marco2 **Socorro**

Quais conceitos foram construídos na realização da Prova 1? (O que você aprendeu sobre o conteúdo da prova?)

Indique páginas da Internet relacionados com esses conceitos e faça algum comentário sobre cada uma delas

Faça uma auto-avaliação do seu desempenho na Prova 1.

Formule questões a partir do que você aprendeu do conteúdo da Prova 1. [Ir para Formulário Especial](#)

Observação: Se alguma questão tiver imagem, especifique o nome e envie o arquivo para o e-mail do professor.

Figure 6. Reflexões dos alunos sobre as provas: students comments.



Afterwards, the teacher must evaluate the student comments using the Microsoft Access interface shown in Figure 7.

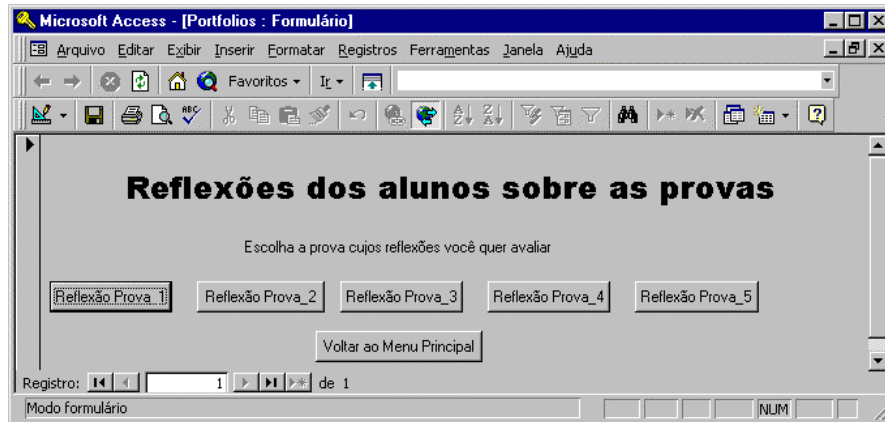


Figure 7 – Evaluation of the student reflection

The evaluation of the student comments is made by clicking in each button. This evaluation is an incentive to establish a better communication, because the student will still comment on this teacher evaluation.

##### 5. Teacher/students communication: the real Formative Evaluation

This part of the system is the phase that follows after the first test reflection. Evaluating the student reflection, the teacher establishes a contact which is maintained by means of messages with comments and suggestions about the student learning, leading to a better and more consistent evaluation.

In the figure 7 are shown web interfaces where the student may insert comments on Formative Evaluation, accessed by clicking *Avaliação Formativa: Formative Evaluation* button on the Student Web Portal.

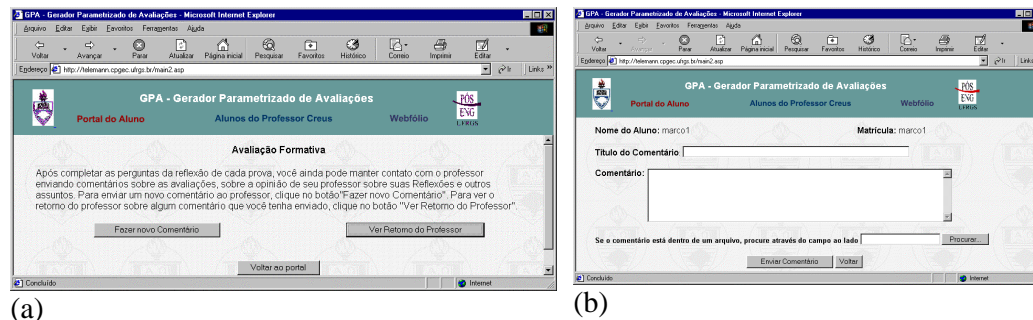


Figure 8. Formative Evaluation

Students access all the comments and the corresponding teacher feedback by clicking in *Ver Retorno do Professor: Access teacher feedback* button, in figure 8-a.

The teacher give feedback to student comments through the Web. At the same time he can register partial evaluations that will be used in the final evaluation.

### B. Webfolio Tools

The aim of the Webfolio is to increase student participation in the learning process and to allow him to systematically use a digital interface to make on-line upgrades of his work. It is a server space where the student can show his work and opinions, making possible the access to anyone, through a visitors interface. The main webfolio screen is shown in figure 8.

Students have two options to build their webfolios: by text messages and files send through the web or by a web page. In each option, the student has his own server space.



Figure 9. Webfolio

## IV. CONCLUSIONS

The development of a Constructivist Evaluation system demands adequate management of the information on the work of the students; it is not enough to store the student documents in a computer directory. Data needs to be analyzed, shared and frequently questioned; communication and feedback are essential.

The system GPA<sub>REDE</sub> presented in this article has been developed using the theoretical framework described in Section II. It provides a space for Formative Evaluation, including comments exchange and self-evaluation. The Webfolio gives additional space for the construction of new concepts and the development of individual projects, allowing communication among students and documents sharing. In this space, the teacher is no more a main focus and the activity becomes a cooperative construction.

This is a project in progress, whose results will be informed in a forth coming paper.

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## BIOGRAPHICAL INFORMATION

### LUCIANO A. CARVALHO DA COSTA

Luciano A. Carvalho da Costa received his Diploma in Civil Engineering and MSc in Structural Engineering from the Civil Engineering Department at the Federal University of Rio Grande do Sul. Now he working in his PhD thesis in the same department. His major research interests are in pedagogical interfaces in structural engineering and learning assessment by Internet.

### MARCO AURÉLIO LISBOA SILVEIRA

Marco Aurélio L. Lisboa is an Electrical Engineering student at the Federal University of Rio Grande do Sul. He is involved as research fellow in the research project in distance learning assessment.

### GUILLERMO JUAN CREUS

Guillermo J. Creus is Professor at the Civil and Mechanical Engineering Departments at UFRGS. His main interests are in structural mechanics, research and teaching.

### SÉRGIO ROBERTO KIELING FRANCO

Sérgio R. K. Franco is Professor at the Department of Education at UFRGS. His main interests is the application of new technologies to learning.