A free application engineering economics developed in C++ to improve the teaching process in distance learning

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ABSTRACT
The present work was developed in a high education institution of Brazil. Because to the difficulty of many students of the superior technology in Industrial Production Management in the study of the discipline of Computer Science where the main objective is to learn computer programming, we chose to work together with the discipline of Engineering Economics to motivate and help in understanding concepts related to the C++ language as well as to promote improvements in the programming steps. Each team of 4 or 5 students developed an application that has the main tools of Engineering Economics and, for social purposes, these students provided free share the respective applications and posted the link in social networks. It was observed that there was a 44.83% improvement in the performance of the students.
in the course evaluations after their participation in the project. It was also possible to observe the good acceptance on the part of the users regarding the applications developed and shared free.

**Keywords:** distance learning, pedagogical practice, engineering economics, C++ programming.

1 INTRODUCTION

Computer programming corresponds to a sequence of steps that direct the processing of a flow of operations that have a utility.

It is an activity that involves art, engineering and science (Sebesta, 2012). To create a computer program is necessary to follow syntactic and semantic rules. Through programming is possible to specify what data to process, how to do it, and what results to display. Currently there are several programming languages that allow the transformation of these steps in machine language that will be executed by the computer. Among several languages, C++ is a universal programming language (Schildt, 2003). The use of the C++ language is interesting because of its powerful performance. However, many students have problems with learning logic and programming language. Often the methodology and examples used in teaching a programming language are not able to initially show its importance.

As we are in a constant search for improvements in the teaching and learning process, we need to think about new methodologies that can improve the learning process. Freire (2002) affirms that it is important to reinforce curiosity of the students and critical ability to achieve their integral education. Behar (2009) believes that there needs to be interactions between students and teachers around the content to be addressed. It is also important that there is meaning for the topics covered in the lessons (Schell & Javicki, 2013). There is concern that reflective practices result in better teaching and better educational outcomes (Jaeger, 2013). The use of technology motivates students to interact more, and Murphy, Walker, and Webb (2013) give some insight about how this is possible. Is clear that if the performance of the students is not good as the expected, it is necessary to make some arrangements for changes in this context.

To promote improvements in the teaching and learning process, once a difficulty in understanding the discipline was detected, we developed a project integrating the disciplines of Computer Science and Engineering Economics, both in the modality of distance learning. In this project, students could program different methods addressed in the discipline of Engineering Economics and intended to solve real problems. With regards to this work, the main objective was to promote improvements in the learning process of students of the Industrial Production Management in relation to the discipline of Computer Science. It was also part of this work to provide family members, friends and people in general access to the possibility of obtaining results related to Engineering Economics such as capital recovery, return of investments, calculation of project viability, among others.
2 THE IMPORTANCE OF BOTH C++ AND ENGINEERING ECONOMICS

C++ is a compiled language. For a program to run, it takes text that will be processed by a compiler and will generate an executable program (Stroustrup, 2013).

This text has a logical structure that involves an often-sequential reasoning. Basically, data are reported, processed through binary operations, arithmetic, repetition structures, and later the results obtained are presented. Currently there are several programming languages, such as C, C++, Java, Python, PHP and others.

C++ is a powerful and widely used language. In face-to-face courses, there is already a very satisfactory methodology for teaching a programming language and it is not usual to search for innovations. However, in distance learning we need to promote improvements because of the expansion of this modality of teaching and the need for students to learn more and more. Because learning occurs in a virtual classroom, the existing computational resources provide a wide variety of options that can and need to be explored. In a classroom, students do not always have this access, but in distance education the student is quite inserted in the virtual world. It is possible to use the computer so that this use contributes to the learning process and facilitates the understanding of concepts related to the studied subjects (Bittar, 2011). It is also important to relate face-to-face and distance contexts when dealing with content management and learning systems (Tori, 2010).

Regarding the subjects of the Computer Science, the students are initially presented with the importance of programming today. Then the design and programming are displayed. The notion of design and programming can be detailed as:

- Expresses ideas in codes.
- Expresses independent ideas in independent codes.
- Represents by means of code relations between ideas.
- Combines ideas expressed in code.
- Expresses simple ideas in a simple way (Stroustrup, 2013).

After these initial presentations, students have access to the first contacts with the C++ language and concepts related to variables, arithmetic, constants, and loops (if, while, for). Also discussed are pointers, matrices, and other important topics. The programming logic is worked in parallel to the programming language.

With regard to Engineering Economics, the main concepts for engineers are addressed (Newnan, Eschenbach, and Lavelle, 2004). Among several topics, we can highlight: single payment, uniform series, capital recovery, arithmetic gradient uniform series, geometric series present worth, continuous compounding at nominal rate, continuous uniform cash flow, depreciation, and more.
All the subjects studied in the discipline of Engineering Economic have relations with real problems very close to the performance of the students, both in business and personal life.

These themes are very important to assist in the study of project viability, for example. Economic decisions differ in the fundamental way from the types of decisions typically encountered in engineering design (Park, 2004).

In the Industrial Production, the knowledge related to the discipline of Engineering Economics are important in what concerns the study of the feasibility of buying or exchanging equipment. They are also important in other decision-making problems such as the best choice for raising funds or the ideal time frame for exchanging equipment.

The problems encountered in the discipline of economical engineering and, consequently, in several real situations can be solved by means of specific formulas. The use of calculators or spreadsheets is very useful. But for this you need knowledge related to the subjects of the discipline. Therefore, the development of a free and self-explanatory application allows anyone to solve these problems.

3 THE PEDAGOGICAL PRACTICE

Students who attend Industrial Production Management in the distance learning have access to the contents available in the learning management system. The online classes contain videos elaborated by the professors of the discipline, books, texts, examples and exercises solved. All students have access to centers of class-room support, a total that corresponds to more than 430 places distributed in several cities in Brazil.

At each center, there are instructors that can assist these students. Students also receive online support. In the learning management system, there is a link for students to contact the instructors. Guidelines are made in writing, by voice or video. It also encourages the formation of study groups and participation in the forums. In addition to face-to-face support and support in the environment management system, students also receive e-mail, chat and telephone support.

The development of the work was done in two stages. In the first stage the 1032 students enrolled in the course had access to the material online, attended the classes, did the activities and performed the evaluations without the relations with the discipline of Engineering Economics that was being offered at the same time. In the second stage, the students participated in the interdisciplinary project. At this stage, in parallel to the regular classes, participated in the development of the application and used the knowledge previously acquired as well as the new knowledge.

The guidelines for the development of the application were: to cover all the subjects of the discipline of Engineering Economics, to have a simple and intuitive interface. Have a brief description of
the concepts of each application function and inform how the data entry should be done. Present the results in a simple way and with the appropriate conceptual explanations.

The applications developed by the students were done in blocks. Each block was intended for a specific function of the application. One of the blocks refers to the calculation of the net present value (NPV) and the respective payments.

The basic structure of this block can be seen below.

```c
#include <stdlib.h>
#include <math.h>
int main()
{
    int a,n;
    float taxa, vpl, vaue, x;
    printf("Calculo do VPL e VAUE.\n\n");
    printf("Informe o numero de periodos: ");
    scanf("%i",&n);
    printf("Informe a taxa (em porcentagem): ");
    scanf("%f",&taxa);
    taxa=taxa/100;
    printf("Informe o valor do fluxo de caixa na data 0: ");
    scanf("%f",&x);
    vpl=x;
    for (a=1;a<n+1;a=a+1)
    {
        printf("Informe o valor do fluxo de caixa na data %i: ",a);
        scanf("%f",&x);
        vpl=vpl+x/pow(1+taxa,a);
    }
    vaue=vpl/(((pow(1+taxa,n)-1)/(pow(1+taxa,n)*taxa)));
    printf("nVPL: %.2f\n", vpl);
    printf("nVAUE: %.2f\n", vaue);
    system("PAUSE");
    return 0;
}
```

It is important to note that this application was intended for people who do not necessarily have technical knowledge related to Engineering Economics, but who need to obtain useful information regarding economics problems.

To the analysis of the results, the development of the project was observed and analyzed to verify the influence of this pedagogical practice in the better understanding and application of the subjects of the Computer Science discipline. In addition to evaluating the application produced in terms of operation, user interface and programming logic, the usual activities and evaluations of the course were carried out.

In order to compare the performance of the students in the phase where the application was developed with the performance of the students during the traditional classes was considered the average obtained by the students in the two phases of the project.
It was observed that initially the performance of the students was lower than expected. The average obtained in the first evaluation was equal to 58. With participation in the project, the average student increased to 84, which corresponds to an increase of 44.83%. In the evaluation research carried out with the students it was evident that the practice contributed to improve the understanding of the subject studied.

In addition to the improvement in academic performance, there was an increase in participation of the students in study groups and a more active stance on the taste for the study of Engineering Economics.

4 CONCLUSIONS

In distance learning one of the great aim is to make the students feel that they belong to the environment management system and that the topics addressed as well as the way these subjects are offered are close to the reality of the students. It is also important to encourage students to constantly seek knowledge and applications of this in other areas and in everyday situations. Often the examples presented in a discipline differ from the reality of the students. This is not bad, but when the applications are closer to the context in which students are inserted the better is the achievement.

In the case of the Computer Science discipline, it was identified that initially the students were not really involved with the topics addressed. The understanding of concepts related to variables, repetition structures and, above all, the importance of the acquisition of knowledge related to computer programming was not effective. Creating the applications and making these applications available to the public was important in perception of the students that computer programming can be useful, not only for their own benefit, but can also help others solve their problems. After analyzing the comments posted by the users of the applications produced, it was possible to identify the satisfaction and gratitude of these users. As for the students, the improvement in the performance in relation to the subject of Computer Science was quite significant. The grades obtained in the evaluations increased by 44.83%. Analyzing the postings of the students and the answers given in the periodical institutional evaluation questionnaire, an increase in their satisfaction with the way the project was developed was also identified. Of course, when it comes to computer programming, there is a lot to study. In the subject of Computer Science, the topics covered correspond to a small part of a great universe of knowledge and possibilities.
REFERENCES


