

Computer techniques and formative evaluations at brazilian universities : a real possibility in presential, semi-presential and distance learning courses

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Introduction

A brief analysis of the evaluation of the teaching-learning process at college courses is required when we have the intention to describe an experimentation of the use of computer systems in the graduating students formative evaluation³⁸.

How to evaluate learning? Or even before, what evaluation are we talking about? Sub-utilized as part of the process and of the didactic-pedagogical strategy, the evaluative tools are frequently used to perpetuate a power structure at reflecting an education concept – and also a society's concept. This conception tries to keep the *status quo*, on preventing, in many ways, the learner autonomy achievement and her/his transformation as an active part of her/his own learning construction^{1, 3, 34}. It is the confirmation of the teaching as reproduction and of the non-interactive teaching methods. These methods are empty of criticism and they cause the learner's conversion into a domesticated being, seen as a simple passive receiver of contents^{13, 39}.

Through this conception to evaluate means, to apply tests that evaluate only the learning results and not the process itself. It is something static and definitely in a position of classifying, focused in memorization – it happens after a sequence of contents that do not consider the learner in its historical feature, as an effective piece of this dynamic and changeable world. Sometimes, the tests are used as punishment tools and through them the authoritarian posture of the educator is confirmed and gets far from the previous established pedagogical goals.

Beyond the traditional classroom

Nowadays the physical size of a classroom has achieved the superlative of shyness. Any kind of knowledge that a student may acquire is multiplied by computer networks (mainly

Internet) and this knowledge can get many different shapes considering the possible technological interactions.

A hypertextual reality and therefore a not-linear learning is possible, allowing transition and movement besides the creation of truly “electronics extensions” that allows students “to touch” a point about any research the student may be interested in and to keep a demonstrable effect about that²³. This can really affect the student performance and we can notice it. The learner can be involved in a truly “oceanic universe of information” based on a larger digital communication infrastructure and afforded by the “worldwide computers interconnection” that has been making possible to build interactions into this universe – the *cyberspace*³⁰. However, this is a vision that requires changes, reconfigurations and reconstruction of the teaching-learning process itself, and also it demands (in some ways) changes in the teacher/student roles into this context. Inside and outside the classroom – that do not need to be extinguished but expanded and updated – the student may act directly in its own construction of knowledge and competencies which remain in a renewal that is constant and dynamic.

With this purpose, the student should have access and should be motivated to use the available technology without missing the teacher’s didactic strategy. The teacher, as an essential element in this process, and learning how to work with these technological tools serving the education, tends to renew and to adapt his practice to the urgent reconfigurations needed in the school. It is about, in a large aspect, to take part into this process as an educator, to really participate of this “transition from an institutionalized education (school, university) to a generalized exchange of knowledge, society’s instruction by itself and a self-managed/changeable/contextual recognition of competencies²⁹. Cardoso⁷ says that there is a rapid change in the “teach classic vision” – it is teacher-centered while the student is only the passive listener. According to the author the new model focus is learner-centered: the student takes an active role into its own learning process.

Teacher and Machines: criticism and participation, not replacements

Evidently, it is not possible to replace teachers by machines. In fact, “the technology does not replace the teacher and must be seen as an instrument to be used in defined phases in the teaching process instead of being the only strategy to be adopted during the course”¹⁷.

Xavier⁴⁶ adds some comments to clarify this aspect: the correct use of the computer in the classroom as a teaching tool tends to increase and validate the teacher role. According to the author, the teacher keeps going as a conductor in the teaching-learning process, giving to the students the possibility of experimentation of new alternatives in the information’s search and in the problem’s solving. That makes the teacher an unreplaceable element, mainly in the orientation, correction, project/tasks suitability into the ideal level of the students background and also into the subject demands, creating the “familiarization conditions in the ones involved with computers”⁴⁶.

Niquini and Botelho³⁷ say that the teacher is an important part of the environments created by the multiple educational technologies, taking a fundamental role into the teaching-

learning process. According to the authors, the technology may supply to the teacher ‘the permanent possibility of the courses reformulation and of the monitoring the students learning’³⁷.

About the same theme, Kenski says that the teacher must be aware that there is no possible replacement of its professional competence by computers. Such equipment, in fact, tend to amplify the teacher role as an educator ‘beyond the classical school (between walls) and of the traditional classroom’²².

Lampert²⁵ highlights the ‘educative technology’ relevance that can make possible ‘new ways of acquiring knowledge’. Besides, it can guarantee indispensable pedagogical practices renewal and the ‘reorganization (through new approaches) of the teaching-learning process’. The author also says that isolated technology will not change anything or will replace an updated teacher. According Lampert, ‘the computer has to be at the same time super-esteemed and under-esteemed, it is not a panacea that will solve all teaching problems’²⁵. The college teacher, in its educator role, has to be aware that ‘when technology is used with ethics, methodology and in a pondered way, it will be at mankind service, bringing him a lot of benefits and updates’. It is also important, according to the author, to be aware of knowledge dynamics and its practically explosive expansion. The teacher must realize that, in this aspect, ‘only through the real use of technology is possible to prepare man to day-by-day and to the future’²⁵.

The use of so called computer technologies in education increases even more the relevance of the teaching staff participation. The teacher takes the fundamental role of a critic of the possible uses of this technology, selecting with discernment the ones that can effectively contribute to the desired learning objectives. In Kenski opinion:

Identifying the best ways to use technology, approaching or reflecting about a determined theme or an specific project, in a way that can join out the specific pedagogical support (in which we cannot take out the classical expositive class and, even harder, the book itself) to a higher objective that is your students learning quality²²

Back to evaluation...

Now, the question must be repeated: how to evaluate learning? and how to do it according to the necessary changes already stated?

The counteracts of the previous picture description are the transformer postures that see evaluation as a longitudinal occurrence and through that it is possible to get resources to improve teaching and to decide about the teaching-learning direction. Through this point of view, it is possible to check the compatibility between the postulated goals in the process and the accomplished results, supplying opportune feedbacks to the students that allow them the opportunity to participate effectively in the teaching-learning process privileging its quality.

As an important part of this posture is the fact that we have to incentive the students to search for alternative sources to knowledge building and its criticism, favouring their autonomy.

Through the accompaniment provided by a multidimensional evaluative process^{*}, it is possible to overcome the reductionist vision that sees mistakes as mere incompetence disclosures and not a valuable occurrence that can be an advantage to the learning process (considering the mistakes correction). At last, in Both's vision⁴ "the evaluation and the teaching must keep a simultaneous and concomitant action of intervention and of effect, because teaching is evaluation and evaluation is teaching"^{4, 8}. This vision tends to insert the "evaluation as part of the teaching-learning process, helping along the whole process, not only as an activity in determined moments"⁸. That is why the computer and communication technologies have important roles to perform.

A Description of a Formative Evaluation Experience Supported by Computer

Firstly, the objective of this work was the introduction of a computer instrument of formative evaluation, based on the artificial intelligence principles, verifying its effectiveness as helpful tool to the teachers and students inside and outside the classroom. That way, along the teaching learning process, it would be possible to the students to continue its learning by a non-presential way (keeping in touch with the teacher by asynchronous communication methods and permitting to check the students doubts in a peculiar way) and to promote its active participation in the process through suggestions, criticisms and questions.

Secondly, the research purpose was offering to the teachers and students a valuable method of the context analysis, and also to realize how the teaching-learning process happens, allowing, eventually the creation of a 'supportive point' to the reconfiguration already mentioned.

As a substantive hypothesis we took into consideration that the mentioned instrument introduction would considerably improve the performance of students submitted to it, and its performance would be measured through the results obtained in the evaluative process, comparing with the students that were submitted to the isolate summative evaluations.

The participants in this research were selected from the same classroom with students from the first year in the Marketing and Publicity course in a private university at the "Use of Computer" subject.

It is interesting to observe that in such choice we took other possibilities into consideration, such as the use of other students from different groups, the most significant alternative among the considered ones. This idea was discarded once it could damage the external validity of the study. Such opinion is based on the fact that the groups were formed during

^{*} The multidimensional feature of the evaluative process would be assured, according Zambelli (1997), by balanced use of summative, formative and diagnostic evaluations. This kind of evaluative process would replace the unidimensional view, based exclusively on summative evaluations.

different phases in the selective process and some of them were from candidates that were not approved at the first moment, what could bring us a bias based on students competence. Besides, considering the adopted procedure, could guarantee that all the participants would be submitted to the same classes with the same teacher, at the same place and time without, any method/contents variation, what could result into differences not applicable to the experimental treatment.

Once established the use of one group only, because of the experimental characteristic of the research, at last we divided it into two distinct parts: an *experimental group*, submitted to the intervention of the equivalent effect, produced through the research instrument application already mentioned, and another group, named *control group*, obviously not submitted to the same experimental effects.

There was the pretense that both groups were as equivalent as possible. Thus, the chosen technique to select the participants of each group was the random choice, proceeded through raffle among the students of the chosen classroom. Before the raffle, however, the research goals were announced and also the composition of the different groups were explained, what allowed us to discard the student that didn't want to take part into it voluntarily. We also discarded the absent students (the ones who had more than five absences consecutively). This happened because such selection occurred in the beginning of the second semester in the school year and, if the student has been absent, it means that he was a school dropout.

Anyway, such exclusions did not cause any damage to research validity in any aspect, as it were done before the random selection of the groups. Thus, we selected 84 participants and raffled them into two groups of 42 students. From the rest of the students, from a total of 119, 16 did not want to take part into the research and 19 had five absences or more (that meant they were school dropout ones).

To the experimental and control groups it wasn't applied any pre-test to confirm their computer skills (a training is given to the whole class every first semester as a part of the computer subject program). Due to the operational simplicity of the software available to the experimental group and to the fact that the software comes with a detailed manual, such initial verification procedures could damage the external validity of the experiment⁶. We can also consider the random selection sufficient to guarantee the equivalence between the two groups.

APRENDE : a computer system of formative evaluation based on AI

The instrument used in this research had a purpose of supplying the necessary treatment to the experimental group. After analyzing the gotten data with its use, we can see how the presented hypothesis in this investigation were assured. It is about a software developed by this author and that was made available to the experimental group through e-mail (or exceptionally through diskettes) that were installed in the participants personal microcomputers. The basic constitution of the utilized system, as its parts description and its theoretical concepts can be seeing in the next frame.

Frame 1
Synthetic description of the prototype system
(instrument applied to the experimental group of research)

Part (theoretical concept)	Purpose
Presentation	Introduces the working and use features of the system, giving the opportunity to the participant to insert personal data and to register a password that will be used to verify the rights to use the tool as the utilization history allowing to personalize the initial messages displayed
Initial	Display the options to use the system
Delimiter	Choose specific contents that will check the learning
Inferential	Intermingling the use of all other modules, fulfil suggestions based on the artificial intelligence principles related to the next activity to be fulfilled and analyse the answers supplied by the user and add them to the system knowledge base giving to the system the possibility to recognize the participant along his/her use of the instrument
Questioner	Sets up questionnaires, based on the knowledge acquired by the system about the user and the content that is being verified
Feedback	Comments results, supplies correct answers and indicates the needs to develop studies
Net (asynchronous)	Supplies support on the contents review and gives the possibility to be in touch with the professor

After the system installation (named *Formative Evaluation System APRENDE*), the participant of the experimental group started to answer multiple choice questions related to a specific theme of the subject chosen by him. After the user registration, the system developed a knowledge about him, while the questions are answered. Comparative mechanisms based on linear logic and in artificial intelligence principles are started up to verify the results and its transformation in scores.

At the users command, the system supplies a feedback about the accomplishments and mistakes committed, a utilization report and also it can suggest new activities to be done right away or in a near future, linked or not to the system possibilities.

A specific site at the Internet worked as a support to the users through the availability of the contents worked until determined point, for studying or doubts checking. The teacher can be requested by e-mail for operational doubts (the system use) or to be questioned about anything related to the subject in study.

During the system use (about two months) the students sent their actions in the research instrument to the teacher, including questions, criticisms and suggestions (involving

recommendations of sites, books, articles about the subject, thus to ask for changes in some questionnaires format) through e-mail.

With these information the teacher could feed the system database in his microcomputer in a way to identify the weak points in the students learning process, besides to add the pertinent suggestions given and make the necessary arrangements.

Later on, the students got back the new knowledge basis amplified by the teacher's actions and individual orientations by e-mail. After that, in the classroom the contents of the studies were increased reaching the major gaps in the learning process. Concomitantly, the artificial intelligence principles used in the system created new ways to orient the students, proportionally to the system use.

Due to a series of relevant facts, among them, the user control of this progress in the modules, the system responsivity, that also has an interactive feature, we must call attention to the formative characteristic of the adopted research instrument. Besides, we can consider that meanwhile, the instrument got an adaptative feature, due mainly to the used artificial intelligence principles, that made it able to adapt the computer system to the user profile, identifying the user potentialities and learning deficiencies.

Regarding to the type, we can say that the developed system as an applied instrument to the experimental group, defined to this investigation, is the *adaptative media type*, and more specifically, a *tutorial system*^{2, 26}. The software developed in this research presents some predominant features already exist in softwares building into these concepts, that are:

- extrinsic feedbacks to the students actions;
- adaptative task focus, relating the current acts into the system with the ones before, and the general goals;
- previous supposed knowledge about the subject;
- the teacher's conception inserted when supplying the feedback to the students;
- learning strategy into the proposed tasks projected, to make clear the wrong concepts (if they occur) in a way to make the students conceptions available to the system;
- possibility of incorporating suggestions, corrections and even new contents through the teacher analysis of the students suggestions.

As already mentioned, some principles of artificial intelligence were used in the formative evaluation system. Such principles are linked to a technique called *learning by memorization* which is based on the premiss that in a computer algorithm, the learning happens when, after the storage and because of it, there is some system improvement of its previous possibilities^{18, 28, 41}.

Previous experiences and concepts about computer tools applied to education, worked as a base to build the theoretical model in which the formative evaluation system was composed also as other theoretical references not less important: *Assessment of practice teaching*, an evaluation method for potential teachers used in australian universities⁵, *Computer-Assisted Assessment*, summative/formative method used in British universities as the Luton and the

Loughborough University⁴³, *Computer-managed Learning*, a manageable learning system by computer that has been used at Curtin University (USA)⁴², *Enseignement Assisté par Ordinateur*², hypertext and hypermedia (Jonassen²⁰, Tolhurst⁴⁵, Laurillard²⁶, Colazzo and Molinari¹⁰, McGreal³⁶, Kerckhove²³, Levy²⁹); multimedia resources (Larillard²⁶, Herrington and Herrington¹⁹); characteristics of teaching/learning traditional and new tools¹⁵, the feedback importance in formative evaluations (Sly⁴², MacDonald, Mason and Heap³⁵); new question of time-space in the educational context (Kershaw and Safford²¹, Gladiaux and Swall¹⁶, Taylor and Eustis⁴⁴); new concepts of management of intellectual interactions³¹, computer networks and shared information service in the Universities – including Internet³²; learning environments in the Internet (McGreal³⁶; Chute, Sayers and Gardner⁹, Cruz¹², Lockyer et al³³); new technologies and teachers work⁴⁰; among others.

Results

As a post-test instrument, it was used the third bimester evaluation, that was a written test applied in the classroom that was composed by seven discursive questions and five multiple choice tests, involving the whole subject content in the course till that point. From the total possible grade, 70% were from the discursive questions and 30% in the multiple choice tests. These kind of evaluations are set by the university – once a bimester – and are prepared by the subject's teacher based on the taught content inside the classroom. Once it has a purpose of attributing a concept, used to compose altogether with the students frequency to at least 75% of classes, the students success or failure criteria, such evaluations have a summative character.

It is appropriate to mention here, that in the end of the data collection period, we could verify that the experimental group finished with 34 participants, while the control group ended up with 35 students. Verifying the collected data after the third bimester summative evaluation, we could verify 18 students that succeed in the control groups (51.43% from the participants), while in the experimental group, 28 students had a higher or equal 7 grade, the minimum necessary for being successful in the school semester (82.35% from the experimental group participants). The observed difference between the two groups in the research was of 30.92%, what indicates, firstly, that the experimental treatment was effective in producing a significant increase in the number of students that had a profitability above the average grade to be successful in the course.

The Frame 2 shows a comparison between the two gotten grades in the summative evaluations in the second and third bimesters by the participants from the experimental and control groups.

Frame 2
Average grade comparisons of the participants from the experimental group and control group in the second and third academic bimester

Group	Average grade 2 nd bimester	Average grade 3 rd bimester
Experimental	6.35	7.80
Control	6.22	6.08

The observed difference in the grades average between the two groups (experimental and controlled ones), in the 2nd bimester was only of 0.13 hundredth for the experimental group which represents a minimum difference between the groups of 2.09%. However, the observed difference between the two groups grade average in the 3rd bimester was 1.72 points for the experimental group, which means, the experimental group average was 28.08% bigger than the average obtained by the students of the control group. Considering the equal conditions of the groups, we can conclude that the considerable difference for the experimental group was due to the treatment this group was submitted through the research instrument (formative evaluation computer system).

Other point that might be mentioned is the different performance of two groups in the two bimesters: while the control group presented a slightly fall in the students average performance (a decrease of 2.3% in the 3rd bimester in comparison to the 2nd bimester), the experimental group performance had a considerable increasing in the same period (plus 22.83%). As the only relevant fact, related to something that could cause the differences in the observed performances from the equal groups, was the experimental treatment introduction so we concluded that it was the factor of such differences. This supposition was confirmed when the realization of the hypothesis test adopted in this investigation (*Mann-Whitney's Test* or *U-test*, non-parametrical statistical method) which results permitted the acceptance of the substantive hypothesis in the research. With the use of the same test, we could realize in the same way, that the observed difference between the second and third bimester average grades for the experimental group was due to the applied experimental treatment before the third bimester summative evaluation.

Conclusions^{**}

The formative evaluation computer system provided (as it was shown) a considerable increase in the number of students that got a satisfactory grade (enough for their success in the course). But that was not the only gotten result – and certainly not the most important one: according to the formative evaluation concepts which was exposed here, it was also possible to provide to the teachers and students, extremely valuable alternatives to the teaching-learning process. Besides this, valuable observations could take place in the computer tools improvement which are similar with the research instrument in which the experimental group was submitted, looking for an improvement in the interface quality with the user and involving essential questions to the success of tutorial systems as the adaptability and interactivity among other relevant ones.

Very often, along this investigation, the teachers received e-mails with doubts like: ‘ – The system is advising me to review part of the subject content in which it considers I can improve, but I do not want to do it right now, could I go further?’ Or also ‘ – To clarify the concept X in one answer, the system mentioned the concept Y that is not available in the subject list. Where can I get more information about the Y concept ?’. Such doubts could have been easily clarified due to an adequate foresight regarding to the teacher time

^{**} The conclusions described here consider, besides the analysis and the reflection of the gotten results in the experimental research, the testimony of teachers and students involved in the process

availability. Certainly, the existence of an user manual, besides a consultation site for some possible problem solving – as it to the formative evaluation system in this research – were extremely useful and convenient, solving these kind of doubts: ‘– What button should I press when I want a feedback about certain questionnaire?’ or ‘ – In which option I can find the statistics?’.

Other observed possibility was to extend the teaching-learning process beyond the classroom environment, with some suitable adaptations; thus, the used system in this investigation can be also used for the formative evaluation in the teaching-learning process of the semi-presential and distance learning courses. With the use of the formative evaluation system, the students undertakes a high level of responsibility about their own learning, and they have, in the place and time that they prefer, the chance to explore the subject contents that they are submitted, controlling their development and alternating the trajectories according to what they think it is more necessary, important or interesting.

Besides that, the proposition model of the questionnaires requests to the students, most of the time, to look for other resources into the subject bibliography supplied by the teacher or for other alternative resources in which are included Internet sites and specialized articles, besides other alternative written sources (books, newspapers, periodicals, journals, etc.). Evidently, such references had already gotten the teachers approval, after her/his analysis. When the application of the instrument to the chosen experimental group in this investigation, we had a common comment from many participants ‘– It was not very difficult to answer the questions, but it was necessary to read that book, to look for something in the Internet, to visit the computer periodicals section in the library’. Once the use of this kind of system becomes common, it can also incentive the systematic study and the research, and such features are very important for a solid learning development.

Other important aspect in the instrument concept, was the possible discussion between the teacher and the participants based on the feedbacks collected in the system. In the individual attendance, the teacher had the possibility of to verify the students course in the system, what was helpful for the further advisement (to study determined topics, to read on specific piece of work, etc.) and to solve pertinent contents doubts (definition, concepts applicability, resources operation, etc.). Such characteristics also allowed the students to get to know their specifics difficulties in a way to ask more valuable and objective questions improving inclusively their suggestions and criticisms. For an individual treatment, similar information were obtained, considering a specific participant and its answers to the questionnaires proposed by the system. Technically, the pertinent information in the general and individual analysis were obtained through a sequence of commands from the teachers, applied to the database management system environment²⁴.

Still, regarding to the use of the system by the teacher, it was possible to be aware of the more frequent problems found by the students, and we could verify if the approach to these subjects could be improved in some way with the use of other pedagogical methods or didactic resources previously not tried. Thus, the system, as a method of formative evaluation, allowed the teacher to realize if the students had achieved the wanted goals; besides it permitted to verify the compatibility between the very same objectives and the gotten results during the activities development. It is also important to mention that the

students can be aware of their successes and mistakes along the teaching-learning process in which was involved, finding this way a higher encouragement to a systematic contents study.

The guiding aspect of the formative evaluation, previously mentioned, was largely provided by the computer system and it was available, as to the students' knowledge building process improvement, as to the teacher work, mainly through the feedback mechanism. The results clearly showed that it is possible to detect and to recover the lacks in the learning process and also to extend it beyond the classroom environment. It is also possible to apply the multidimensional aspects of evaluation and to incentive the student in his autonomy achievement.

Another important aspect that can be mentioned here refers to the characteristics and the didactic-pedagogical strategy of the formative evaluation computer system used as an experimental instrument in this research. In general ways the computer systems into the teaching-learning are seeing as ways to get, to store, to link or to transmit data, providing a more convenient and advanced method to the use of resources linked to subject contents and related matters. However, it is opportune to remind at this point that the foundation of technologies linked to the mentioned process is the creation of "learning environments"³⁷. So, it is very important, according to this point of view, the clear delimitation of a didactic-pedagogical strategy as a base to the construction of computer systems as the one used in this research. The indistinct fulfillment of the academic space with advanced computer equipment and the aleatory introduction of educational softwares, does not guarantee the results gotten here. It is necessary to have a very clear distinction between the educational aims and the means to achieve them. According to the background acquired along this investigation, we have to confirm that the computer systems are not part of the mentioned goals, but they can – if correctly built – to become powerful means to execute them.

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