INTEGRATING ICTS TO PBL METHODOLOGY WITH APPLICATION IN THE FIELD OF GYNECOLOGY AND OBSTETRICS

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Abstract: This study is an analysis of a support system for learning the Gynecology and Obstetrics discipline in a Medicine course using the PBL methodology. Its objective is to point out a computer model that can measure the similarity index between the patient's anamnesis as done by the student and the solution proposed by the professor. The study also presents concepts of the PBL methodology and its several applications, as well as the techniques used in learning with the use of this methodology. Additionally, it shows the actual iteration of ICTs with the PBL methodology. It is this hoped that the investigative analyses and the implementation of this system offers students possibilities to experience in anticipation the daily routine of their future profession, with the aim of aiding them in the teaching-learning process by creating the conditions to help the instructor in evaluating the student's performance, while giving the student the chance to debate the solution proposed by the professor.

1 INTRODUCTION

We live in a world in constant change, powered by great technological advances, of which education could not possibly be immune. Currently, Information and Communication Technologies – ICTs are greatly aiding the teaching/learning relationship in education, and the Internet has been decisive in presenting new alternatives for teachers and students alike. Many educators and researchers have been using new methods and paradigms in the education field. In the medical field, new methodologies for teaching and learning have appeared; among them is Problem-Based Learning – PBL. Besides to the diversification of the areas in which PBL has been applied, the introduction of the ICTs has created new virtual platforms, and new software programs are integrating solutions and adaptations for the development of PBL-based teaching and learning.

Medical education in particular has taken a more direct approach in this field, and today there are several success stories in the formation of physicians and healthcare professionals.

The presentation of clinical cases is one of the main points in the teaching of medicine using the PBL methodology. The premise for the use of this methodology is to offer students the possibility of experiencing in advance the daily routine of their future profession, with the objective of facilitating their learning process by creating the ideal conditions for both the professor (in evaluating the student's performance) and the students themselves (by allowing them to discuss the solution proposed by the professor).

In (Rodrigues, 2006), a study was conducted to guide students and professors in developing teaching and learning strategies in Gynecology and Obstetrics according to the PBL method. This study was developed as part of the Learning Program in Gynecology and Obstetrics at the Pontifícia Universidade Católica do Paraná – PUCPR, for the Women's Health discipline. After a detailed analysis of the research, a need was detected to incorporate into the system an instrument to measure the

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similarity in the paths followed by the students in the course and that predetermined by the professor. This congruence was recorded into the system after an analysis by the faculty member responsible for the Gynecology and Obstetrics course. Student data and the professor's answer sheet have been stored into a data base.

Considering the data contained in the data base, the need was verified to obtain an automated or semi-automated solution, in an adequate format, in order to provide a greater level of autonomy for students in the teaching/learning relationship. In other words, it was necessary to add into the system a module that allowed for a match between the path taken by the student – step-by-step, from the beginning to the end of the clinical case – and the solution proposed by the professor, thereby presenting a similarity index between the two approaches.

In this manner, the system contains a computational model that allows the measurement of the similarity index between the patient's medical history and the solution proposed by the professor. Based on this index, it is possible for students to measure and analyze where the divergence took place between the decisions they made and those indicated by the instructor. Thus, the results obtained in this work can contribute to learning within the medical community, as well as in the development of medical students.

This study introduces the concepts of PBL methodology and its many fields of application, as well as the techniques used in PBL-based learning. It also features a study on the anamnesis in the clinical cases used in Gynecology and Obstetrics Learning Program at PUCPR. Furthermore, it highlights the current interaction between ICTs and the PBL methodology. It concludes with an analysis and discussion of the contributions this system can offer to the medical community.

2 PROBLEM-BASED LEARNING

2.1 PBL and its Applications

PBL methodology was first developed in Canada in 1965, within the medical curriculum of McMaster University. It represented a split from the learning philosophies of the time, in which (Burgardt, 2000) affirmed that the teaching of traditional medicine was already geared towards the application and repetition of the same practices, in a methodology that used expository lectures, guidelines, summaries and knowledge and the main reference points for medical education.

Additionally, it is important to consider that upon the implementation of the PBL methodology, the educational process shifted towards four mental spheres of the student – the education of behaviors and attitudes; learning and discovering; learning how to do; learning to coexist and learning to be (Delors, 1998).

In the PBL methodology, traditional expository lectures are not abandoned altogether, but take on the purpose of clarifying unresolved issues from the problematization stage (Behrens, 2005).

According to Ribeiro (2005), the PBL approach is used almost worldwide, with characteristics capable of promoting student learning, while also aiding in the development of the professional abilities and attitude expected. One of the greatest benefits of this methodology is precisely that it approaches the problem as a starting point for the study process, focusing and motivating the learning of new concepts.

In (Amaral, 2007), there is a description of two experiments conducted with medical students, aiming at evaluating whether these students could take part in the Osce (Objective Structured Clinical Examination), which evaluates beginning medical students regarding their basic clinical abilities. Two groups of students were submitted: the first group was formed by students who had studied under the traditional methodology, and the second was composed of students from universities that used the PBL methodology in their medical education curriculum. The values were quite close, between the two groups and between professors. The conclusion was that students in training can be used as reliable examiners in an exam of basic clinical abilities for beginning students. Therefore, neither of the two aforementioned methodologies was responsible for the difference in student results, which to a certain extent does not guarantee greater development of students from one or the other

In (Johnstone, 2006), the importance of PBL is analyzed as a method for the facilitation of learning, and has made use of several tools to engage students in different educational activities, such as: tutorials, problem-solving, workshops, exercise groups, etc.

In the current decade, several technologies have aided the education field; the Internet has certainly had a decisive role in new solutions in the teaching-learning relationship. Within PBL, in addition to the diversification in the fields of application, new virtual platforms have integrated solutions and adaptations for the development of PBL-based teaching and learning.

In an article by (Amen & Nunes, 2006), a discussion is presented on the use of ICTs as a pedagogical option for creating a learning environment. The article also features and evaluation of the contributions these technologies can make to the interdisciplinary requirements contained in the mandatory curricular guidelines for medical schools. According to (Amen & Nunes, 2006), ICTs can facilitate the interdisciplinary process, as they feature a series of advantages as compared to the conventional learning methods and facilitate the immediate exchange of information, the visualization of sub-tasks as parts of wider tasks, the tailoring of information to individual learning styles, encouraging exploration, greater organization of ideas, greater integration and interaction, improved speed in information retrieval, greater power of distribution and communication in the most varied contexts.

The work of (Masarenti Jr. et. AL, 2006) features a report on the use of open software in distance education in the field of Medicine. This study describes the technological support used by the Edumed Institute for Medical and Health Education, based on the six-year experience of that institution. The support is based mainly in two Virtual Learning Environments: Teleduc and Moodle. Teleduc was developed by the Núcleo de Informática Aplicada à Educação at the Universidade de Campinas (Unicamp) (Rocha, 2002). This environment features several tools for administration, coordination and work, which significantly aid professors in the authoring, follow-up and evaluation of their learning proposals.

Moodle is an open software program for course management, similar to TelEduc, but which some additional advantages – the ability to implant extra modules, greater flexibility in the use of tools and the selection of appearance and layout, and the possibility of using the same user profile for other course, according to (Dougiamas, 2003).

With the use of these technologies, several courses have been implemented and ministered, and many consulting jobs have been conducted by the Edumed Institute. In regards to extending the functionalities of Teleduc, the Edumed team designed and implemented – among other improvements – a system of online authorship and management of multiple-choice and open-answer questionnaires, integrating them to the Teleduc menu and tools. This allows for the effective evaluation of distance-education students that make use of their courses.

Therefore, with the evolution in ICTs, the PBL methodology is no longer confined to the medical education field. It can now be applied into a much wider scope that transcends health education and spreads into several other areas that mold their curricula to the medical model.

The use of the PBL methodology in Brazil began at the Universidade de Marília in 1997. Soon after, in 1998, it was implemented at the Universidade Estadual de Londrina. The PUCPR Medical School began applying PBL starting in 2000.

2.2 The PUCPR Case

The purpose of implementing the PBL methodology at PUCPR was precisely to build an environment where, by having students actively participate in solving the problems presented by professors, they would build the basis for their own learning and professional development.

Faced with the challenge, PUCPR began to use the PBL methodology for classes. The students are divided into groups of 8 to 15 members, which meet twice a week for case studies. Each of the groups has the participation of a tutor, who plays the role of facilitator in the teaching-learning process. The tutors themselves meet in groups of two to conduct theoretical classes and to complement the knowledge acquired by students. Evaluations are conducted every other month, with a final exam at the end of the bimester.

All case studies presented by the tutors during meetings with students are elaborated by the course's group of tutors. These cases are built with predetermined results in structured form, and serve as motivation for students to achieve a critical view and develop skills for solving the problems that are presented, as well as creating a sense of responsibility that will aid them in their conduct as professionals.

To believe in the principle that presenting clinical cases is one of the main points of teaching Medicine through the PBL methodology, as well as the premise for using this methodology, is to offer students the possibility to experience in advance the daily routine of their future profession. Believing in these principles, the PUCPR Medical School, in its Learning Program in Gynecology and Obstetrics, implemented the PBL methodology and began to create a collection of clinical cases, which have been optimized in an efficient and effective manner.

Additionally, PUCPR has a Graduate Program in Health Technologies, with the main objective of integrating and using new technologies in the health care field. Thus, the aim of this work is to give continuity to studies on the teaching-learning process, and is inserted in its models of research. For this study, research works were developed beginning with an evaluation of Internet access viability and the interest of students in a support system that would offer the possibility solving clinical cases in gynecology. Next, a tool was developed to classify exercises and practice, with the concern of creating a user-friendly interface and matching the teaching methods applied at PUCPR. This resulted in several research projects, among them (Rodrigues, 2006), whose aim was to obtain a Gynecology and Obstetrics Teaching Support System. The main objective was to study, specify and implement a system, based on the Internet platform, of support for the teaching of Medicine through the solving of clinical cases. The tool was tested by a sample of students of the ninth period of Medicine, who were able to analyze the ease of use, which was considered "easy" by 90% of students. The applicability to the study method was also analyzed; 95% of sampled students affirmed that the tool stimulated them to think about the clinical case, and 65% of students indicated that the case solved using the tool has the same degree of difficulty as that discussed in the tutorial.

This system further allows the professor to analyze in detail the solution found by students to the cases, using the PBL methodology. The solution is given in graphic form, making visualization easier and allowing tutors to check for possible hitches in the teaching-learning process.

3 THE APPLICATION

3.1 The System

The system (Rodrigues, 2006) was developed in the Program in Gynecology and Obstetrics at the Pontifícia Universidade Católica do Paraná – PUCPR, has as its basic characteristics the features:

- **Access - Login:** each user (student or tutor) has his own credentials for access, recording of solutions and all actions carried out for the solution.
- **Solution:** graphic representation of user-selected variables.
- Variables can be added or removed from the solution.
- Follow-up questions can be defined for these variables by the tutor at the time of creation of the clinical case.
- **Diagnostic Impression:** open fields for answers on diagnostic hypotheses, differential diagnostics, conduct and additional exams.
- **Comparison:** the solutions of all students and tutors can be compared through a graphical interface.
- **Printing:** all solution items are displayed, to be printed if desired.
- **Statistics:** the results of solved cases are presented with the following information: student's name, selected hypothesis, differential diagnosis, exams and conduct, duration of solution, start time, end time, number of variables included.

The system initially interacts through the modules presented in Figure 1, identifying the requirements that originated the need.

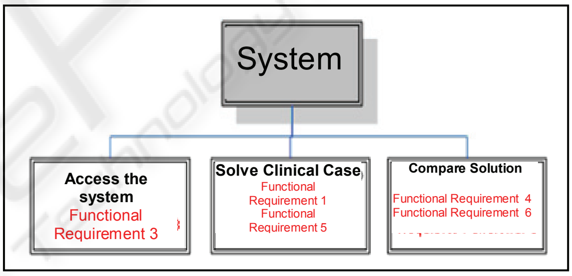

Figure 1: System Modules – first interaction – Source: Rodrigues (2006).

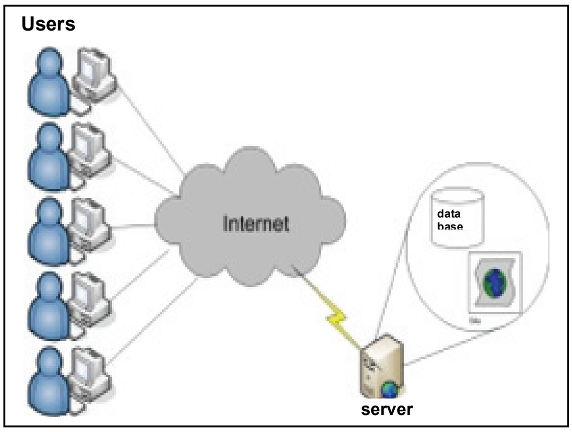

Figure 2: Initial system architecture – Source: Rodrigues (2006).

After the construction of use cases was completed, the data base model was created to store the clinical cases, user information and their respective solutions.

In Figure 2, the proposed architecture is shown, in which the tutors and students specify a URL from a computer connected to the Internet. At the other end of the network, there is a server that responds to this access request.

The Access Module was developed with the objective of guaranteeing security, with the student using a login and password to begin the first records of solving the clinical case. At the moment of user authentication, the following data are recorded in the solution of the clinical case, in the form of logs (records of activities generated by system computer programs):

a. Number of case being solved.
b. User code.
c. Performed action.
d. Date and time.

In order to access the system, students must indicate a username and a password previously registered at the site. When building the clinical case selection module, a clinical case variable selection screen was created, in which the clinical findings are displayed in selection menu format. They vary in position from case to case – at each solution start, it is located in a different order. This prevents students from fixing item positions instead of selecting the variables in the sequence they consider adequate. This structure was positioned laterally on the screen to allow more space for the presentation of answers to the requested questions.

In the Construction of Logs, two types of logs were developed, in order to enable the verification of the activities conducted by students during solving. The two types of logs are:

- Navigation: with the actions of visualizing case description, solve the case, fill out diagnostic hypothesis and compare the clinical case.
- Request: records the activities during variable selection, with inclusion and removal of elements.

The objective of this module is for students to request information about the patient based on the selection of items from the menu. As they select the question, the patient's answer is displayed on the screen.

In Figure 3, all system modules are presented in the **second iteration** with the requirements that generated the need. It demonstrates the relation between the impression module and the solution comparison module. This indicates that, in order to access this module, the comparison module must have been previously accessed.

The remaining use cases were described to define the new system modules::

Use Case 4: Record Diagnostic Impression;
Use Case 5: Follow-up questions
Use Case 6: Access statistics;
Use Case 7: Include new clinical case.

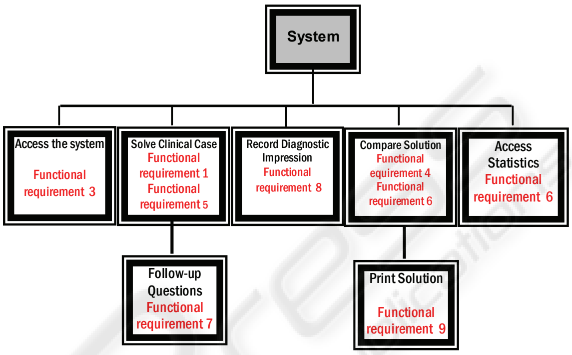

Figure 3: System Modules – second interaction – Source: (Rodrigues, 2006).

The system contributed efficiently to the insertion of ICTs in the medical education environment, specifically in the field of gynecology and obstetrics. This gives students a support tool that gives them information of previous clinical cases, which serve as reference in their professional development for studying new case, as well as giving them quick and specific access.

The system evaluation in the second iteration was conducted an acceptance test, in which the tutoring professor, along with a group of 15 of gynecology and obstetrics students , used the tool as a group during a tutorial, in which they discussed the clinical case as usual and then began solving the case using the proposed tool. At the end of the tutorial, the students answered a system evaluation questionnaire, made up of five closed questions (YES or NO) and one open question for observations. Of the 15 students, five declared there had been changes in the discussion of the case in class with the aid of the tool. The students' observations were:

- It enables comparisons among classmates and with the professor.
- The tool required greater need for clinical knowledge.
- Tool features easy visualization.
- It is a unique tool; it improves interest in discussing the case.
- It promoted simultaneous discussion among

students.

The gynecology and obstetrics students were questioned about their interest in working on other cases using the tool; 73.33% answered YES and 26.67% said NO. In an interview with the tutoring professor, she considered the tool ready for wider-scale tests. These tests would be conducted with the students solving clinical cases separately. This would be considered the final step in the development stages.

At the end of the system development stages, it was confirmed that the system could be used by a larger number of students. In order to validate the system, 20 medical students undergoing gynecology tutorials took part in the process.

After the system was validated, the discussion of cases by the students was studied. It was believed that the students who had added and removed variables were analyzing all possibilities in order to form a diagnosis, in the same manner as they did in the classroom during the tutorials.

Lastly, clinical case comparisons were made. After filling out the entire clinical case, the complete solved case solution is displayed, after which the gynecology and obstetrics student can select other answered cases in order to visually compare case solutions. The student may not return to the case to alter it after finishing the solution to the clinical case.

At this stage and after analyzing the project (Rodrigues, 2006), it was verified that there is no comparison between the paths taken by the medical student and that predetermined by the professor, which was recorded according to an analysis by the faculty member responsible for the Gynecology and Obstetrics discipline. The data are stored inside the system, but their analysis was not done directly.

Based on that need, we observed the importance of proposing a solution that aims to automate or semi-automate a process that can make a match between the path taken by the student, step-by-step, form beginning to end, regarding the clinical case and the solution proposed by the professor.

3.2 Analysis and Discussion

In item 2.1, we showed that in the current decade, several ICTs have contributed to the education field, and that the Internet has been decisive in presenting new solutions in the teaching / learning relationship. Moreover, the use of the PBL methodology, in addition to diversifying the areas in which it is applied, new virtual platforms and software programs are integrating solutions and adaptations for the development of PBL-based teaching and learning, thus demonstrating an ever-greater integration between the PBL methodology and ICTs.

According to items 2.2 and 2.3 and after a detailed analysis of the obtained results, it was verified that there is no automated or semi-automated comparison between the paths taken by the medical student and the predetermined path set by the system, which was recorded according to an analysis by the faculty member responsible for the Gynecology and Obstetrics discipline. As the students' data and the professor's answer sheet are stored in the system data base, it is possible to match between the student's data and the professor's answer sheet automatically or semi-automatically.

With the use of math-based tools, it is possible to compare these two paths, thus obtaining an adequate solution to this problem: automating or semi-automating the process that can make a match between the path taken by the student, step-by-step, form beginning to end, regarding the clinical case and the solution proposed by the professor.

The main characteristic of the PBL methodology is the use of clinical cases as study objects. The Learning Program in Gynecology and Obstetrics at PUCPR has been a great ally to PBL, as both students and professors adapted efficiently to the process. This methodology offers students the conditions to experience in their studies what would really be happening in their professional lives.

In order to integrate the student with reality, and so that individual performance can be monitored and recorded, the support system for the teaching of gynecology and obstetrics can be further improved to include automation or semi-automation of the analysis of similarity indices between the solution found by the student and the professor's answer sheet.

In order to solve this problem, the system (Rodrigues, 2006) was provided with a module where information related to the patient's anamnesis was stored. The System features logs, and was built as follows: at each variable inclusion or exclusion request by the user, a record is made. To that end, two types of system logs were created: one that records navigation, case description visualizations, the possibility of the user solving the case, fill out diagnostic hypothesis and compare clinical case. The second log records activities that take place while the variables are being selected, named requests, Figure 1.

The log represented in Figure 3 demonstrates all the requests made by the student and recorded in the system developed by Ana Paula Rodrigues. The log in figure 1 contains the following data:

- **Student:** the student who is performing the patient's anamnesis.
- **Question:** the question asked by the student to the patient.
- **Action:** the action the student takes regarding the question, whether or not it is included in the system data base
- **Date:** date and time the consultation took place.

The records are of fundamental importance, as with their comparison and the steps established as parameters defined by the instructor of the discipline, a similarity comparison will be made and we will trace the levels of correct and wrong answers of students in a manner closer to that described by the faculty member.

A diagnostic hypothesis screen must be filled out in the system by the student, with a description of the consultation, thus making it possible to describe the differential diagnoses and the additional exams that can be requested for the patient. These data will aid in the creation of the comparative diagnosis.

The access request will be answered by an architecture in which the tutors and students have access to the Internet by accessing the URL address of the application, which resides in a server on the other side of the network.

Next, the similarity is measured between the anamnesis conducted by the student (path taken in the data base) and that proposed by the professor (path defined by the professor – answer sheet). Thereby it is possible to present the difference between the two solutions, in order to aid both the student and the professor in analyzing the student's performance.

To gauge the similarity between the two models – the one defined by the student and that fed into the system by the professor (answer sheet) – we use mathematical models that enable us to calculate the distance between them.

As such, the mathematical models allow us to analyze the system logs, by making a comparison between the entire path executed by the student throughout the anamnesis and later compared to that suggested by the professor. At the end, data will be given that will greatly aid in their academic and professional life. In (Zeferino, 2007), we can affirm that giving feedback to students is fundamental in the teaching-learning process. For clinical medical education, an answer to the student regarding his performance will give him the conditions for self-evaluation and to take decisions that will aid in decision during future diagnoses.

During system validation, a questionnaire was created and sent to a group of specialists, who analyze it and later give their verdict on its use. If the questionnaire is approved by the specialists, it serves as reference for evaluating the tool.

The final result is adapted to a computational model for monitoring the performance of the medical student during initial patient evaluation.

To that end, the anamnesis conducted by the student is monitored, and subsequently compared to the proposal made by the professor, who use the faculty member and professional experience to set the best path to be taken during the consultation, so that the final result can be achieved with the least possible waste, both in material resources as well as in patient's and student's time.

This comparison provides a report in which the entire process followed by the student is described, as well as the deviation in his case analysis, both during the consultation and after receiving the comparative results.

It is hoped that this becomes a cooperative tool for students in their academic and professional development as physicians.

The final results of the calculation of the similarity indices are in the final stage of validation, and in the future the system will be practically automated or semi-automated.

4 CONCLUSIONS

The discussion of the results obtained in the program in gynecology and obstetrics study and the analysis of the contribution that the solution contained herein will bring to the medical community and development of medical students will certainly be important. This evidences the importance of integrating ITCs with the PBL methodology in the teaching-learning process. The use of a data base tool can feature devices that can aid the participants in the teaching-learning process to trace the initial parameters of their solution to the problem proposed by the instructor; later, they are evaluated through the stored data and verifying the similarity index. Based on this evaluation, the student can reach a lower deviation index from the path proposed by the professor. In spite of being a study with partial results in regards to validation of the similarity indices – the instructor's evaluation is fundamental to the validation of learning – in general, students and faculty alike indicated the viability of the use of this teaching method within the studied context.

REFERENCES

Amaral, E., Domingues, R.C.L., Bicudo-Zeferino, A.M., 2007. Avaliando competência clínica: o método de avaliação estruturada observacional. *Revista Brasileira de Educação Médica*.

Amem, B.M.V., Nunes, L.C., 2006. Tecnologias de informação e comunicação: contribuições para o processo interdisciplinar no ensino superior. *Revista Brasileira de Educação Médica.*

Behrens, M.A., 2005. *O paradigma emergente e a prática pedagógica*. Vozes. Petrópolis. 1nd edição.

Burgardt, C.I., 2002. A aprendizagem baseada em problemas na fase pré-clínica do curso de medicina da PUC-PR. *Dissertação Mestrado em Educação* – Pontifícia Universidade Católica do Paraná, Curitiba.

Delors, J. 1998. Educação: *Um tesouro a descobrir* - Relatório para UNESCO da Comissão Internacional sobre Educação para o Século XXI. São Paulo, Cortez/UNESCO.

Dougiamas, M.; Taylor, P., 2003. Moodle: Using learning communities to create an open source course management system. In: P. Kommers & G. Richards (Eds.), Proceedings of World *Conference on Educational Multimedia, Hypermedia and Telecommunications.* Chesapeake, VA, USA.

Johnstone, A.H., Otis, K.H., 2006. Concept mapping in problem based learning: a cautionary tale, *Chemistry Education Research and Practice.* The Royal Society of Chemistry

Massarenti Jr., N.D., Sampaio-Ralha, J.L., Ribeiro, W., Romaniuc, A.; Sabbatini, A., Cardoso, S.H., Sabbatini, R.M.E., 2006. Utilização de Softwares Livres em Educação a Distância em Medicina e Saúde: uma Experiência de 6 Anos. *Congresso Brasileiro de Informática em Saúde*. CBIS.

Ribeiro, L.R.C., Mizukami, M.G., 2005. An experiment with PBL in higher education as appraised by the teacher and students. *Interface (Botucatu).*

Rocha, H. V., 2002. O ambiente TelEduc para educação a distância baseada na web: Princípios,funcionalidades e perspectivas de desenvolvimento. In: Moraes, M.C. *Educação a distância: fundamentos e práticas*. Campinas. UNICAMP/NIED, cap.11, p. 197-212.

Rodrigues, A.P., 2006. Sistema para Apoio ao Ensino de Ginecologia e Obstetrícia, Através da Resolução de Casos Clínicos, Dissertação de Mestrado em Tecnologia em Saúde – Pontifícia Universidade Católica do Paraná, Curitiba.

Zeferino, A.M.B., Domingues, R.C.L., Amaral, E., 2007. Feedback como estratégia de aprendizado