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# RESULTS OF NEW TEACHING TECHNOLOGIES OF RADIOLOGY IN AN UNDERDEVELOPED COUNTRY

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## Summary

*Rational and Objectives. The aim of the study is to design, implement and evaluate a teaching tool as complementary material for distance learning to cover the discipline of Radiology for interns at the Radiology Department of the Faculty of Medicine.*
*Materials and Methods. A Web-based tool was designed to be acessed by the students of the last period of the medicine course of the UFRJ. The access to the digitilized material was optional.*
*Results. During three semesters 164 students were evaluated, 65 made use of the material and 99 did not. The differences between the two groups were statistically significant.*
*Conclusions. Medical students that acessed the material showed an improvement of 9.68% in their grades when compared with the group that did not use the material.*
*Key Words. Medical student education; educational technology; distance learning; internet; teaching tools; computer-assisted instruction; radiology.*

## Introduction

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Education is the primary goal of academic institutions[1]. Film-based teaching files require a substantial investment in human, logistic, and financial resources. During many years radiographies and other means of diagnostic images have been tested and studied[2] to make this filed material available to be studied. Such materials can be handled however they need to be displaced from their original storage place. An appropriate solution for the lack of didactic material is the use of modern educational technologies[3]. Therefore, we have chosen the Internet. The association of computer and network technology facilitates the workflow integration of distributing radiology teaching cases within an institution (intranet) or via the World Wide Web (Internet).

The Radiology Department of the Faculty of Medicine of the Federal University of Rio de Janeiro has developed a teaching tool to facilitate the access of didactic material by the radiology undergraduate students (interns). Therefore, it was taken advantage of the large exams´ files and teaching materials produced and stored by professors and medical doctors throughout decades.

Classes and clinical cases were provided for the graduation students, so that several students could have simultaneous access to them, using a computer without the risk of damaging the original copies.

The aim of this work is to show the results obtained by the students who used the teaching tool and to compare it with the students that did not use the same available technology.

**MATERIALS and METHODS**

The radiographic images were digitalized and texts and questions were elaborated to be used along with the images. The students were invited to participate, by simply contacting via e-mail the responsible for the tool management.

The material was created in the Power Point (Microsoft Corporation, Redmond, WA) program and allocated on the Internet in the Hyper Text Markup Language (HTML) format, which is the simplest way to use and make available information on the Internet.

The content was divided into themes, which are: cough and fever, dyspnea, atelectasis x pleural effusion, chest pain, jaundice and digestive disturbances, abdominal and pelvic pain, abdominal masses, neurologic abnormalities, bone lesions, trauma and breast cancer. Each theme includes the most important diseases in the clinical routine.

Themes and topics the course:

- Cough and fever: Lung abscess, Pneumonia, Lung tuberculosis;
- Dyspnea, atelectasis x pleural effusion: Heart chamber enlargement, Bullous emphysema, bronchiectasis, Pleural effusion, COPD, Pulmonary venous hypertension, Kerley B lines, Pneumothorax;
- Chest pain: Aortic aneurysm, Lung cancer, Mediastinal tumor;
  Jaundice and Digestive disturbances: Achalasia, Oesophagitis, CT and ultrasound (liver, pancreas and bile ducts), Oesophageal tumor, Oesophageal varices;
- Abdominal and Pelvic pain: Appendicitis, Abdominal calcifications, Ulcerative colitis, Diverticulitis, Crohn´s disease, Ectopic pregnancy, Ureteric calculi, Pneumoperitoneum;
- Abdominal masses: Renal cysts, Intussusception, Uterine fibroids, Pancreatic pseudocyst, Hhorseshoe kidney, Policystic kidney, Colon cancer, Ovarian tumors, Kidney tumors;
- Neurologic abnormalities: Cerebral aneurysms, Ischaemic and haemorrhagic lesions, Cysticrecosis, Meningitis, Sinusitis, Toxoplasmosis;

- Bone lesions: Arthrosis, Spinal tuberculosis, Osteolytic and osteoblastic metastases, Osteomyelitis, Osteoporosis, Bone tumor;
- Trauma: Skull fracture, Extradural haematoma, Subdural haematoma, Pneumocephalus, Abdominal trauma, Spinal trauma, Chest trauma;
- Breast Cancer: Breast cancer, Cost-benefit of radiological examination, Radiological protection.

The model adopted started with an evaluation called pre-test. Afterwards, the students participate in the regular activities that begin everyday with a test about the theme of the day, followed by the analysis of the clinical cases and of the several images selected each day by the professor

These tests will provide partial average grades that will be part of the final evaluation. In the last day, the student makes a post-test that evaluates all the topics discussed along the course and has the same level of difficulty of the pre-test.

During 3 semesters, 164 students divided in three groups each, have been evaluated.

The groups were evaluated as independent samples, separating the **G**roup that **U**sed (GU) the toll from the **G**roup that did **N**ot use the tool (GN).

The performance of the students was compared separately, the pre-test (on which all the students were in the same condition, i.e. they have not yet used the tools), the average of the tests in the classrooms, the average of the post-test and the final average of each group.

The statistical analysis was exploratory and used the Box-Plot graphs. The confirming analysis used the *F*-test to verify the equality of variants and corresponding *t*-test to compare the averages. In the confirming analysis the outlier values were withdrew. The software used was the Statistica version 6.0 (StatSoft Inc, Tulsa, OK).

**RESULTS**

The average rates of 164 students in the 11$^{th}$ term the Faculty of Medicine of the Federal University of Rio de Janeiro were assessed; they were attending the elective discipline of radiology of the internship. From the 164 students, 65 made use of the tool and 99 did not.

In the pre-test the average of the group that used the material (GU) was almost the same as the one that did not use it (GN): 6.73 and 6.66, therefore the difference was not significant.

The averages of the GU and GN tests were 7.12 and 6.73 respectively.

The averages of the GU and GN post-tests were 9.10 and 8.24 respectively.

The final averages were 8.61 for GU and 8.24 for GN.

Figure 1 suggests a normal distribution of data and shows that in the pre-test, the rates of the groups that did not use the material (GN) and the students that used the material (GU) have a similar distribution. In the graph we can verify that the group who used the available material obtained higher grades in the average of the test, in the post-test and in the final average. It could also be observed that the group that used the material was much more homogeneous, what is emphasized in the post-test and in the final average.

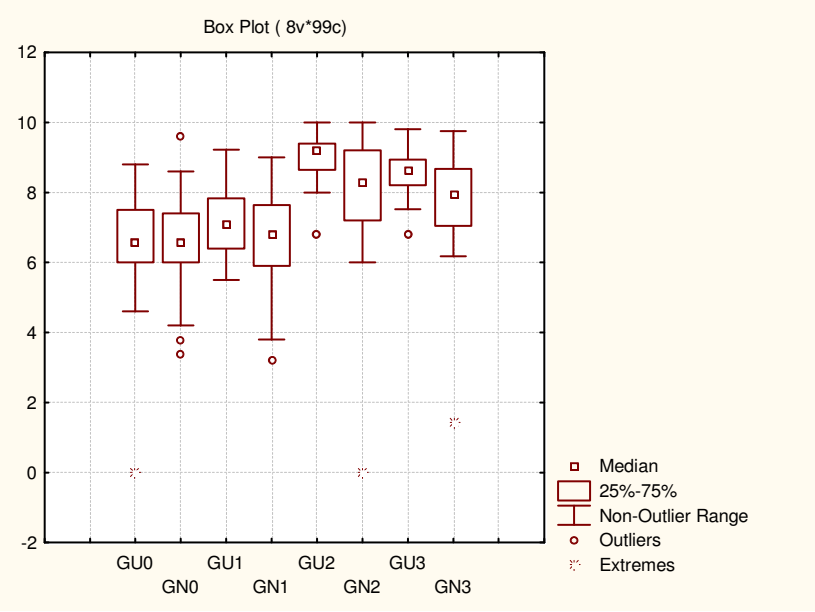
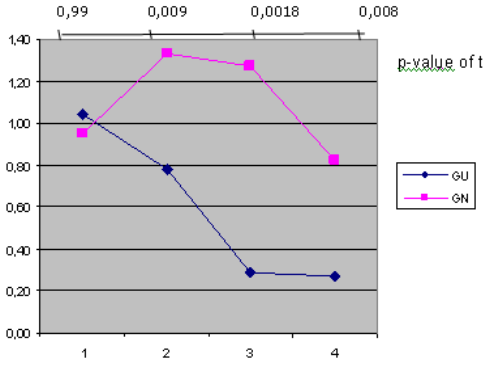



Figure 1 – Box Plot average of the students

The statistical tests, confirming these initial observations pointed out that in the pre-test the variants were the same ($F$=1.096 and $P$=0.679) and the averages were the same ($t$=0.441 and $P$=0.659). In the average of the grades, the variants were different ($F$=1.698 and P=0.025) and different averages ($t$=2.450 and $P$=0.015). In the post-tests the variants were different ($F$=4.371 and $P$=0.000) and the different averages too ($t$=6.513 and $P$=0.000) and the final averages, the variants were different ($F$=2.981 and $P$=0.000) and different averages ($t$=6.688 and $P$=0.000). These results indicate that the differences between the




groups are statistically significant (Figure 2 and 3).

Figure 2 – Variants of the grades.

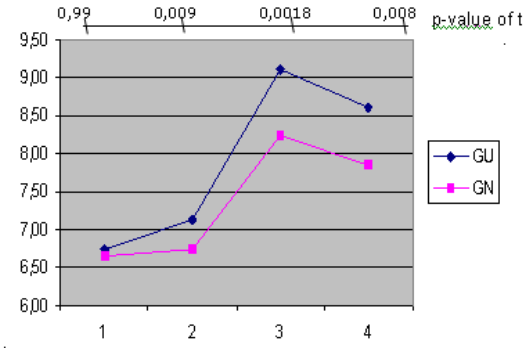



Figure 3 – Average of the grades of the students.

## DISCUSSION

The comparative analysis of the students´ performance, in order to validate the teaching tool/method, should be based on the premise that the group is homogenous and that the tool to be tested was not offered by chance to the group that would be formed by the best students, the most dedicated or the most interested. With that aim, the assessment was performed separating the group into two groups , the ones which looked for the tool and those which did not access it. In the method adopted, this comparison is possible because before beginning the study and the offer of the tool, the group was submitted to an initial evaluation, the pre-test. In this pre-test the average of the students that would look for information was practically the same as the group that was not interested (6.73 and 6.66). Throughout the course, in the tests of every class, it was observed that the average of the group that accessed the tool was 6.26% higher than the group that did not access it (7.12 and 6.73). The group that got interested in the material offered, obtained an average of 6.20% higher than the other group (9.10 and 8.24) in the post-test. As a comparison, the final average of the course of the group that used the internet to access the study material was 9.43% greater than the group that did not use it (8.61 and 7.85).

The variants that were the same at the beginning became different, and so it was possible to infer that the access to the material must have influenced such difference in the performance of the students during the course. The tool offered was important in the acquisition of knowledge by the students and allowed the group that used the tool to become more homogeneous. The difference between the two groups was statistically significant.

Therefore, it could be observed that when a group of students is exposed to a greater amount of information, in this case offered by the distance teaching tool over the internet, their performance tends to increase. The results of this research work showed the importance of new teaching tools, computing and the Internet, in the health area, specially Radiology where the association of the clinic with image is of major importance.

The students of the Faculty of Medicine of the Federal University of Rio de Janeiro have access to several computers located in different areas of the department. In the Radiology Department a computer lab was built with 20 computers connected to the internet providing free access to the students. . With the use of a password, the students have also remote access to the system. There is no doubt that Internet is a key tool nowadays, as source of information, not only for the students of medicine but also for the medical doctors who can use it to update their knowledge.

These results, obtained with the use of one distance teaching tool in the discipline of radiology for internship of the Faculty of Medicine of the Federal University of Rio de Janeiro, originated from a Master Degree thesis[4] showed the importance of creating new teaching tools based on the computer, as described in previous works[5-8]. The interactive format offers significant results of learning when compared to the non interactive[9-11].

## CONCLUSION

With this resource, several students could analyze simultaneously the same radiographs, even if they were not in the same classroom. The percentage of students that accessed the material was 39.63% in a universe of 164 students, and it was observed an improvement in the grades of 9.68% in comparison with the students that did not use the material, which correspond to 60.37%.

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