

# Mathematics applied to nursing: calculation of drug dosage and dilution in an educational portal

## *Matemática aplicada a enfermagem: cálculo de dosagem e diluição de medicamentos em um portal educacional*

Adriano dos Santos Cunha<sup>1</sup> • Claudia Maria Messias<sup>2</sup> • Ana Cláudia Lopes Almeida<sup>3</sup>

### RESUMO

O presente trabalho tem como objetivo verificar os principais saberes de Matemática empregados em Enfermagem, bem como a analisar a utilização de um portal de apoio educacional como forma de auxiliar estudantes com cálculo de dosagem e diluição de medicamentos. Foi realizado um estudo comparativo com pré e pós teste baseado em um instrumento composto de oito questões objetivas utilizadas em concursos ou processos públicos de avaliação. O estudo foi realizado com alunos concluintes do curso de graduação em enfermagem da Universidade Castelo Branco uma instituição particular localizada na cidade do Rio de Janeiro, e apresentou um portal online de apoio educacional intitulado “cálculo tem remédio” que foi testado como ferramenta de ensino. Após a realização de pré e pós teste do uso do portal, os dados foram analisados pelo programa estatístico Minitab® - versão 17. Como resultado, foi observada uma diferença significativa ( $p < 0,05$ ) entre as médias do pré-teste e pós-teste, e concluiu que a pesquisa logrou êxito quanto aos objetivos propostos e que o portal de apoio educacional pode contribuir para a formação do profissional de enfermagem.

**Palavras-chave:** enfermagem, matemática; cálculo de dosagem; portal educacional.

### ABSTRACT

The present work aims to verify the main knowledge of Mathematics applied in Nursing, as well as to analyze the use of an educational support portal as a way to assist students with calculation of drug dosage and dilution. A comparative study with pre and post-test was carried out based on an instrument composed of eight objective questions used in contests or public evaluation processes. The study was carried out with graduating students of the nursing undergraduate course at Castelo Branco University, a private institution located in the city of Rio de Janeiro, and presented an online educational support portal titled “calculation has medicine” that was tested as a teaching tool. After the pre and post-test of the portal use, the data were analyzed by the statistical program Minitab® - version 17. As a result, a significant difference ( $p < 0.05$ ) was observed between the means of the pre-test and post-test and concluded that the research was successful in terms of the proposed objectives and that the educational support portal can contribute to the training of the nursing professional.

**Keywords:** nursing, mathematics; calculation of dosage; educational portal.

### NOTA

<sup>1</sup>Estudo baseado em Dissertação de Mestrado de Adriano dos Santos Cunha intitulada “Matemática Aplicada A Enfermagem: apoio ao ensino do cálculo de dosagem e diluição de medicamentos através de um portal educacional.” Apresentada a Universidade Severino Sombra, Vassouras/RJ 2014.

<sup>2</sup>Mestre em Educação Matemática, Especialista em Docência do Ensino Superior, Especialista em Planejamento, Implementação e Gestão de cursos em EAD, Graduado em Ciências com habilitação plena em Matemática, Professor da Universidade Castelo Branco RJ. profadrianocunha@hotmail.com

<sup>3</sup>Doutora em ciências da enfermagem Professora auxiliar da Universidade Castelo Branco e Enfermeira do HMMC.

<sup>4</sup>Mestre em enfermagem pela Escola de Enfermagem Anna Nery - UFRJ, Pós-graduação em Enfermagem em Alta Complexidade pela faculdade de enfermagem da UERJ.

## INTRODUCTION

Theories and practices associated with informatics in education have repercussions worldwide, precisely because digital tools and media offer didactics objects, spaces and instruments capable of renewing situations of interaction, expression, creation, communication, information, and collaboration, making -a very different from that traditionally based on writing and print media <sup>(1)</sup>.

Brazilian and world education have been incorporating new interventions in the last ten years, regarding the presence and implementation of recent technologies in education.

In health education, the responsibility of mathematics teachers, especially for nursing staff, is remarkable, because it is through the mastery of basic mathematical calculations that the future professional will resolve dosing calculations involving the preparation of dosage of medicines. These professionals always have the lives of people in their hands and must carry out their work with responsibility and competence <sup>(2)</sup>.

Associating the activity of the nursing professional with the contents of Mathematics, some of these knowledges are necessary in nursing practice and those that present a greater degree of difficulty are those related to the operations that need division, such as percentage and fractional numbers. These operations are widely used in calculations of serum drip, preparation and dilution of medications, changes in concentration of some drugs and preparation of solutions <sup>(3)</sup>.

Some prescriptions, based on International Measurement Units, do not always coincide with the presentation of the drug itself, as there are many variations in the presentations, according to each manufacturer. At other times, the form of presentation differs from that prescribed, necessitating conversion of units of measurement, as well as dilution or adequacy in concentration and redilution of prescribed drugs. The topic of calculation of drug dosage and dilution covered in nursing courses also requires knowledge of basic concepts of mathematics, such as the four fundamental operations, units of measure, percentage, and especially rule of three.

Working with numbers is a necessary cognitive competence for the health professional, who faces the deficits in learning that many have faced in primary and secondary education, so it is a challenge for those conducting the training to make the activity easy and interesting, hence the importance of using teaching techniques that enable learning <sup>(4)</sup>. The preparation of drugs in hospital institutions is the legal responsibility of the nursing team. Therefore, it is necessary that the professional who prepares them is aware and confident of their action <sup>(3)</sup>.

It is necessary, therefore, that the nursing training,

even during the pedagogical activities in the university, is the space of reference that the students need to face with agility, competence and wisdom issues that may involve an error during the nursing care, thus ensuring to the patient, the family, the health institution and the professional himself the safety and quality they so long for. <sup>(5)</sup>

The present study deals with the mathematical skills developed, applied to the knowledge of the calculation of medicines and aims to verify and analyze the effectiveness of an educational support portal for nursing students in the practice of drug dosage calculation.

It is known that educational technologies are necessary and relevant, since they are able to provide information that improves the knowledge and the confrontation of the professional <sup>(6-7)</sup>.

## MATERIAL AND METHODS

### PRODUCT DESCRIPTION

In general, an educational portal refers to the use of digital communication resources, mainly through web-based educational software that brings together various interaction tools <sup>(8)</sup>.

The educational support portal was developed as a dissertation product related to the Professional Master's in Mathematics Education of Severino Sombra University (USS), the project was presented to senior students of the undergraduate course in Information Systems of the same university, and voluntarily two of these students joined to the project and completed their course completion work based on the same research. The portal is available on the world wide web - in the website [www.calculotemremedio.com.br](http://www.calculotemremedio.com.br).

In the main page, the portal offers five options with the available resources:

- Tools button - there are the calculator and the rule of three calculation tool. These tools have been developed to provide interactivity and teaching.
- Handouts - three handouts are available to assist the user with the rationale, with examples.
- Video Classes - three classes about three simple rule, where the user can follow how to organize and determine the value of x.
- Bank of Questions - a list of exercises with questions that were part of the public examination exams, national exams and also questions elaborated by the author of this study is available on the portal.
- Tutorial - is a teaching and learning tool, aims to help the understanding of the educational portal showing the product and facilitating learning process.

One of the options of the educational portal is the tool to aid in the calculation of simple three rule, Figure 2 shows the initial screen where the user can select the quantities, enter the values, observe the equation and, when clicking the calculate button, get the value of the variable.

Two calculators are available in the educational portal. One of them has the purpose of assisting in the teaching of dilution and dosage calculation of drugs, as shown in Figure 3.

The other calculator available in the portal helps in the calculation of drip, where the main function is to control the volume and the time that the solutions must be assimilated. In Figure 4 the initial screen of the drug calculator can be viewed.

## METHOD

The study was conducted in 2014 at Castelo Branco University, located in the Realengo neighborhood, West Zone of the city of Rio de Janeiro. An experimental study was conducted divided in two moments of participation.

The first phase, held in July 2014, called the pre-test, counted on the participation of 20 randomly selected students, graduating from the Nursing course. A data collection instrument was used consisting of eight objective questions on the calculation of medication used in contests or public evaluation processes. The evaluation criterion of the instrument was the percentage of correct answers.

The second phase, called the post-test, was performed 30 days after the pre-test. It occurred in August 2014 and had the participation of 18 students, since one participant escaped from the institution and another one was on medical leave. The portal was presented and oriented to the students who learned about the tool and after solving at least three math questions per week and remaining at least 30 minutes in the platform exploring and creating situations to be solved.

In order to test the effectiveness of the portal, a statistical analysis was performed based on the percentage of correct answers using the data collected in the pre-test and the data obtained with the post-test. The data were analyzed using the statistical program Minitab® - version 17<sup>(9)</sup>.

The study was enrolled in the Plataforma Brasil, which is a national and unified system of research registries involving human beings, and approved by the Research Ethics Committee of Severino Sombra University under the CAAE: 36932114.9.0000.5290.

## RESULTS

The experimental study evidenced the existence of difference in the significant learning with the use of the

educational portal in the process of teaching and learning of calculation of dilution, dosage and drug drip.

Researches point out that the knowledge and doubts of the students need to be considered in the elaboration of educational technologies; the close relationship between the quality of the educational material and the use of defined principles and forms of elaboration<sup>(10)</sup>.

The validation of technologies supported by the impact on student learning is considered a strategy that, through the systematic use of available knowledge, aims to elaborate a new intervention and significantly improve an intervention.

The evaluation process consists in determining to what extent the educational objectives are actually being achieved<sup>(11-12)</sup>.

These goals produce desirable modifications in student behavioral patterns. Therefore, the assessment should assess students' behavior early in the process, and then in others, to identify the changes that may be taking place. Without knowing the initial conditions of the student, it is not possible to determine if there were modifications. Another evaluation framework is also necessary to obtain an estimate of the permanence of learning, which must be done after some time the teaching is completed.

The evaluation of learning allows us to verify how the student is assimilating knowledge, how this modifies his or her vision in relation to the world, stimulates the development of reasoning and increases their capacity to participate in the reality they are living.

After correction of the instruments, students' scores in the pre-test and post-test were organized as shown in Table 1.

These are two dependent samples, since the same students participated in both groups. The last two values, referring to students A19 and A20, had to be discarded, since they only participated in the pre-test.

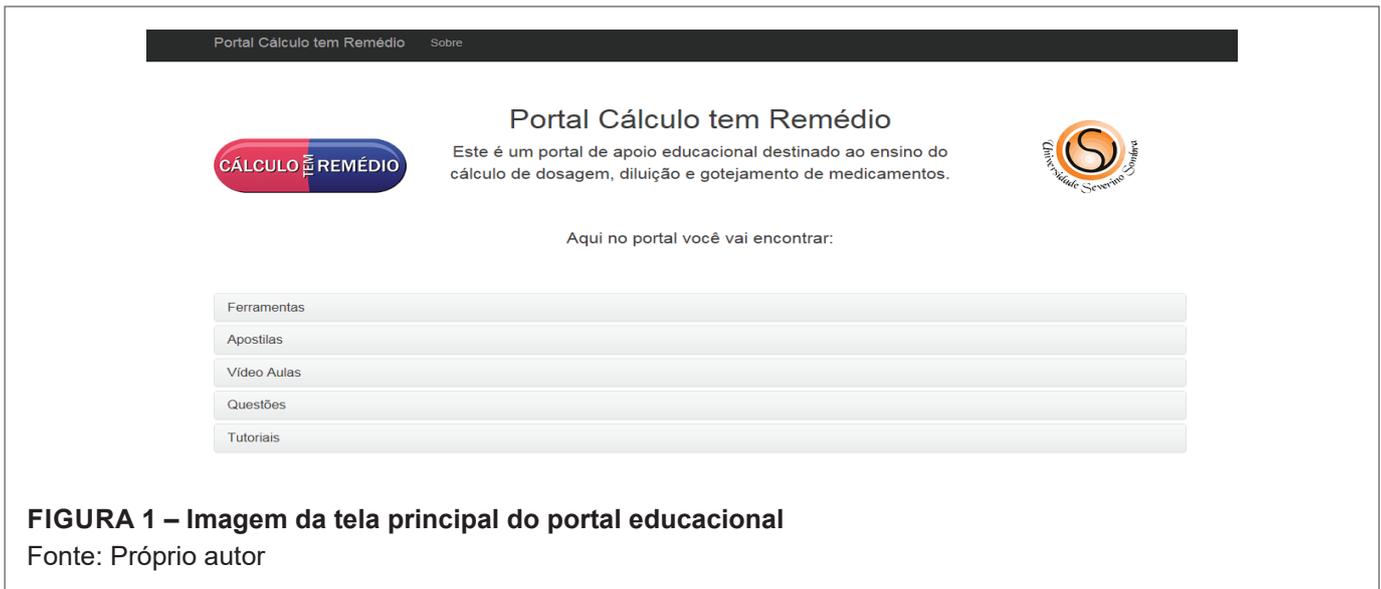
A Shapiro-Wilk normality test was performed, since there are less than 50 observations for the analysis of pre-test and post-test variables. The results were expressed in graphs, as shown in Figure 2 (pre-test) and Figure 3 (post-test).

It was found that p values in both cases were higher than the significance level of 5% (0.05), and it can be said that students' incomes follow the normal distribution.

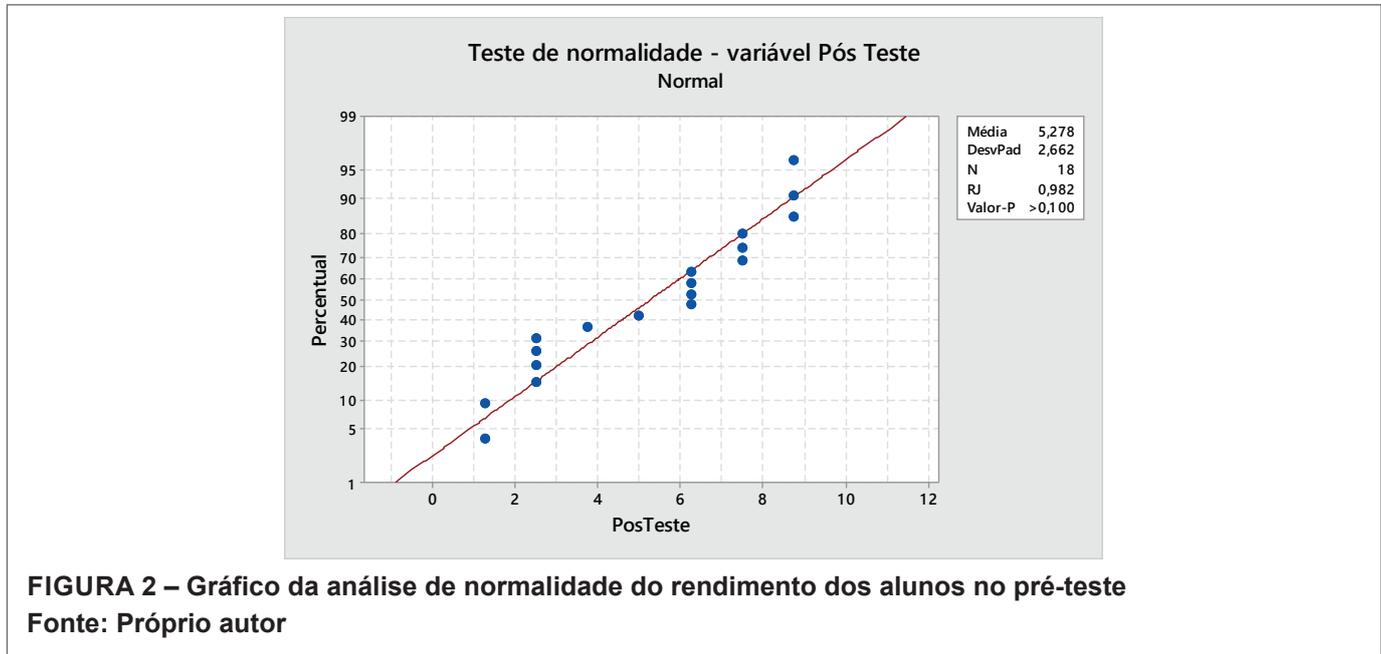
The Levene homoscedasticity test was performed for the two variances, pre-test and post-test, and the results were expressed in graph, as shown in figure 4.

It was observed that the value of p was higher than the level of significance of 5% (0.05), which indicates that the students' incomes are homoscedastic, that is, the variances are equal.

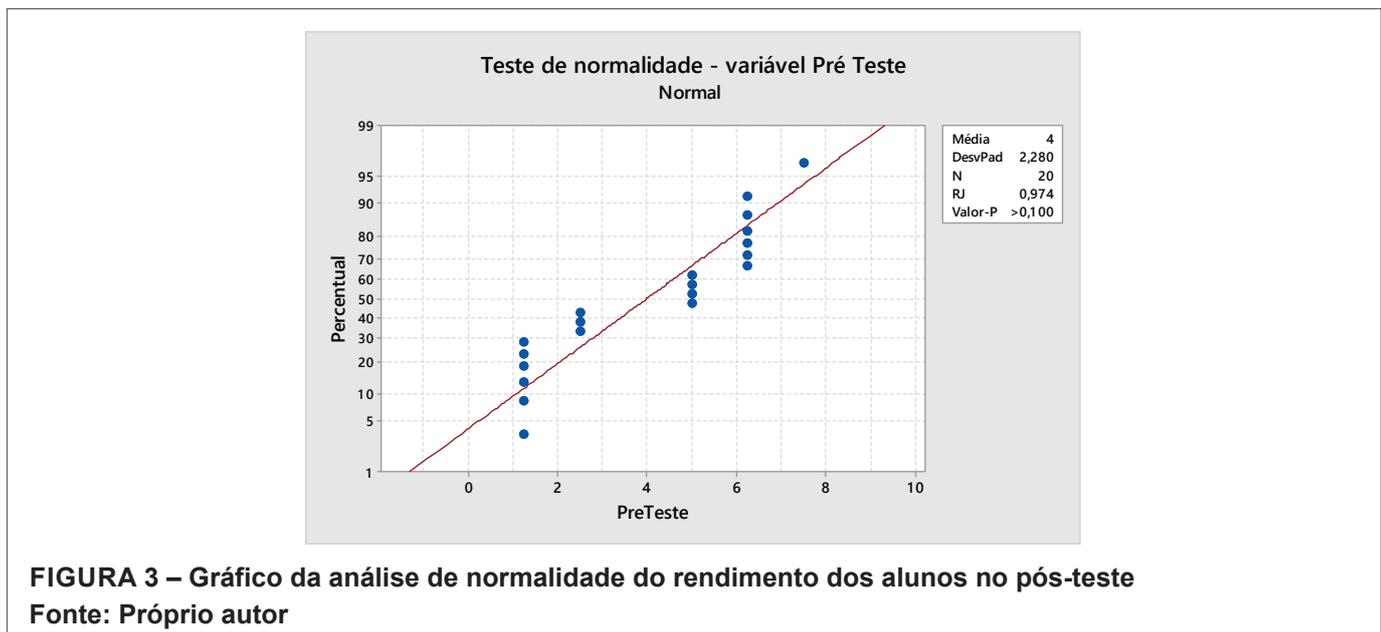
Having satisfied the assumption of normality and ho-



**FIGURA 1 – Imagem da tela principal do portal educacional**  
 Fonte: Próprio autor



**FIGURA 2 – Gráfico da análise de normalidade do rendimento dos alunos no pré-teste**  
 Fonte: Próprio autor



**FIGURA 3 – Gráfico da análise de normalidade do rendimento dos alunos no pós-teste**  
 Fonte: Próprio autor

TABLE 1 – Grades in the pre-test and post-test

STUDENT	Grades	
	Pre-test	Post-test
A1	7,5	6,25
A2	6,25	7,5
A3	6,25	7,5
A4	6,25	8,75
A5	6,25	8,75
A6	6,25	8,75
A7	6,25	7,5
A8	5	6,25
A9	5	6,25
A10	5	6,25
A11	5	5
A12	2,5	3,75
A13	2,5	2,5
A14	2,5	1,25
A15	1,25	1,25
A16	1,25	2,5
A17	1,25	2,5
A18	1,25	2,5
A19	1,25	---
A20	1,25	---

Source: author

moscedasticity, one can proceed with the comparison analysis of the means of the two samples. The paired Student's t-test was used to compare means of two dependent samples.

### T-Test and IC: Pretest; PostTest

Paired T-Test for Pre-Test-Post Test

	N	Average	DesvPad	EP	Average
Pre-Test	18	4,306	2,196	0,517	
Post-Test	18	5,278	2,662	0,627	
Difference	18	-0,972	1,098	0,259	

95% IC for the mean difference: (-1.518; -0.426)

Test of mean difference = 0 (versus  $\neq$  0): Value T = -3.76 p-value = 0.002

A significant difference ( $p < 0.05$ ) was observed between the means of the pre-test and post-test, which can be confirmed in the Boxplot graph expressed in figure 5.

## DISCUSSION

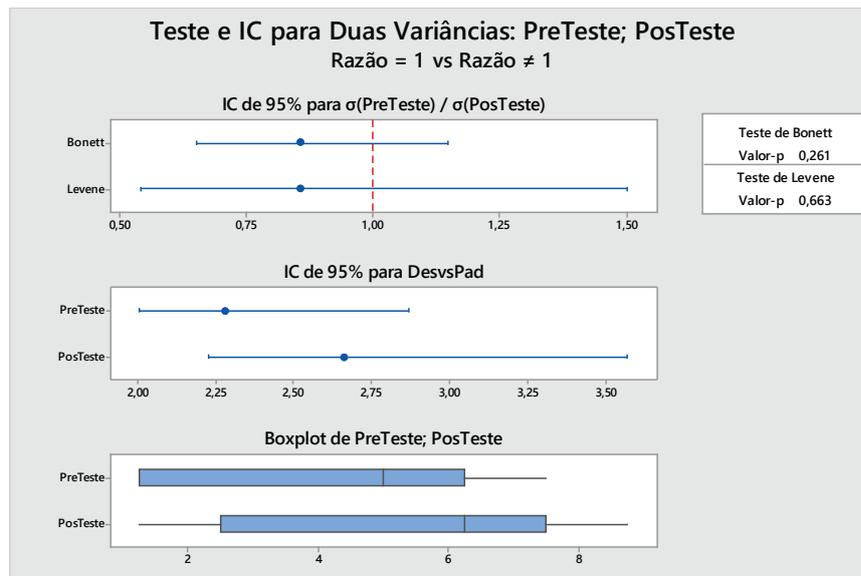
When computing has its proper use in schools, it can provide many benefits to students, such as problem-solving agility, research skills, new thinking ability, intelligence

enhancement, opportunity openings, giving students the possibility to get new information and to meet a new world, to learn about various cultures, to learn about the history of ancient populations and to be a new character in the writing of their own history in society<sup>(13)</sup>.

Computer literacy also modifies the student as an individual, as students become more thoughtful, critical, creative, hardworking, independent, and have skills to interact and meet people on a continuous and ongoing basis, as well as various other skills that students can obtain with the inclusion of informatics in Brazilian schools.

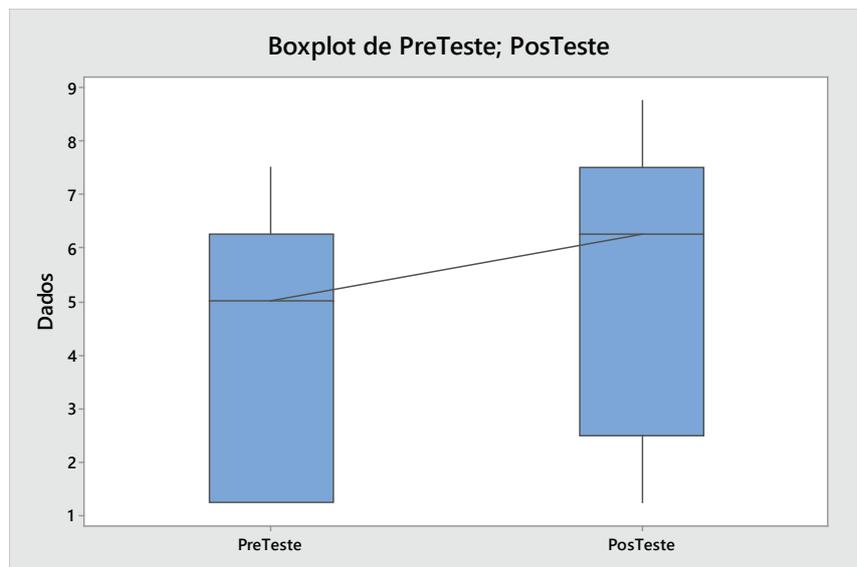
The scientific and social relevance of the education technologies (TE) produced in nursing is evident, since in addition to generating new knowledge, the TE aim to meet social demands and needs that emerge from numerous contexts, contributing to the broadening of Nursing thinking-doing as a science under construction<sup>(14)</sup>.

In order for technological training to take place, it is necessary for all those involved in the teaching-learning process to participate, with the responsibility for walking together, as described in the "4 pillars of education": learning to know, that is, acquiring the instruments of understanding; learn to do, to be able to act on the envi-



**FIGURA 4 – Gráfico do teste para as duas variâncias**

Fonte: Próprio autor



**FIGURA 5 – Gráfico Boxplot de pré teste e pós teste**

Fonte: Próprio autor

ronment; learning to live together in order to participate and cooperate with others in all human activities; and, finally, to learn to be, an essential way that integrates the three precedents <sup>(15)</sup>.

In this sense, we believe that updates and exercises enrich nursing undergraduate education through the use of computer programs, based on satisfactory validations and the general evaluation favorable to the application of this technological resource in Nursing teaching.

The satisfactory results of the studied sample contribute to the reflection of the academic society, since it demonstrated that innovative strategies for students and teachers make it possible to overcome problems, such as demotivation, lack of time and differences in the pace

of learning among students. Finally, the evaluation of educational materials by the users can encourage them to construct and use other innovative resources in nursing education <sup>(11)</sup>.

## FINAL CONSIDERATIONS

The realization of this study made it possible to present a process of construction and validation of educational material based on the relationship between the students' needs and the scientific knowledge about the thematic calculation of medication.

The methodology used was able to subsidize the elaboration of an attractive and comprehensive educational technology, which may facilitate the elaboration of

other educational technologies, both in this theme and in any other that involves the need to exercise accuracy.

The experimental research with the portal was successful regarding the proposed objectives and confirmed the hypothesis that the construction and availability of an educational support portal for the teaching of mathematics applied to the calculation of drug dosage can contribute to the training of the area professional reducing the risks of incorrect dosages applied to patients.

Given the simplicity, quality and precision of the developed product, it is estimated that future results are

promising, and new research can be made available to a greater number of users.

This study was far from exhausting the theme about the possibilities and limitations of the use of educational software in the training environment of the nursing student. However, we can't stress enough that educational software can be an important tool for the learning process of the students, if they are used in a contextualized way with the contents worked in the classroom and with objectives clearly established by the teachers and pedagogical team of the university.

## REFERENCES

1. SOUSA, R. P, FILOMENA M. C, MOITA S. C, CARVALHOA. B. G.. Organizers Digital Technologies in Education. Digital technologies in education. -Campina Grande: EDUEPB, 2011. 276 p.
2. ANDRADE, R. S de. SAMPAIO, M. E de C e S. Mathematical fundamentals for the Nursing Technical Course. In: XXV Congresso de Matemática Aplicada e Computacional. Curitiba, 2002.
3. SILVA, J R S. Nursing and difficulties in arithmetic calculations. Revista Nursing, São Paulo, v. 81, n. 8, p. 91-98, fev. 2005.
4. COREN – SP CONSELHO REGIONAL DE ENFERMAGEM. Good Practices: Safe Calculation: Calculating and Diluting Drugs. Volume I. São Paulo; 2011.
5. SILVA M. N, ARAÚJO J. L, FERNANDES N. C. S, OLIVEIRA J. D, SILVA R. T. S, NASCIMENTO E. G. C. Nursing and patient safety errors: the knowledge of nursing undergraduates. Revista Enfermagem Atual. < [http://revistaenfermagematual.com.br/revistas/revista\\_18-01.pdf](http://revistaenfermagematual.com.br/revistas/revista_18-01.pdf)> [periódico na Internet]. jan-fev-mar 2017; [acesso 3 abril 2018].
6. FREITAS F.V, REZENDE FILHO L.A. Models of communication and use of printed matter in health education: a bibliographical research. Interface Comun Saúde Educ. 2011;15(36):243-55.
7. BERARDINELLI L.M, GUEDES N.A, RAMOS J.P, SILVA M.G. Educational Technology As a Strategy for the Empowerment of People with Chronic Illnesses. Rev. Enferm UERJ. 2014;22(5):603-9.
8. OLIVEIRA, C. C; COSTA, J.W.; MOREIRA, M. Computerized learning environments. In: COSTA, J.W.; OLIVEIRA, M.A. M. (orgs.) Novas linguagens e novas tecnologias: Educação e sociabilidade. Petrópolis: Vozes, 2004.
9. MINITAB. MINITAB QUALITY COMPANION. 2005: MINITAB: Statistical software. Disponível em: < <http://www.minitab.com> >. Acesso em: out/2011.
10. VASCONCELOS C.T, PINHEIRO A.K, CASTELO A.R, COSTA L.Q, OLIVEIRA R.G. KNOWLEDGE, attitude and practice related to the pap smear test among users of a primary health unit. Rev Latino Am Enfermagem. 2011;19(1):97-105.
11. GÓES. F.S.N, FONSECA. L. M. M, FURTADO M. C. C, LEITE A. M. SCOCHI C. G. S. Evaluation of the virtual learning object “Diagnostic reasoning in nursing applied to prevention”. Rev. Latino-Am. Enfermagem. [periódico na Internet]. jul-ago 2011 [acesso 24/10/2012]; 19(4):[08telas]. Disponível em: [http://www.scielo.br/pdf/rlae/v19n4/pt\\_07](http://www.scielo.br/pdf/rlae/v19n4/pt_07)
12. ALVAREZ A.G, DAL SASSO G. T. M. Application of Virtual Learning Object for simulated acute pain assessment in nursing students. Rev. Latino-Am. Enfermagem. [periódico na Internet]. mar-abr 2011; [acesso 3 jan 2011]; 19(2):[09 telas]. Disponível em: [http://www.scielo.br/pdf/rlae/v19n2/pt\\_02](http://www.scielo.br/pdf/rlae/v19n2/pt_02)
13. LOPES, M. C. L. P. Technological training: a phenomenon in focus. Campo Grande: UCDB, 2005.
14. TEIXIRA E, SABOIA V. M. Health education: educational technologies in focus. 1ª edição. São Caetano do Sul, SP: Difusão editora, 2011.
15. DELORS, J. Education, a treasure to discover. 7 ed. São Paulo: Cortez, 2005.