

E-LEARNING: A COMPARATIVE STUDY FOR KNOWLEDGE APPREHENSION AMONG NURSES¹

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The end of the twentieth century and the beginning of the twenty-first century are marked by technology revolution and strategic changes in organizations. Strategies such as the e-learning, has been used for training human resources. This study aimed to compare the knowledge acquired among groups of nurses who used e-learning and those who undergone a traditional classroom training. The true-experimental design was used followed by a quantitative analysis. This study was performed at the Hospital and Maternity São Luiz. The study population was composed by 60 nurses, randomly assigned to two groups, named A and B. Group A received the traditional classroom training and group B received the computer-assisted training. In the data collection, participants filled in a questionnaire before and after the training to evaluate their knowledge and to characterize the population. Results showed there was an equal acquisition of knowledge in both groups; confirming the efficacy of both methods.

DESCRIPTORES: education, distance; education, nursing, continuing; nursing, informatics

E-LEARNING: ESTUDIO COMPARATIVO DE LA APREHENSIÓN DEL CONOCIMIENTO ENTRE ENFERMEROS

El final del siglo XX e inicio del siglo XXI se caracterizó por la revolución tecnológica y los cambios estratégicos en las organizaciones, estrategias, como e-learning, vienen siendo utilizadas. El objetivo de este estudio fue comparar el conocimiento aprendido entre los grupos de enfermeros que utilizaron el e-learning y los que recibieron el entrenamiento presencial. La metodología cuantitativa utilizada fue el método experimental verdadero. El local de estudio fue el Hospital y Maternidad São Luiz. La población fue constituida por 60 enfermeros, los cuales fueron divididos de forma randomizada en dos grupos, denominados A y B. El grupo A realizó el entrenamiento presencial y el grupo B a través del computador. En la recolección de datos, los participantes llenaron un cuestionario antes y después del entrenamiento para poder evaluar su conocimiento y características de la población. Los resultados mostraron que hubo aprehensión de conocimiento por parte de los dos grupos, lo cual permitió concluir que los dos métodos utilizados son eficaces.

DESCRIPTORS: educación a distancia; educación continua en enfermería; enfermería; informática

E-LEARNING: ESTUDO COMPARATIVO DA APREENSÃO DO CONHECIMENTO ENTRE ENFERMEIROS

O final do século XX e começo do século XXI caracterizam-se pela revolução tecnológica e as mudanças estratégicas nas organizações, estratégias, como e-learning, vem sendo utilizadas. O objetivo deste estudo foi comparar o conhecimento apreendido entre os grupos de enfermeiros que utilizaram o e-learning e os que receberam o treinamento presencial. A metodologia quantitativa da pesquisa constituiu-se de um método experimental verdadeiro. O local de estudo foi o Hospital e Maternidade São Luiz. A população constituiu-se de 60 enfermeiros que foram divididos randomizadamente em dois grupos, denominados A e B. O grupo A realizou o treinamento presencial e o grupo B, via computador. Na coleta de dados, os participantes preencheram um questionário antes e após o treinamento para avaliação do conhecimento e caracterização da população. Os resultados demonstraram que ocorreu a apreensão do conhecimento pelos dois grupos de forma equiparada, permitindo concluir a eficácia dos dois métodos.

DESCRIPTORES: educação a distância; educação continuada em enfermagem; informática em enfermagem

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INTRODUCTION

Globalization has made the world more dynamic and highly competitive. To manage and operate their processes, corporations call for human resources with up-to-date abilities, considering the setting in which they take part. In these settings, new techniques, technologies and knowledge are constantly created and changed. Hence, professionals face the need to update faster and constantly*.

Many organizations have developed a range of educational strategies to prepare employees for the new market demands. For this reason, new teaching technologies are constantly being developed, which has encouraged distance learning practices⁽¹⁾.

In the corporative domain, the use of information technology and communication to support continuing professional development, promoting collaborative learning in geographically apart groups has been referred to as *e-learning*.

E-learning is one kind of distance learning that promotes self-learning, mediated by educational resources, systematically organized, presented through different information technology supports, either isolated or combined, and is done over the *Internet*. Some terms, despite some conceptual differences, are used as a synonym for *e-learning*; for example: *web training*, *web education*, *Internet-based distance learning*, electronic learning, technology-mediated teaching, computer-directed teaching**.

E-learning is defined as: a solitary/individual or collaborative/group activity involving synchronous (happening in "real time", with all participants online at the same time) or asynchronous (with flexible choices of study time) communication processes⁽²⁾.

E-learning addresses a broad set of processes and applications, such as *web*-based and computer-based teaching, using virtual classrooms and digital collaboration. It also includes delivering content through the *Internet*, *Intranet/Extranet*, audio, video and radio recordings, through satellite, interactive TV, and CD-ROM. Thus, *e-learning* is interactive and offers instructional flexibility⁽³⁾.

To be successful, personnel training and development programs should be planned with goals that are established according to the organization's

human resource policy, and take into consideration the instructors and trainees, as well as the phases of situational diagnosis, objectives, method/strategies, evaluation and result and costs analysis⁽²⁾.

When planning continuing education and personnel training programs, *e-learning* should be adopted, aiming at the benefits of using information technology in education.

In nursing, this educational practice is more frequent abroad. The experience of a hospital in Toronto, Canada, in 1995 can be highlighted. They planned a training program for nursing personnel, both on-site and at a distance, during working hours, using the computer as the teaching mediator, based on *self-learning*⁽⁴⁾.

In Brazil, the development of technology-mediated educational programs in the nursing area is linked to university research projects. Therefore, most of them tend to focus on undergraduate courses and health education for clients. This can be confirmed in studies like: an educational program in first aid⁽⁵⁾; a leap into the future in medication teaching: developing a computer-assisted instructional program⁽⁶⁾; developing an educational *web site* about the nursing intervention: tracheobronchial secretion aspiration⁽⁷⁾; administering injectable intramuscular medications in the ventral-gluteal region: evaluation after training by videoconference⁽⁸⁾; educational software about Diabetes Mellitus for health professionals: stages of creation and development⁽⁹⁾; in-service nursing education delivered by videoconference⁽¹⁰⁾; implementing a videoconference system applied to nursing research and teaching environments⁽¹¹⁾; educational technology: creation and evaluation of the *site* nursing personnel shift⁽¹²⁾; nursing physical examination of full-term newborns: self-instructional *software*⁽¹³⁾.

To reach a market advantage, in which knowledge is a powerful weapon, the São Luiz Hospital and Maternity has invested in intellectual capital, developing human competencies related to the institution's policies regarding quality and human resources and adopting *e-learning* in the personnel training process.

In this perspective, the Hospital implemented Phase 1 of the Education Program for Quality through the Total Quality *e-learning* training. The program plan

* Available from: <http://www.elearningbrasil.com.br/clipping/index.asp> [cited 2004 mar 29]

** Available from: <http://www.dtcom.com.br/paginas/page.asp?setor=ead6> [cited 2005 mar 8]

started on August 25th 2003, and counted on an education team who planned the content in three months. All operational managers contributed to create the program content.

The purpose of this training program was to develop and implement an innovative *e-learning* Distance Learning project at the Hospital, to train all employees: directors, managers, supervisors, medical teams, outsourced employees and internal partners from other units (Itaim and Morumbi). The program should be carried out in a short period of time, and should not require employees to move from their work site, since there were not enough training rooms or funds for costs with additional rooms, equipment and instructors.

The *e-learning* Total Quality program was implemented on November 1st 2003, and ended in February 2004. Thus, it corresponded to a training of, approximately, two class hours, for 2500 internal employees and over 600 outsourced employees from the units Itaim and Morumbi.

For the implementation, basic system access instructions were provided to the multipliers, who were the managers, initially. Later, the supervisors became the multipliers, and the role was passed on, successively, until instructions reached the operational level, that is, all employees, thus decentralizing the education process. These instructions comprised information like how to access the *site*, how to insert the functional code and create a password. From this moment, the employee would be participating in the *e-learning* training program.

For this training program, a *desktop computer* was available in each sector of the nursing units, in the continuing education sector, nursing management and *e-learning* room.

Initially, the *e-learning* program was positively evaluated as a learning tool, meeting all the needs and goals of the Hospital program. Hence, the Hospital invested in Phase 2 of the Education Program for Quality, named "Quality Tools". This phase had the same premises, principles, objectives, and infrastructure as previously determined, and was directed to all managers, supervisors, employees, and leaders of the several areas in the Itaim and Morumbi units.

The São Luiz Hospital and Maternity Program for Quality Phase 2 - Quality Tools is subdivided in three modules: module 1 consisted of the program presentation, introduction, instructions on how to navigate, and a review of the first *e-learning* Total

Quality training program; module 2 was composed of the module presentation, PMQ corporate structure of the Program for Quality (PMQ), PMQ principles, and activities; module 3, composed of the module presentation, Quality Tools, process model 1, process model 2, activity flow chart, check-list, brainstorming, Pareto chart, five "S" program, activities, cause and effect chart, 5W2H tool, and conclusion.

The program is hosted on the Hospital's *intranet*, with access limited to employees, who receive a login and password from the institution. Hence, the moment was ideal to perform this research, evaluating the knowledge learned by the nurses who used the "Quality Tools" *e-learning* program, through an experimental study.

OBJECTIVE

To compare the group of nurses who took part in the *e-learning* with those who received on-site training, in terms of the knowledge they acquired.

MATERIAL AND METHOD

This present quantitative study uses a true experimental method to compare on-site and computer-mediated training programs.

The experimental research design is used in studies in which the researcher wants to test cause and effect relationships. The true experiment has three identification properties: randomization, control and manipulation⁽¹⁴⁾.

Randomly assigning individuals to groups involves their distribution to an experimental or control group, on an entirely random basis⁽¹⁵⁾.

The strength of the true experimental design is its ability to help the research and reader to control the effects of any extrinsic variables that could threaten internal validity. Those extrinsic variables can be antecedent or intervenient. The antecedent variable occurs before the study, but it may affect the dependent variable and cause results to be confusing.

Factors like age, gender, and socioeconomic conditions are likely to be important antecedent variables in the research, because they may affect the dependent variables⁽¹⁴⁾.

The experimental method was performed in the "Quality Tools" training program delivered to the

night shift nurses. The control group was composed of trainees who attended on-site training, while the experimental group comprised those who took part in the e-learning program. The nurses were randomly assigned to the groups. However, the antecedent variables were treated because of their potential to affect or confound the research results.

The study was performed at the Itaim unit of the Sao Luiz Hospital and Maternity, which is a large scale private hospital, with 397 beds, located in the city of Sao Paulo.

The nursing management is directly linked to the Administrative Board, which offers autonomy and power of decision to the nursing team. The nursing staff is composed of 836 nursing employees: one Nursing Manager, five Nursing Supervisors, eight Heads of closed units, 142 head nurses, seven *trainee* nurses, 165 nursing technicians and 508 nursing auxiliaries.

The population was composed of 60 nurses from the night shift, from the Itaim unit, regardless of their job position. The following were excluded from the study: the nurse-researcher who works in the night shift as a supervisor and multiplier of all training programs in her shift, nurses on vacation or on medical leave, and nurses who took part in only one of the research phases. Therefore, the study population included 49 nurses who voluntarily agreed to participate in the study and signed the Informed Consent Form.

This population was considered statistically significant for the present study objectives, since it comprised all night shift nurses and presented the characteristics inherent to that shift, mainly regarding work hours and changes in workers' biological clock.

Two questionnaires were used to collect the data: one for population characterization, which was created by the researcher, and the other named Pre/Post-test about Quality Tools, which was created by the Education Team responsible for developing the *e-learning* training program. The pre and post-test questionnaire was administered in the experimental as well as the control group before and after the training programs, in order to evaluate the nurses' knowledge apprehension. Thus, this second instrument was used as a way to check the extent to which nurses learned the facts, principles and methods included in the training program about Quality Tools.

This research project was approved by the Research Ethics Committee of the institution where

the study took place. All ethical regulations were complied with, and anonymity and secrecy of those involved were guaranteed.

After the nurses spontaneously agreed to participate in the research by signing the consent term, the questionnaire was handed out. Thus, it was possible to characterize the nurse group's profile, obtaining the variables of age, time of work at the hospital, time and degree of education, computer knowledge, and participation in computer-mediated courses.

These variables were classified as antecedent, which could influence or confuse the research results if they were not previously controlled. Therefore, the population was stratified according to these antecedent variables, thus forming homogeneous subgroups. After this stratification, the subgroups were randomly distributed, forming groups A and B. This avoided any confusion regarding study results.

According to the methodological framework, the stratified random sample requires the population to be divided into layers or subgroups. The subgroups or subsets in which the population is divided are homogeneous. An appropriate number of elements from each subgroup is selected, based on its proportion in the population⁽¹⁴⁾.

Hence, the 49 participants were randomly divided into two groups: group A (24 participants), which attended the on-site training program; and group B (25 participants), which took part in *e-learning* training.

The on-site training about Quality Tools for group A was delivered by the researcher to two groups: night shift one (even) and night shift two (odd). The two-hour course was held at the Hospital's training room, which is located outside the complex, at 2 AM.

The same content was taught on-site and in *e-learning* training, using *power point* presentations. The post-test was administered shortly after each training, using an instrument identical to the pre-test, in which participants informed what they had learned in the on-site training.

The *e-learning* training about Quality Tools delivered to group B was also done in two groups: night shift one (even) and night shift two (odd). The post-test instrument was administered shortly after the end of each training course.

The *e-learning* training courses could be performed using the computers in the sectors and at

the moment the participant chose to be most convenient. However, to assure that there were no interferences from a third party, during the course as well as on the tests, three nursing management rooms, with four computers each, were selected in four night shifts, where the training courses could be performed. The nurses completed the training course in about forty minutes, with no interference.

Data were analyzed descriptively, based on the results presented in charts and tables with descriptive measurements (mean, median, standard deviation, maximum and minimum values).

The average scores in the different groups and moments of evaluation were compared, using a variance analysis model (ANOVA) with two factors: *moment of evaluation* (Pre-course or Post-course) and *group* (on-site or Internet), considering repeated measurements in the moment of evaluation factor. The existence of a possible interaction effect between these factors was also evaluated. It is worth mentioning that, when the interaction effect is not significant, the main effects (that is, moment of evaluation and group) can be analyzed directly. On the other hand, if the interaction effect is significant, the behavior factor must be evaluated within the levels of the other factor⁽¹²⁾. The adopted level of significance was 5% (p=0.05).

RESULTS AND DISCUSSION

The research data analysis, as shown in Tables 1 and 2, provides relevant information on the initial proposal. In view of the study objective, which was to compare the knowledge acquired by nurses who attended a traditional training program, i.e. on-site, with that acquired by nurses who used *e-learning*, it should be considered that, in both methods, subjects got a higher score on the post-test, which proves that knowledge apprehension occurred in both methods.

In general, it is observed that both the on-site group and the computer-mediated group got a higher score on the post-test than on the pre-test. This shows that the number of correct answers was, on the average, higher after the training course, regardless of the form in which it was delivered. However, the *e-learning* group reached slightly higher average scores.

For this analysis, the total score of each individual was considered at the first two moments (pre and post tests) for both groups. Tables 1 and 2 present the descriptive measures of the test scores for the on-site and computer-mediated groups.

Table 1 - Total number of correct answers of the on-site group (N=25) on the pre and post-tests, Sao Paulo, 2006

Assessment moment	Mean	Median	Standard deviation	Minimum	Maximum
Total correct answers pre-test	16.4	19.0	4.5	6.0	21
Total correct answers post-test	17.8	19.0	3.2	11	22

Table 2 - Total number of correct answers of the computer-mediated group (N=24) on the pre and post-tests, Sao Paulo, 2006

Assessment moment	Mean	Median	Standard deviation	Minimum	Maximum
Total correct answers pre-test	17.7	19.0	3.1	9.0	21.0
Total correct answers post-test	19.4	20.0	1.7	16	22

It is observed that average group scores are close, with slightly higher average values in the post-test of the computer-mediated group. This shows that the *e-learning* strategy is just as effective as on-site learning.

Learning strategies are procedures used in the education process which can be changed to increase learning effectiveness in a specific activity or environment. This means that there are no best strategies. Rather, the strategies are adjusted to the type of activity that is meant to be learned⁽¹⁾.

Data analysis shows that, in general, scores were lower in the on-site group, for both the pre-test and post-test. The statistical analysis did not give any evidence of significant differences between the average scores of the on-site and *e-learning* groups (p=0.072). That is, no significant group effect was observed. Moreover, an increase in the average score after training (p=0.002) was observed. That is, there was a significant moment of evaluation effect. Hence, it is concluded that the average score on the post-test was higher than that obtained on the pre-course; with average scores (at 95% confidence intervals) of 18.6 (17.9 to 19.3) and 17.1 (16.0 to 18.2), respectively.

Table 3 shows the increase in scores after training, obtained by calculating the difference (post-test score - pre-test score) for each individual in the sample.

Table 3 - Descriptive measures for score increase according to training group, Sao Paulo, 2006

	Mean	Median	Standard deviation	Minimum	Maximum
Presential (n=25)	1.3	1.0	3.8	- 7.0	9.0
E-learning (n=24)	1.7	1.0	2.8	- 3.0	7.0

The statistical analysis did not indicate an interaction effect between moment of evaluation and group ($p=0.682$). These results show that the average test score increase for individuals who received *e-learning* training was not significantly different from the average increase for individuals with on-site training. Since there was no interaction effect on the estimated model, the main effects could be evaluated.

The comparative results between the training programs showed that programs were effective in both forms, on-site as well as *e-learning*, since there was an increase in the trainees' average score in both groups, which proves that the presented contents were apprehended.

E-learning provides the opportunity for instructors or teachers to teach better, since it allows them to use a range of both technical and pedagogical teaching tools, as opposed to the old standard one-to-many presentation⁽¹⁶⁾.

Organizations have been adopting *e-learning* as a strategy to train and capacitate professionals, thus increasing the company's intellectual capital through knowledge management⁽¹⁷⁻¹⁹⁾.

Computer and communication technologies are part of the contemporary society, which pushes people into adapting and using new technologies in their personal and professional lives⁽²⁰⁾.

Within this business context, distance learning aims to meet the need for qualified workers, and should be adopted as a new way to educate and not as a "garment" for traditional education, presenting innovative techniques, such as critical autonomy and processes mediated by synchronous and asynchronous communication⁽²¹⁾.

FINAL CONSIDERATIONS

It is observed that the average score in both groups, A and B, increased between the first two moments of pre and post-test. In the on-site group, the average increased from 16.4 to 17.8, and the standard deviation decreased from 4.5 to 3.2. In the *e-learning* group, the average also increased from 17.7 to 19.4, and the standard deviation was reduced from 3.1 to 1.7. Data analysis shows that there was similar knowledge apprehension by both groups of nurses, thus confirming the effectiveness of both methods.

Research data shows that knowledge apprehension occurs regardless of the strategy used in the training program, either on-site or computer-mediated. However, it is inferred that *e-learning* is effective and efficient, since it combines several advantages regarding flexibility and time- and cost-effectiveness, which is not obtained with on-site training, due to its limitations.

Hence, it is understood that *e-learning* provides the individual with a more individualized study, adjusted to the trainee's rhythm, thus providing time flexibility and overcoming geographical barriers, since the student chooses when and where training will take place. *E-learning* in nursing provides optimization and flexibility of the time spent in training courses. In addition, it emphasizes the importance of implementing new tools in nursing education, which should fit each individual's learning dynamics and be a fast and efficient way to train and capacitate professionals.

Hence, it is concluded that adopting *e-learning* in the continuing education process in nursing represents a strong impact on the improvement of knowledge management, care quality and client satisfaction.

In this perspective, it is considered that *e-learning* allows for changes in educational paradigms and behaviors, thus creating a new culture regarding learning and the implementation of technological advancements in nursing education.

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