

Computerized nursing staffing: a software evaluation*

DIMENSIONAMENTO INFORMATIZADO DE PROFISSIONAIS DE ENFERMAGEM:
AVALIAÇÃO DE UM SOFTWARE

DIMENSIONAMIENTO COMPUTADORIZADO DE PROFESIONALES DE ENFERMERÍA:
EVALUACIÓN DE UN SOFTWARE

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ABSTRACT

The complexity involved in operationalizing the method for nursing staffing, in view of the uncountable variable related to identifying the workload, the effective working time of the staff, and the Technical Security Index (TSI) revealed the need to develop a software program named: Computerized Nursing Staffing (DIPE, in Portuguese acronyms). This exploratory, descriptive study was performed with the objective to evaluate the technical quality and functional performance of DIPE. Participants were eighteen evaluators, ten of whom were nurse faculty or nurse hospital unit managers, and eight health informatics experts. The software evaluation was performed according to norm NBR ISO/IEC 9126-1, considering the features functionality, reliability, usability, efficiency, and maintainability. The software evaluation reached positive results and agreement among the evaluators for all the evaluated features. The reported suggestions are important for proposing further improving and enhancing the DIPE.

DESCRIPTORS

Personnel management
Nursing staff
Nursing informatics
Software validation

RESUMO

A complexidade para operacionalizar o método de dimensionamento de profissionais de enfermagem, diante das inúmeras variáveis relativas à identificação da carga de trabalho, do tempo efetivo de trabalho dos profissionais e do Índice de Segurança Técnica (IST), evidenciou a necessidade de desenvolver um software, denominado: Dimensionamento Informatizado de Profissionais de Enfermagem (DIPE). Este estudo exploratório descritivo teve como objetivo avaliar a qualidade técnica e o desempenho funcional do DIPE. Participaram como sujeitos da pesquisa dezoito avaliadores, sendo dez enfermeiros docentes ou enfermeiros gerentes de unidades de saúde hospitalar e oito especialistas em informática em saúde. A avaliação do software baseou-se na norma NBR ISO/IEC 9126-1, considerando as características funcionalidade, confiabilidade, usabilidade, eficiência e manutenibilidade. A avaliação do software obteve resultados positivos, sobre os quais os avaliadores concordaram em todas as características avaliadas. As sugestões relacionadas serão importantes para a proposição de melhorias e aprimoramento do DIPE.

DESCRIPTORIOS

Administração de recursos humanos
Recursos humanos de enfermagem
Informática em enfermagem
Validação de programas de computador

RESUMEN

La complejidad para operacionalizar el método de dimensionamiento de profesionales de enfermería, ante las innumerables variables relativas a la identificación de la carga de trabajo, del tiempo efectivo de trabajo de profesionales y del Índice de Seguridad Técnica (IST), evidenció la necesidad de desarrollar un software, denominado Dimensionamiento Informatizado de Profesionales de Enfermería (DIPE). Este estudio exploratorio descriptivo objetivó evaluar la calidad técnica y el desempeño funcional del DIPE. Participaron como sujetos de investigación dieciocho evaluadores, diez de ellos enfermeros docentes o gerentes de unidades de salud hospitalaria, y ocho, especialistas en informática en salud. La evaluación del software se basó en la norma NBR ISO/IEC 9126-1, considerando las características, funcionalidad, confiabilidad, usabilidad, eficiencia y facilidad de mantenimiento. La evaluación del software resultó positiva y concordante entre los evaluadores para todas las características analizadas. Las sugerencias relacionadas serán importantes para la propuesta de mejoras y optimización del DIPE.

DESCRIPTORIOS

Administración de personal
Personal de enfermería
Informática aplicada a la enfermería
Validación de programas de computación

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INTRODUCTION

Nurses working in health services face innumerable challenges. In terms of human resource management, nurses deal with absences, layoffs, leaves, user demands above the facility's service capacity, among others. In an attempt to overcome these problems, some of the nursing team members face a change in their work shift, sector, or activity. This often causes discontent, which is reported by the nursing team, and distress on the nursing manager⁽¹⁾.

On the other hand, the users' demand for care, who have presented increasingly complex needs, has caused a work overload on the nursing team, thus affecting and hindering the implementation of any measure that would improve the quality of the care being delivered⁽²⁾.

In this context, nursing staffing is a systematic process that grounds planning and the evaluation of the number and quality of nursing professionals. Therefore, it is necessary in order to promote nursing care according to the particularity of the health service, and guarantee the security of users'/clients' and workers⁽²⁾.

Studies about nursing staffing permitted to polish the method that that permitted to analyze and calculate the innumerable variables that aim to describe the reality of health services from the perspective of nursing⁽³⁻⁴⁾.

Generating this knowledge increased the complexity of the method's operationalization in the everyday management activities, which evidenced the need to develop a specific program that facilitate the process of making the project and evaluate the nursing staff⁽³⁾.

Therefore, the software Computerized Nursing Staffing (*Dimensionamento Informatizado de Profissionais de Enfermagem* - DIPE) was developed, which provides the projection of the nursing staff for the hospitalization units of clinical medicine, surgery, adult intensive care, pediatric and neonatal intensive care, and rooming-in facilities of hospital institutions.

It is emphasized that there is a growing concern with the development of efficient information systems that permit making advancements in service management, increasing productivity and improving the quality of the care that is provided, considering that health services deal with the processing of a large amount of information in a small period of time, hence the need for a rapid organization of information and an error margin tending to zero⁽⁵⁾.

When information is organized and made available, health professionals are able to assist in health service management, but, to do this, there is a need to develop appropriate systems to manage that information⁽¹⁾.

Nursing, in its everyday working process, constantly generates data due to the process of care, management, teaching, or research⁽¹⁾.

As data are collected, registered, classified, organized, stored, and made available for computerized searches, this information can help health organizations, whether involved with health care, management, education or research, to analyze the health condition, nursing staff performance at work, negotiate, and make decisions⁽¹⁾.

Therefore, to structure the DIPE software, data regarding the categories *environment* and *human resources* were identified, conceptualized and detailed, then mapped, organized and interpreted under the light of knowledge. The method proposed by Gaidzinski⁽⁴⁾ was adopted, which considers the variables: workload; Technical Security Index (TSI) and effective working time of the professionals.

The DIPE software was developed on a *Microsoft® Web.NET* platform, and hosted on the University of São Paulo School of Nursing (EEUSP) website: <http://www.ee.usp.br/dipe>, where users can access the program after registering.

Generally, software construction models consist of phases of definition, construction, production, and maintenance. The software quality study areas are basically those of process quality, which work with software definition and construction, and product quality, which work with the software product⁽⁶⁻⁸⁾.

Software evaluation is essential in order to guarantee its quality, identify the technical reasons of any existing deficiency and limitations, observe user performance, and verify the parts of the system that should

be changed to improve the software before it is made available⁽⁹⁾.

OBJECTIVE

To evaluate the technical quality and functional performance of the DIPE software.

METHOD

This is a quantitative evaluation study of the DIPE software.

The study subjects were divided into two evaluator categories: nurse faculty/hospital health unit managers (G1) and health informatics specialists (G2).

The random, convenience, non-probabilistic sample consisted of 18 evaluators; 10 nurses (G1) and eight informatics specialists (G2).

According to regulation NBR ISO/IEC 14598-6⁽¹⁰⁾, there should be at least eight participants in each evaluator category.

Therefore, the inclusion criteria for G1 were: to be a faculty member of a higher education nursing course, or work as a nurse manager of a hospital health unit (head of unit, division manager, nursing manager) for G1, and, for G2, to be a health informatics specialist.

In order to evaluate the technical quality and functional performance of the DIPE software, specific data collection instruments were developed based on the model of quality evaluation process, in compliance with resolution NBR ISO/IEC 9126-1⁽¹¹⁾, and applied by another researcher⁽⁹⁾, in three phases: defining the requirements for quality, preparing the evaluation, and performing the evaluation.

The data collection instruments were evaluated by graduate students attending the class discipline *Nurse and Health Personnel Staffing*, offered in the EEUSP Graduate Program on Nursing Management, with the purpose of testing the appropriateness of the adaptations made for the studied theme.

After defining the subjects, the evaluator candidates were contacted by email and by the phone. Next, they were sent an invitation letter, the Free and Informed Consent Form, instructions of how to perform the evaluation, and the evaluation instruments.

The evaluators accessed the DIPE software using the Internet and returned the completed evaluation instrument to the researchers by email or in person.

Software quality was evaluated considering the features: Functionality, Reliability, Usability, Efficiency, and Maintainability; as proposed in other studies^(9,12).

In this study, the **Functionality, Reliability, Usability, and Efficiency** features of the DIPE software was evaluated by the two groups, while **Maintainability** only by the health informatics specialists, because it requires deep knowledge in informatics.

The specificities of the DIPE software were measured quantitatively and mapped on a scale divided in ranks corresponding to the users' satisfaction levels, whose evaluation criteria corresponded to the following scoring levels: **1- Unsatisfactory; 2- Reasonable; 3- Satisfactory; 4- Excellent**. Participants were asked to justify the items they

evaluated as **1- Unsatisfactory** and **2- Reasonable** to allow for improving the software.

A percentage above 70% percentages regarding the evaluation of the features was required for positive answers, and a same percentage of agreement between evaluators from G1 and G2.

Data collection occurred from November 15, 2010 to February 07, 2011. The data were stored on *Excel*[®] worksheets, and served as the basis to decide on the metrics to be used in the software. The results were presented in relative frequencies, which permitted to decide on accepting or rejecting the evaluated features. The analysis was performed following the theoretical-methodological framework relative to the theme of this investigation.

The study was approved by the EEUSP Research Ethics Committee according to protocol 900/2010/CEP-EEUSP. All participants of both evaluator groups freely accepted to participate, and provided written consent, in compliance with Resolution 196/96 of the National Health Council.

RESULTS

In both groups, it was observed that most participants were female, the mean age was 45 years, and time since graduation was around 23 years.

In G1, 10 (100%) evaluators had a degree in nursing, with a complementary obstetrics and licentiate degree, four (40%) hold a doctorate degree, four (40%) had a specialization degree, and two (20%) had a master degree. Three (30%) evaluators had teaching as their main activity, and seven (70%) worked with activities associated to managing hospital units.

In G2, six (75%) evaluators had a nursing degree, one (12.5%) had a bachelor degree in marketing and one (12.5%) graduated in social communication. The eight (100%) evaluators of this group held some degree in informatics, two (25%) had a doctorate degree in health informatics, one (12.5%) in information marketing, one (12.5%) had a Master Business Administration (MBA) degree in information quality technology, and four (50%) had a master degree in health informatics.

The DIPE software evaluation was performed considering the following features: Functionality; Reliability; Usability; Efficiency and Maintainability.

Table 1 – Evaluation of the agreement between G1 and G2 regarding the feature **Functionality** of the DIPE software - São Paulo - 2011

Functionality	Excellent		Satisfactory		Reasonable		Unsatisfactory		No Answer		Total	
	F	%	F	%	F	%	F	%	F	%	F	%
G1	45	75	12	20	3	5	0	0	0	0	60	100
G2	29	51.8	15	26.8	5	8.9	0	0	7	12.5	56	100
Total	74	63.8	27	23.2	8	6.8	0	0	7	6	116	100

In Table 1, it is observed that the **Functionality** of the software to promote the functions of the nursing staffing in hospital institutions achieved 94% of positive answers, as of the total 116 answers, 101 (87%) were rated as ex-

cellent and satisfactory, eight (6.8%) reasonable and seven (6%) were left unanswered. Therefore, the feature was evaluated as positive and without agreement between the two groups of evaluators.

Table 2 – Evaluation of the agreement between G1 and G2 regarding the feature **Reliability** of the DIPE software - São Paulo - 2011

Reliability	Excellent		Satisfactory		Reasonable		Unsatisfactory		No Answer		Total	
	F	%	F	%	F	%	F	%	F	%	F	%
G1	10	25	12	30	5	12.5	5	12.5	8	20	40	100
G2	5	15.6	24	75	3	9.4	0	0	0	0	32	100
Total	15	20.8	36	50	8	11.1	5	6.9	8	11.1	72	100

In Table 2 it is observed that **Reliability** reached 81.9% of positive answers. Therefore, the characteristic was

evaluated with agreement between groups 1 and 2, as more than 70% of the answers were positive.

Table 3 – Evaluation of the agreement between G1 and G2 regarding the feature **Usability** of the DIPE software - São Paulo - 2011

Usability	Excellent		Satisfactory		Reasonable		Unsatisfactory		No Answer		Total	
	F	%	F	%	F	%	F	%	F	%	F	%
G1	32	46	26	37	9	13	2	2.8	1	1.4	70	100
G2	23	41	27	48	5	8.9	1	1.7	0	0	56	100
Total	55	44	53	42	14	11	3	2.3	1	0.8	126	100

Table 3 gives evidence that the software **Usability** reached 97% of positive answers. This feature was evalu-

ated with agreement between the two groups of evaluators as it obtained more than 70% of positive answers.

Table 4 – Evaluation of the agreement between G1 and G2 regarding the feature **Efficiency** of the DIPE software - São Paulo - 2011

Efficiency	Excellent		Satisfactory		Reasonable		Unsatisfactory		No Answer		Total	
	F	%	F	%	F	%	F	%	F	%	F	%
G1	22	73.3	8	26.6	0	0	0	0	0	0	30	100
G2	11	45.8	13	54.1	0	0	0	0	0	0	24	100
Total	33	61.1	21	38.8	0	0	0	0	0	0	54	100

In Table 4 it is observed that **Efficiency** was evaluated with positive agreement between the two groups of evaluators (G1) and (G2).

Table 5 reveals that the **Maintainability** of the software achieved 71.9% of positive answers, which shows that this feature received a positive evaluation by the health informatics specialists (G2) as more than 70% of the answers were positive.

Table 5 – Evaluation of the agreement between G1 and G2 regarding the feature **Maintainability** of the DIPE software - São Paulo - 2011

Maintainability	Excellent		Satisfactory		Reasonable		Unsatisfactory		No Answer		Total	
	F	%	F	%	F	%	F	%	F	%	F	%
G2	6	18.7	15	46.9	2	6.2	1	3.12	8	25	32	100

Finally, the evaluators expressed their opinions, made comments and suggestions regarding the software, evidencing the need to create workshops to present the DIPE, invest in technical-practical training programs to use the software, as well as to provide users with accessibility to supporting literature about nursing staffing.

DISCUSSION

In this study, the researchers used the quality evaluation requirements proposed by regulation NBR ISO/IEC 9126-1⁽¹¹⁾, according to the model developed and applied by other researchers^(9,12), which promoted the foundation of the methodological pathway.

Knowledge production about the use of regulation NBR ISO/IEC 9126-1⁽¹¹⁾ to evaluate products in nursing is incipient, with scarce studies on the subject, which made it unfeasible to perform a comparative analysis of the results.

Functionality is defined as the capacity of the software to promote functions that meet explicit and implicit needs, when used under specific conditions⁽¹¹⁾. Regarding the functionality of the DIPE software, it was found that it execute the planned function appropriately, i.e., to perform nursing staffing in hospital institutions achieving 94% of positive answers among the evaluators.

Reliability is the software's capacity to maintain a specific performance level when used in specific conditions⁽¹¹⁾. The evaluation of this feature reached 81.9% of positive answers, obtaining agreement between groups, as it presented more than 70% of positive answers, which shows the software maintains the performance level while being used.

Usability is defined as the software's capacity to be understood, learnt, operated and be attractive to users when used under specific conditions⁽¹¹⁾. The evaluation of this feature reached 97% of positive answers.

Efficiency refers to the execution time and the resources involved, if they are compatible with the software's performance level⁽¹¹⁾. This feature was evaluated by both group of specialists, and all considered the resources provided by the software as being excellent and satisfactory.

Maintainability refers to how easy it is to change the software, including the improvements and extensions of functionality as well as corrections of defects, failures or errors⁽¹¹⁾. The evaluation of this feature of the software achieved 71.9% of positive answers, which shows it received a positive evaluation by the health informatics specialists (G2) as it achieved more than 70% of positive answers.

The evaluators highlighted the DIPE software as a tool that helps the administrator to make decisions about staffing in hospital institutions. Furthermore, they consider it is of easy accessibility and understanding.

On the other hand, they pointed at the need to provide detailed information about the levels of care, TSI, type of unit and leaves that could be made available to users through a help menu. It is emphasized that the suggestions and comments that were made will be used to implement improvements and enhance the DIPE software.

CONCLUSION

Performing this study permitted the evaluation of the technical quality and functional performance of the DIPE software by ten nurse faculty/nurse hospital unit managers that comprised G1, and eight health informatics specialists that comprised G2.

The DIPE software was evaluate according to the following features: **Functionality, Reliability, Usability, Efficiency** by both groups of evaluators; and the feature **Maintainability** only by the group of health informatics specialists, as their requirements needed deep knowledge in informatics. All feature evaluations obtained positive answers and agreement between the two groups of evaluators.

In conclusion, the DIPE software can be used by professionals who need to perform nursing staffing for hospitalization units, as it permits to use informatics to help planning and making decisions regarding the nursing staff.

In this perspective, the software is currently hosted on the USP School of Nursing website, with free access upon registration, increasing the mobility for searches and for performing nursing staffing in hospital health units without the need to implement the software in every institution.

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