Moodle platform for the construction of knowledge in intensive care: an experimental study

Plataforma *Moodle* na construção do conhecimento em Terapia Intensiva: estudo experimental

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Abstract

Objective: To compare the improvement of knowledge and skills of undergraduate students who participated in activities developed in the Virtual Learning Environment, Moodle, with those who did not participate, during hospital practice in an intensive care unit; to understand the students' perceptions regarding the use of Moodle for teaching the construction of knowledge associated with hospital practice.

Method: This was a study conducted in two stages, experimental and descriptive, with nursing students from a higher education institution in the capital of São Paulo. The experimental group consisted of Moodle and hospital practice, compared to the control group with the traditional strategy . The outcome in the experimental study was evaluated by a validated instrument. In the descriptive qualitative study, content analysis was used.

Results: With a mean age of 23 years and digital fluency, the experimental group had a mean score of 9.1 before the intervention, and the control group had 9.4. After the intervention, the experimental group had 11.5 and the control group had 10.2. Qualitative data reinforced the advantages of associating Moodle with the performance of practical care.

Conclusion: There was an improvement in the learning outcome in the group that used Moodle. The experimental group participants reported greater security and confidence in their practice.

Resumo

Objetivo: Comparar o aprimoramento de conhecimentos e habilidades dos graduandos que participaram das atividades propostas no Ambiente Virtual de Aprendizagem, *Moodle*, no período de prática hospitalar em unidade de terapia intensiva, com os que não participaram; compreender a percepção dos estudantes em relação ao uso do *Moodle* associado ao ensino da prática hospitalar para a construção do conhecimento.

Métodos: Estudo desenvolvido em duas etapas: experimental e descritivo, com graduandos de Enfermagem, de uma instituição de ensino superior da capital de São Paulo. Grupo Experimento constituído pelo *Moodle* e prática hospitalar, comparado com estratégia tradicional, Grupo Controle. O desfecho no estudo experimental foi avaliado por instrumento validado. No estudo descritivo, qualitativo, utilizou-se análise de conteúdo.

Resultados: Com Média de idade 23 anos e fluência digital o Grupo Experimento, pré-intervenção, apresentou média de acertos de 9,1 e o controle de 9,4. Ao final, Grupo Experimento apresentou 11,5 de acertos e controle 10,2. Dados qualitativos reforçaram as vantagens da associação do uso do *Moodle* no desempenho da pratica assistencial.

Conclusão: Houve melhoria no resultado do aprendizado no grupo que utilizou o *Moodle*. Participantes do Grupo Experimento relataram maior segurança e confiança para a assistência.

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Introduction

In education and, consequently, in the practice of nursing care, the current demand is for professionals with a critical posture, able to analyze different situations and make decisions, with evidence-based practice as a guide to their thinking and actions.[1,2] The adoption of participative and innovative methodologies, using educational technologies, has demonstrated positive results, especially in regard to student receptivity.[3] In nursing undergraduate education, the ethical and safety issues of patients overlapping those in real care situations are currently discussed.[4-6] It is desirable that the students acquire knowledge and skills in simulated learning situations so that they are able to make decisions and for the action of care when providing nursing services to patients.

From this perspective emerged the intention to associate the use of new strategies contained in a Virtual Learning Environment - VLE, Moodle, to the traditional form of education[7] in order to develop the potential of students to construct knowledge for care of critically ill patients in the general education level. The Moodle platform is an environment for the development of learning that has the main features of a VLE. In the Moodle platform, there are tools that allow for course evaluations, survey, questionnaires, tasks and reviewing work; chats, forum posts, workshops, and also the ability to create collaborative texts.[8]

The intention of associating Moodle to the theoretic and practice learning in a hospital environment delineated the study questions: are there differences in undergraduate learning outcomes and the development of knowledge for the care of patients when traditional teaching is compared to the combination of a VLE? What is the opinion of students regarding the use of the Moodle platform in this development?

The objectives of this study were to: describe the sociodemographic profile of the students; identify the undergraduates' digital fluency; compare the improvement of knowledge and abilities of those who participated in the activities proposed in the VLE, Moodle, in hospital practice, with those who did not participate; and, to understand the students' perception regarding the use of Moodle associated with hospital practice education in building knowledge.

Methods

This was a study designed in two stages. The first stage was experimental and quantitative. The second stage was descriptive and qualitative.

The participants were students enrolled in 2012 and 2013, attending the Intensive Care Nursing course of the fourth semester of the undergraduate nursing course at the *Escola Paulista de Enfermagem* (EPE), *Universidade Federal de São Paulo* (UNIFESP).

For the characterization of the subjects, the following data were obtained: age; previous healthcare training (mid-level or graduate) and current experiences in health, working or participating in extracurricular activities related to hospital practice. Inclusion criteria were: being enrolled in the intensive care nursing course for the first time; having access to the internet, having skills to surf the Internet, and to upload and download files.

Students were randomly assigned into two groups consisting of the Experimental Group (EG) and Control Group (CG), under supervision of the same professor, a nurse specialist in intensive care. All students participated in the lectures and were scheduled in the intensive care units in the same period. Participants in the EG additionally accessed the activities available in Moodle.

The educational activities introduced by the Moodle platform were related to three learning modules: management of central venous catheters (CVC), management of fluid balance (FB), and nursing care for patients receiving norepinephrine (NCPN), which were also delivered in the classroom by means of dialectic lecture.[9] The educational activities in Moodle were de-

veloped into four modules. The first module was student adaptation, in which the VLE Moodle features were explained. The second was on the CVC management; the educational strategies used were "link to a video", the "daily" and the "wiki", which is a text of collective construction feature. In the third module, on FB, the "file exchange" was used, a feature for a simulation activity, based on a clinical case in which students were asked to record, analyze and describe actions to be taken. In the fourth and final module, each student chose a patient from his/her hospital practice activities, and from a script, described a case in the "daily" feature, determining the care according to the steps of the nursing process. In all modules, forums for discussion and sharing of questions and opinions were opened.

The level of knowledge of the groups was evaluated by applying the Learning Outcomes Assessment Tool, developed by the researchers, which consisted of an assessment using 15 multiple-choice questions, equally divided among the topics. This assessment tool was validated by a jury of five experts, selected on the following criteria: being a nurse with a minimum of a master's degree; professional experience in nursing care of critically ill patients or nursing care in pharmacotherapy, or evaluation of central venous catheters.

For validation, two experts evaluated the 15 questions regarding three of the modules and the other three assessed the five questions regarding one of the modules, thus there were three experts for every five questions. To calculate the agreement rate for each of the questions, the mean response score was calculated to be used in the denominator and 1 (one) was used in the numerator, the number representing the best answer. For general agreement, the mean of the agreement rates of the 15 questions was calculated among the three evaluators. The result was a general agreement equal to 0.78, i.e. above 75%.[8]

In the first, experimental stage, the Moodle platform was associated with activities in hospital practice, in comparison to the traditional strategy (hospital practicealone). In the first and last day of hospital practice, pre and post intervention, respectively, the same evaluation was administered to both groups. Descriptive statistics were used to analyze the characteristics of the subjects and the results of their evaluations. The data were presented in absolute numbers, percentages, means, medians, standard deviation, maximum and minimum values.[10]

In the second stage, the focus group (FG) technique was used to obtain qualitative data.[11] The utilization of this technique aimed at understanding the students' perceptions of learning content for clinical decision-making with the association between Moodle and hospital teaching practice. Thus, 17 EG students participated in the FG, at the end of hospital practice in the years 2012 and 2013, forming three FG with four students and one FG with five students. The main investigator was the moderator for all groups. The meetings were conducted in a meeting room at the university and utilized the same script of questions. The moderator began the activities, clarified the rules of the FG and identified the central question ("What were the benefits provided by the association of VLE, Moodle, with hospital practice for learning technical procedures and for clinical decision making in care critical patient? "), which in the FG technique aims to lead participants to reflect and prepare them for questions with greater objectivity, which were: "Do Moodle resources support the acquisition of new knowledge, new skills, and new attitudes?" and "What are the feelings experienced in the hospital from the implementation of activities proposed in Moodle? Make comments and suggestions as wished".

The duration of each FG was one hour, on average, the meetings were recorded, and verbal narratives were transcribed. After transcription, the Bardin Content Analysis technique was applied.[12] The answers were coded from E1 to E17, initially quantified by repetition, separated in thematic units, submitted to inferential analyses, and subsequent categorization. The objective was to evaluate the construction of knowledge and the ability to associate the different educational strategies in order to strengthen the performance of intensive care ac-

tivities in practice by undergraduate students. Thus, the theoretical framework of the development of knowledge and skills to generate making effective and contextualized decisions was selected.[13] The data generated by the FG were analyzed under these conceptual perspectives.

The study submitted to the Committee of Research Ethics of the *Universidade Federal de São Paulo*/Hospital Sao Paulo who has reviewed and approved under number 1704/11.

Results

Thirty-four students participated, representing 17 students in the EG and 17 in the CG, with a mean age of 22.3 and 23 years, respectively. Table 1 shows the demographic characteristics of the sample.

Table 1. Sample characteristics

Category	Experimental Group n(%)	Control Group n(%)	Total n(%)
Gender			
Male	0(0.0)	5(29.4)	5(14.7)
Female	17(100.0)	12(70.6)	29(85.3)
Technical training in health			
Yes	3(17.7)	1(5.9)	4(11.8)
No	14(82.3)	16(94.1)	30(88.2)
Training Area			
Dietetic nutrition	2(66.7)	0(0.0)	2(50.0)
Nursing	1(33.3)	0(0.0)	1(25.0)
Surgical instrumentation	0(0.0)	1(100.0)	1(25.0)
Previous degree in health			
Yes	0(0.0)	0(0.0)	0(0.0)
No	17(100.0)	17(100.0)	34(100.0)
Employment relationship in health			
Yes	0(0.0)	0(0.0)	0(0.0)
No	17(100.0)	17(100.0)	34(100.0)
Training in nursing (extracurricular hospital practice)			
Yes	7(100.0)	4(100.0)	11(100.0)
No	0(0.0)	0(0.0)	0(0.0)
Participating in extracurricular activities in care			
Yes	11(64.7)	7(41.2)	18(52.9)
No	6(35.3)	10(58.8)	16(47.1)

The use of computers and use of digital communication by the subjects was evaluated, as well as digital fluency, as shown in table 2.

Table 2 . Computer use and digital fluency

Activities	Experimental Group n(%)	Control Group n(%)	Total n(%)
School work	17(100.0)	17(100.0)	34(100.0)
Search for texts in order to study	17(100.0)	17(100.0)	34(100.0)
Send and receive e-mail	17(100.0)	17(100.0)	34(100.0)
Participates in a distance learning course	8(47.1)	5(29.4)	13(38.2)
Edits and produces videos	10(58.8)	8(47.1)	18(52.9)
Develops software	0 (0.0)	1(5.9)	1(2.9)
Edit images	13(76.5)	14(82.3)	27(79.4)
Participates in social networks	17(100.0)	17(100.0)	34(100.0)
Reads news	17(100.0)	16(94.1)	33(97.1)
Navigates the internet	17(100.0)	17(100.0)	34(100.0)
Uses instant messaging	16(94.1)	14(82.3)	30(88.2)
Installs and uninstalls software			
With difficulty	8(47.1)	5(29.4)	13(38.2)
Easily	8(47.1)	11(64.7)	19(55.9)
Doesn't know how to do it	1(5.8)	1(5.9)	2(5.9)
Uses text editor			
Only simple formatting	0(0.0)	2(11.8)	2(5.9)
Simple formatting and basic resources	12(70.6)	12(70.6)	24(70.6)
Uses all software resources	4(23.5)	3(17.6)	7(20.6)
Does not edit texts	1(5.9)	0(0.0)	1(2.9)
Uses spreadsheet			
Simple calculation	6(35.3)	5(29.4)	1(32.3)
Simple calculation and basic resources	7(41.2)	7(41.2)	4(41.2)
Does not use	4(23.5)	5(29.4)	9(26.5)
Uses slide show presentation			
Simple presentation	1(5.9)	1(5.9)	2(5.9)
Creates using basic resources	13(76.5)	3(76.5)	6(76.5)
Develops presentation using all resources	3(17.6)	3(17.6)	6(17.6)

The results are related to the application of the Learning Outcomes Assessment Instrument. Table 3 shows the measures of central tendency and dispersion for the successes, mistakes and ignorance of the issues contained in the evaluation tool administered to students of both groups, before and after the hospital practice.

Figure 1 shows the difference in performance between EG and CG, before and after a period of hospital practice.

In the second, qualitative, stage of the research, students were asked about acquisition of new knowledge, skills, and attitudes, favored by Moodle resources. The statements of the students generated two categories: (1) Moodle favors the acquisition of new knowledge, skills and decision making (n=17) and (2) advantages of VLE: doing exercises (n = 10);

Table 3. Measures of central tendency and dispersion obtained from the evaluation instrument in the pre- and post-intervention

Question corrections	Mean	Median	Standard Deviation	Minimum	Maximum
Post-hospital practice					
EG - Correct	11.5	12.0	1.5	9	14
CG - Correct	10.2	10.0	1.9	6	13
EG - Wrong	3.3	3.0	1.6	1	6
CG - Wrong	4.2	4.0	2.0	2	9
EG - Does not know	0.2	0.0	0.5	0	2
CG - Does not know	0.5	0.0	0.7	0	2
Pre-hospital practice					
EG*- Correct	9.1	10.0	2.2	5	12
CG+ - Correct	9.4	10.0	1.9	6	13
EG - Wrong	3.8	4.0	1.5	1	6
CG - Wrong	3.3	3.0	1.9	1	8
EG - Does not know	2.1	1.0	2.3	0	9
CG - Does not know	2.3	2.0	1.5	0	6

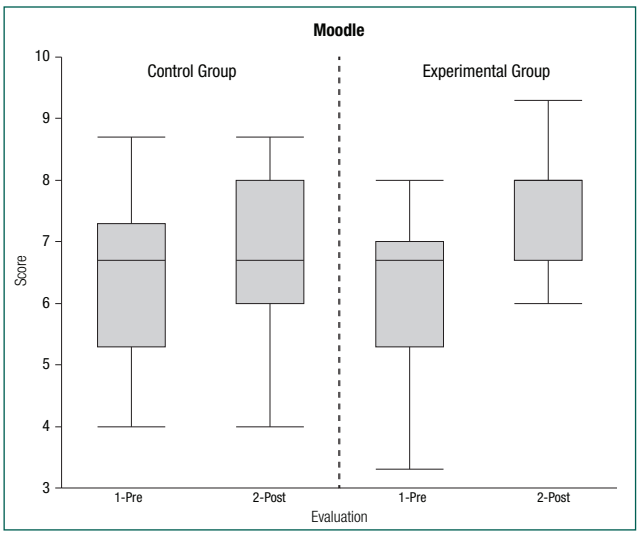

Figura 1. Gráfico em Box-Plot compara a evolução dos Grupos, Experimento e Controle, em momento pré e pós prática hospitalar

Chart 1. Stages of data analyses from FG questions

FG Question	Examples of speech in full	Inferential analysis	Categorization
Do Moodle resources support the acquisition of new knowledge, new skills, and new attitudes?	I acquired knowledge, Moodle gives us a direction because we have the theoretical content of the course and when it comes to practice, I felt a little lost, I think that helped contextualize ... (E6)	There was acquisition of new knowledge (n=17) Oriented the hospital practice (n=17)	Moodle favors the acquisition of new knowledge, skills, and decision-making (n=17)
	One thing I found cool in the Moodle environment, the advantage of being able to access anytime you are with a doubt, you can access and resume that knowledge at any time, moreover, exercises enable correlation. (E7) The very interaction with the group, because that feature you can comment and everyone sees what you are commenting on. You can post articles, help with group interaction. (E17)	Exercise promotes learning (n=10) Ease and convenience: time and place (n=6) Freedom to study (n=6) Quality material to study (n=7) Interaction among students (n=4)	Advantages of Virtual Learning Environment: Developmental exercises (n=10); accommodation of scientific material previously evaluated by the professor (n=7); time and local flexibility (n=6) and discussion possibilities(n=4)
What are the feelings experienced in the hospital from the implementation of activities proposed in Moodle?	I think the key word, the greatest feeling was safety, we can only have safety if you have knowledge, as a great tool for us to have knowledge and direct the study, served well for us to have safety.(E15)	Provides safety (n=11) Provides confidence (n=5)	Moodle provides safety (n=11) and confidence (n=5) to develop the hospital practice
	I found it very cool not to have that restriction of time, you can adjust your schedule, gives a sense of freedom, it is a question of autonomy ... (E8)	Provides autonomy(n=3) Freedom to manage time (n=2)	Using a Virtual Learning Environment to study generates autonomy (n=3) and freedom (n=2)
Make comments and suggestions/ wishes.	... should have in all courses (...) and if you are with a doubt. It allows you to come in and ask the professor. (E5) ... It would also be interesting if I had more days to discuss cases that are posted on Moodle.(E17)	Have in all disciplines (n=6) Allocate more days for the activities of Moodle (n=1)	Associate the use of Moodle in curriculum subjects (n=6) and allocate days to use Moodle (n=1)
	... gradually opening was a positive point in my opinion. (E6) The suggestion I would have is that the last activity that is a little more complex, could be made available earlier.(E5) ... but it would be nice to know if your colleague is on, then if you have any questions you call your colleague. (E7)	Maintain the gradual opening of activities (n=3) Use more media features (n=1) Delivering more complex activity at the beginning (n=1)	Customizing Moodle: gradual release of activities (n=3), anticipate complexity (n=1), use of media, and viewing of participants who are online (n=1)

accommodating scientific material previously evaluated by the teacher (n=7); time and local flexibility; (N=6) and possibility for discussion (n = 4), as shown in chart 1.

The second question to the EG approached which feelings were experienced in the hospital from the implementation of the proposed activities in Moodle, and the statements enabled the construction of two categories: (1) Moodle supports safety (n=11) and confidence (n=5) for developing the hospital practice, and (2) Using a VLE to study provided autonomy (n = 3) and freedom (n = 2) as shown in figure 1.

As for the final question of the FG, it was requested of the students that they make comments and give suggestions. From these statements, the creation of two more categories was possible: (1) associate the use of Moodle in curriculum subjects (n = 6) and allocate days to use it (n = 1) and (2) Customizing Moodle: release gradual activities (n = 3), use of media (n = 2), start with the most complex activities (n = 1) and enable the display of participants who are online (n = 1). Chart 1 shows steps of the technique.

Discussion

The subjects were mostly female, conistent with the literature, which also highlights the predominance of women in choosing a nursing career.[11] The age range of the participants also corresponded to the characteristics of students in a Brazilian public universities, mostly adolescents and young adult students, none had an employment relationship; certainly, the full-time course limits the possibilities for students to reconcile work and university study.[14,15]

Regarding the familiarity with computers and the task execution ability of the computer, students from both groups demonstrated to follow the generation of which they are a part, with at least knowledge about the basics to the advancedin the use of tools that are required for the Distance Learning (DL) course.[16] Thus, in the characteristics stage, both the CG and EG demonstrated homogeneity in the investigated items, which was relevant as a condition for the following data to be analyzed.

The assessment tool obtained similar results for correct answers, errors, and ignorance. However, when applied after the hospital practice, the EG demonstrated a higher number of correct answers, with a minimum of nine questions of the total of 15, compared to the CG, in which there were students with unsatisfactory results, not reaching 50% of the total number of questions. Studies with similar populations denoted that traditional education, when associated with VLE, was able to provide better results in student learning as well as studies with larger populations that highlighted that there was an increase in educational post-intervention assessment correct answers.[17]

The FG, performed in a sequence of hospital activity with EG students, highlighted that the association of the VLE to hospital practice enabled the acquisition of new knowledge, and encouraged the clinical decision making in patient care, as demonstrated in the category "Moodle favors the acquisition of new knowledge, skills, and decision-making". The practices of activities that simulated nursing care of patients in a virtual environment and, thus safe, enabled the student to anticipate the learning experience of care for patients in a real situation; these findings are shown to be consistent with the scientific literature.[15]

Patient safety is an important intentionality that may permeate the education process and learning of health professionals. The longer the intellectual preparation and motor skills in simulated environments, preceding the care of the patients, the higher the degree of safety of students in care practice and, consequently, patient safety, according to the World Health Organization.[16]

Another factor highlighted as favorable for the construction of knowledge was the ability to find the Moodle scientific texts closely related to what needed to be studied. It is understandable that the student verbalizes comfort and safety in relation to scientific papers indicated by the professor regarding the content to be learned, because although there is a strong supply of online publications, in general, students still do not have security for interpret their findings.[18] Another analytical facility is the very ease of obtaining the article by the student, a lazy attitude. In this sense, the role of the teacher-tutor in Moodle deserves reflection, in that one can only monitor whether or not the student opened the text (which is possible via control tools) or provoke them with activities that may denote a real reading and reflection.[19]

Perhaps this configures an important analytical aspect of this study, the safety provided by the association of different educational strategies, articulated to prepare the health care student for the effective and efficient professional action.

The contemporaneity of this condition has been demonstrated by scientific publications linking the occurrence of adverse events with patients to healthcare environments with a high level of ethical and moral injury to professionals, as well as the services of institutions.[20,21] The care actions shaped in unsafe practices are the main causes of adverse events. Thus, it is the institutional graduation that promotes a safety culture.[22]

Taking advantage of the digital skills of the current generation of young people to refine the process of teaching and learning, as well as favoring of health care quality policy, has been a trend not only of educational institutions with teaching hospitals, but also of the institutions that are exclusively hospitals. In fact, the expansion of options in terms of teaching strategies is thought-provoking and motivating from the exploration of literature and research results, as this brings approval and praise from students, as denoted the category on "Advantages of VLE: developmental exercises; accommodation of scientific material previously evaluated by the professor; time and local flexibility; and discussion possibilities".

Thus, it was possible to evaluate the advantage of the combination of the VLE with hospital practice by the student's ability to perform exercises that promoted understanding of the content and, consequently, the ability to use them in practical situations. This produced satisfactory results, as expected of a well prepared and competent student, able to associate thought, action and good results.[17] From the concept, students signaled that the hospital VLE-practice association can promote the development of knowledge that, under propitious conditions, can strengthen decision making.

The discussions in the FG revealed the category "Using VLE to study provides autonomy and freedom", which demonstrated the need that the student must feel respected in his/her learning process. Feelings reported by some students demonstrate that the use of VLE enables respect for the learning style and allows for time management in the way that best fits one's learning style. Another weakness in university education is highlighted with this analytical possibility: low educational investment for detecting cognitive styles and the consequent diversification of teaching strategies and assessment in respect to different demands. Cognitive styles can be classified into superficial, strategic or deep.[23] By the answers obtained, Moodle provided some students the opportunity to deepen the content, a typical student style that is not limited to memorizing, but interpreting; giving meanings, adding them to previous experiences; understanding what is being studied and views its applicability, finally, attitudes expected for the professional performance of the learner in the ICU.[24]

The students' suggestions and comments expressed in the category "Associate the use of Moodle in curriculum subjects and dedicate days to use Moodle", in addition, reinforced the importance attributed by students to the VLE to support the regular courses, and also highlighted the need for inclusion of these study hours in planning educational disciplines. In this study, the Moodle activities were not included in the class plan because it was a research study. Thus, certainly, students realized that the inclusion of VLE, added to other curricular activities common to all other students, was excessive.

The suggestion of the students on the use of media and the possibility of interaction with colleagues, expressed in the "Customizing Moodle: gradual release of activities, anticipate complexity, use of media, and viewing of participants who are online," revealed that even in a small group, the different learning styles are present and have their needs. Thus, in this category and the one previously discussed, the perceptions of students are in accord with those described in the most recent report by the New Media Consortium (NMC). This report, prepared in 2013, focused on trends in educational technology in Latin America, and highlighted collaborative environments, online learning, open content and social media as part of higher education in Latin America.[20]

The outcomes of both quantitative and qualitative research stages allowed for the inference that the construction of knowledge can be increased by the union of teaching strategies that allow for the autonomy of the student, the dialogic relationship,

and deepening of the content. Quantitative data showed that the concepts were best learned by the students in the EG. However, as the effectiveness of the application of this content to the decision-making in a practice situation could not be measured objectively, the qualitative data from the content analysis of the perceptions of students were valuable contributions, demonstrating that the effectiveness of conceptual learning favored the execution of activities in practice, signaling the improvement of procedural and attitudinal skills.

The small number of research subjects was a limiting factor for better results. There was the possibility that the number of questions contained in the Outcome Assessment Instrument was insufficient for proper evaluation or measurement of the learning characteristics of the chosen content.

Conclusion

This study demonstrated that the association of Virtual Learning Environment- Moodle with the teaching strategy applied in the hospital practice period favored the learning process expressed in higher performance presented by the students of the experimental group. From the students' perception, performing the activities proposed in Moodle provided them the ability to acquire knowledge and skills, as well as increased feelings of safety and confidence in caring for patients in critical care during their hospital practice.

Collaborations

De Domenico EBL and Cohrs CR participated in the project conception, result analysis, writing of the article and final approval of the version to be published. Cohrs CR executed the intervention and data collection.

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