Influence of the virtual learning environment on the academic performance of nursing students

Influência do ambiente virtual de aprendizagem no desempenho acadêmico de estudantes de enfermagem

Influencia del ambiente virtual de aprendizaje en el desempeño académico de estudiantes de enfermería

Daniela Miranda Ferreira[1] https://orcid.org/0000-0002-6759-1082
Jaqueline Lemos de Oliveira[1] https://orcid.org/0000-0003-3699-0280
Nayara Gonçalves Barbosa[1] https://orcid.org/0000-0003-3646-4133
Angelina Lettiere-Viana[1] https://orcid.org/0000-0002-4913-0370
Ana Carolina Guidorizzi Zanetti[1] https://orcid.org/0000-0003-0011-4510
Jacqueline de Souza[1] https://orcid.org/0000-0002-6094-6012

Abstract

Objective: To analyze the influence of the virtual learning environment on the academic performance of nursing students.

Methods: Quantitative, retrospective study, with secondary data from 108 first-year undergraduate nursing students, obtained through a virtual learning environment (*e-Disciplinas*). The indicators were: number of accesses to the virtual environment, number of materials accessed, number of mandatory tasks performed, number of attempts and correct answers in the *quiz,* and final grade in the course. The Mann-Whitney test and the Spearman correlation test were performed using *software* for statistical analysis.

Results: 92% adherence to the *quiz* and a positive correlation between the number of correct answers and the final grade were identified. Furthermore, there was a positive correlation between the number of accesses to the virtual environment, the number of correct answers in the *quiz,* and the final grade in the course. The final grade was also correlated with the number of materials accessed and the number of mandatory tasks performed.

Conclusion: The use of the virtual environment as a support strategy in the course had a positive impact on students' academic performance, suggesting that it facilitates the strengthening of the students' autonomy and protagonism in their development and their teaching-learning process.

Resumo

Objetivo: Analisar a influência do ambiente virtual de aprendizagem no desempenho acadêmico de estudantes de enfermagem.

Métodos: Estudo quantitativo, retrospectivo, com dados secundários provenientes de 108 estudantes do primeiro ano da graduação em enfermagem, obtidos por meio de um ambiente virtual de aprendizado (*e-Disciplinas*). Os indicadores foram: número de acessos ao ambiente virtual, número de materiais acessados, número de tarefas obrigatórias realizadas, número de tentativas e de acertos no *quiz* e nota final na disciplina. Foram empreendidos o teste de Mann-Whitney e o teste de correlação de Spearman, utilizando *software* para análise estatística.

Resultados: Identificaram-se 92% de adesão ao *quiz* e correlação positiva entre o número de acertos e a nota final. Além disso, houve correlação positiva entre o número de acessos ao ambiente virtual, o número de acertos no *quiz* e a nota final da disciplina. A nota final também foi correlacionada com o número de materiais acessados e o número de tarefas obrigatórias realizadas.

Conclusão: A utilização do ambiente virtual como estratégia de apoio na disciplina apresentou impacto positivo no desempenho acadêmico dos alunos, sugerindo ser um facilitador para o fortalecimento da autonomia e do protagonismo do discente em seu desenvolvimento e em seu processo de ensino-aprendizagem.

Resumen

Objetivo: Analizar la influencia del ambiente virtual de aprendizaje en el desempeño académico de estudiantes de enfermería.

Métodos: Estudio cuantitativo, retrospectivo, con datos secundarios originarios de 108 estudiantes del primer año del grado en enfermería, logrados por medio de un ambiente virtual de aprendizaje (*e-Disciplinas*). Los indicadores fueron: número de accesos al ambiente virtual, número de materiales a los que se accedió, número de tareas obligatorias realizadas, número de intentos y de aciertos en el *quiz* y en la calificación final en la asignatura. Se realizaron las pruebas de Mann-Whitney y la prueba de correlación de Spearman, utilizando *software* para el análisis estadístico.

Resultados: Se identificó el 92 % de adherencia al *quiz* y correlación positiva entre el número de aciertos y la calificación final. Además, hubo una correlación positiva entre el número de accesos al ambiente virtual, el número de aciertos en el *quiz* y la calificación final de la asignatura. La calificación final también se correlacionó con el número de materiales a los que se accedió y el número de tareas obligatorias realizadas.

Conclusión: La utilización del ambiente virtual como estrategia de apoyo en la asignatura mostró un impacto positivo en el desempeño académico de los alumnos, lo que sugiere que sea un facilitador para el fortalecimiento de la autonomía y del protagonismo del discente en su desarrollo y en su proceso de enseñanza-aprendizaje.

Introduction

The potential of virtual learning environments to enhance the teaching process and encourage students' autonomy has been highlighted in the literature on the subject.[1-9] Studies carried out specifically in nursing have focused on the development and validation of remote learning strategies, such as *games*, *quizzes*, and *chats*;[4-6] in the experience report on the use of such strategies, as complementary to traditional education,[3,7] and in the evaluation of students about them.[8,9]

The themes of the strategies described are mostly focused on procedural aspects of nursing practice, such as wound care, Basic Life Support, newborn care, medication administration, and indwelling vesical catheterization;[4,10,11] preventive aspects related to adverse events, pressure injuries, work accidents and smoking,[5,6,12] and also on the development of communication skills.[13]

Recent research on the virtual learning environment in the context of nursing teaching deal mainly with objective aspects of clinical practice and not necessarily with more reflective and transversal themes, such as the construct of comprehensive healthcare.

The concept of comprehensiveness is linked to interdisciplinarity and is influenced by humanistic proposals for approaching health. It comes from questions about the medicalization of society, the need to expand the field of action in health, and the limits of rationality and medical knowledge.[14] It also starts from a criticism of the fragmentation of care into specialties, the reduction of the view of biological aspects, the curative practice, and the limits of the dichotomization between individual and collective health.[15]

Thus, comprehensiveness, in its complexity, refers to a non-fragmented approach, based on the perception of the human, which considers the subjectivity and complexity of the subjects and provides an open dialogue between professionals and users and between different courses.[14]

Other meanings attributed to comprehensiveness consist of promotion, treatment, rehabilitation, and prevention actions, which must occur in an articulated manner at all levels of complexity of the system; in the access of users resolutely to all the health actions they need and in the existence of public policies that promote the horizontalization of practices and programs.[16]

As for teaching, these conceptions assumed greater importance in the Brazilian context from the 1990s, when curricular guidelines highlighted the need for more flexible professionals with more comprehensive, interdisciplinary knowledge and focused on users' needs and social demands.[15] The importance of diversifying teaching scenarios from the perspective of comprehensiveness of health also gained prominence.[15]

Thus, a knowledge gap is perceived to expand the studies that assess the potential of using the virtual learning environment in approaching transversal and complementary contents to the training of clinical competencies, as is the case of comprehensive care in health. Furthermore, studies on the effect of using the virtual learning environment at the national level have been developed with nurses who have already graduated.[3,10-12] The analysis of this effect on the academic performance of nursing

students is mostly undertaken internationally.[7-18] The present study should contribute to highlight didactic possibilities for undergraduate teaching and which also facilitate the assimilation of more subjective contents, which guide the Brazilian health system, permeating the practice of nurses in different care *settings*.

The aim of this study was to analyze the influence of the virtual learning environment on the academic performance of nursing students.

Methods

This quantitative research was carried out at the University of São Paulo at the School of Nursing of Ribeirão Preto, in Ribeirão Preto (SP). The study setting was the course of Health Care Comprehensiveness I offered in the first year of the bachelor's degree in nursing. The course is annual and aims to provide the student with a theory-practice dialogue using resources from the territory and the Primary Health Care services. It is understood that this can help students to identify the real demands of these spaces and to draw reflections that incorporate the theoretical knowledge discussed in the classroom and the virtual learning environment for a more comprehensive practice that considers the different aspects of the life of the subjects and stimulate social-clinical reasoning, covering both individual and collective aspects.

Regarding access to the virtual learning environment, the medium (*tablets, smartphones*, computers, among others) and the location (any place with internet access) were free to the student's choice. On average, 12 topics were covered throughout the course (11 in 2017 and 15 in 2018). The categories of materials provided by teachers in the virtual learning environment during 2017 and 2018 corresponded to 34 texts for further reading, three videos for reflection on the contents, a concept map, and *slides* corresponding to each of the nine theoretical classes taught, in addition to 16 scripts related to practical skills and six optional fixation exercises, similar to a case study. Still, that environment had seven mandatory tasks (text reading/review, crit-

ical reflection on a documentary, and exercises to assimilate the skills developed in professional practice laboratories – genogram and ecomap, nursing notes, observation, and interview).

The professors also provided a *quiz* consisting of ten multiple-choice questions with five alternatives to review the main aspects of the content taught during the two semesters of the course. The *quiz* was prepared by professors and graduate students and has been used in the course since 2015. For each use, *feedback* is requested from students regarding the relevance and clarity of the questions. In 2017, it was tested by three student monitors, specifically for evaluation and adjustments to the questions and answer options. The student had the option to do it as many times as deemed necessary, and the score for this activity did not make up the final grade in the course since it was not a mandatory task.

The study population consisted of undergraduates who attended Health Care Comprehensiveness I in 2017 and 2018. The institution in question offered, annually, about 80 spots for the first year of the bachelor's degree in nursing. In 2017, 81 students were enrolled in the course and, in 2018, 75 students. Thus, the study population consisted of 156 students.

Eligibility criteria were having completed the Health Care Comprehensiveness I course in 2017 and 2018, not having failed for non-attendance, and being 18 years old or more at the time of data collection. In 2017, two students and, in 2018, four dropped out in the first semester of the course. Data collection was carried out between August 2019 and January 2020. During this period, all students who attended the course were 18 years old or older. Thus, 150 students were eligible. All were invited to participate in the study.

The main author made the invitation during breaks in classes so as not to interfere with academic activities. All eligible individuals received the invitation, and 108 (72%) students agreed to participate in the study. The reasons for refusal were lack of time or personal reasons.

The variables considered in this study were: number of accesses to the virtual learning environment (how many times the student accessed

the course on the *online* platform); the number of materials accessed in the virtual learning environment (number of texts that the student *downloaded* via the *online* platform); the number of mandatory tasks performed (how many mandatory tasks the student completed within the proposed deadline); final grade (grade obtained by the student at the end of the course); the number of *quiz* attempts (how many times the student answered the question set of the *quiz*) and correct answers in the *quiz* (final score obtained for the last time the student answered the question set of the *quiz*).

Information on these variables was collected from individual reports made available in the university's virtual learning *environment*(e-Disciplinas) and those issued by professors, with students' grades at the end of each semester. The collection was carried out separately by two researchers, and later, the similarity of the information obtained was verified. In cases of divergence, both returned to the data sources for checking and correction. Data collection was guided by a previously defined script containing the variables in question.

The data obtained were tabulated in an *Excel for Windows* spreadsheet and double-entered to reliability validation and verification. Subsequently, the data was transported to a definitive database in the *IBM® Statistical Package for Social Sciences software*, version 23.0.

In the present study, the term "academic performance" was conceived as an indicator of student achievement in the face of various learning strategies used to address the curricular content proposed in the course. Still, for analysis purposes, the academic performance indicators considered were the number of correct answers in the *quiz* and the final grade obtained by the student in the course. The number of correct answers in the *quiz* is computed by the virtual learning environment and varies from zero (when the student does not answer any question correctly) to ten (when the student answers all the questions correctly). The course's final grade also ranged from zero (no achievement) to ten (maximum achievement). The composition of such grade included cognitive assessments, acting in the practice scenario, and performing mandatory tasks

in the virtual learning environment. The maximum score for each of these items was respectively ten, ten, and one. During the course, two biannual cognitive assessments were carried out, addressing the contents taught in the period. In the practice scenario, the student's potential to operationalize such contents in recognition of the territory, interaction with users and professionals, and home visit was considered.

Descriptive statistics were used to present the percentage of participants who joined the *quiz*; the number of attempts to perform it, and the median, minimum, and maximum number of correct answers in the *quiz,* and the final grade.

To identify the normality of the distribution of the outcome variables (number of correct answers in the *quiz* and final grade in the course), the Kolmogorov-Smirnov normality test was used, the result of which showed that their distribution was not normal (p=0.000 and p= 0.016). Thus, the non-parametric tests described below were performed, considering a significance level of ≤0.05. The Mann-Whitney test was performed listing as dependent variables the number of correct answers in the *quiz* and the final grade in the course and, as independent variables, the completion of the *quiz* (yes/no) and the number of attempts to complete it (one attempt/two or more attempts). Spearman's correlation was undertaken in two steps. First, the relationship between the number of accesses to the virtual learning environment, the number of correct answers in the *quiz* and the final grade in the course was analyzed, considering the total sample. Subsequently, the same test was used to analyze the variables: the number of materials accessed, the number of mandatory tasks performed, the number of correct answers in the *quiz,* and final grade in the course, according to the year the course was offered. This methodological option was because the number of materials provided by the professors was different each year.

The study was approved by the Undergraduate Committee and by the Research Ethics Committee of the University of São Paulo at the School of Nursing of Ribeirão Preto, under protocol CAAE 68745217.7.0000.5393 of February 28, 2019. The
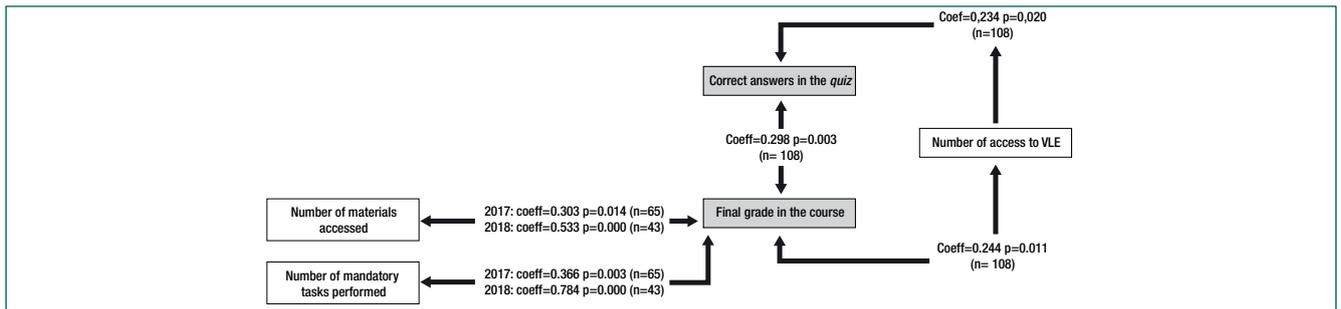
VLE - Virtual Learning Environment; Coeff - Coefficient
Figure 1. Factors correlated to the proposed academic performance indicators

development of the study followed the guidelines and regulatory standards for research involving human beings, as established by resolution 466/2012 of the National Health Council.

Results

Overview of the studied variables

Throughout the course, students accessed the virtual learning environment several times (median 194, minimum six, and maximum 556 accesses), *downloaded* most of the materials available (median 21.2, minimum zero, and maximum 77.5 materials), and performed most of the mandatory tasks (median of four, minimum of one, and maximum of seven tasks). Among the participants, 92% (n=99) took the *quiz*. As for the number of attempts to perform this activity, 66% of students (n=71) made a single attempt to answer the set of questions, and 25.9% of them (n=28) made two or more attempts. The median number of correct answers in the *quiz* of the total number of participants was 8.22 (minimum of zero and maximum of ten). The final grade in the course was nine (minimum of 5.9 and maximum of ten).

The influence of the virtual learning environment on students' academic performance

Regarding the number of correct answers in the *quiz*, the first academic performance indicator, the number of accesses to the virtual learning environment, was positively correlated with it (Figure 1). Participants who took the *quiz* more than once showed an increased value in this indicator - the
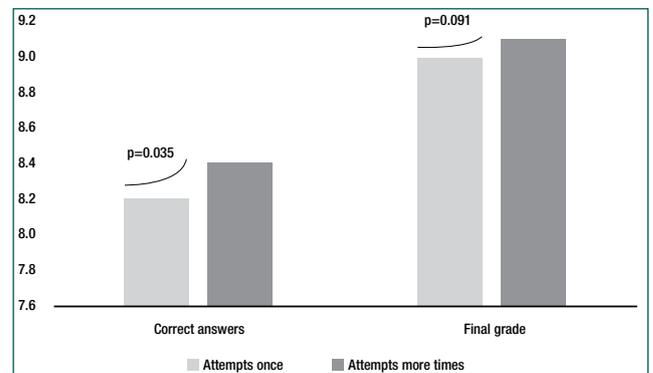

Figure 2. Number of attempts in the *quiz* correlated with the number of correct answers and the final grade in the course

median of those who undertook a single attempt was 8.2, and those who undertook two or more attempts was 8.4 (Figure 2).

The number of access to the virtual learning environment, materials accessed, and mandatory tasks performed positively correlated with the final grade in the course. This indicator differed between students who took the *quiz* or not (median of 9.1 for those who adhered to the *quiz* and 8.2 for those who did not; p=0.000).

Considerations on indicators and variables adopted

The number of correct answers in the *quiz* (performance indicator 1) did not make up the final grade (performance indicator 2), and the two performance indicators correlated positively. Furthermore, the number of accesses to the virtual learning environment was positively correlated with the variables number of materials accessed, number of *quiz* attempts, and number of mandatory tasks performed (Figure 3).
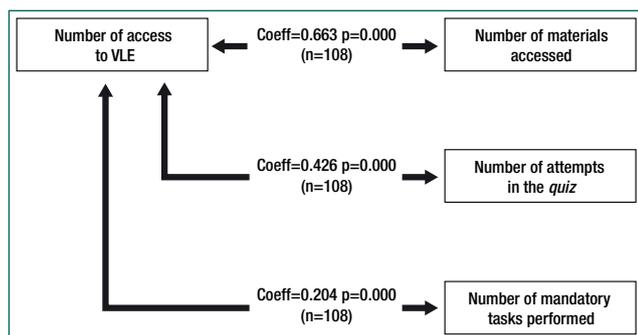
VLE - Virtual Learning Environment; Coeff - Coefficient

Figure 3. Correlation between the number of accesses to the virtual learning environment and other variables considered in the study

Discussion

Regarding the study limitations, the possible bias related to the mandatory tasks that made up the *corpus* of criteria for the student's final grade is highlighted, which certainly culminated in a positive correlation between the performance of mandatory tasks and the final grade. Another limitation concerns the researchers' reflexivity. Despite being a quantitative study, the fact that everyone is involved, directly or indirectly, in the development of the course may have raised biases related to the direction of the discussions held. In this sense, it is worth noting that an external member was invited to assess the final version of this article to reduce possible biases.

Concerning the adoption of the final grade in the course as the main indicator of academic performance to analyze the possible influence of the use of the virtual learning environment in the teaching of comprehensive care, it also configures, in a way, a limit to be considered, as it does not allow us to assess whether there has really been a change in the development of critical training and in the competence of comprehensiveness itself. The results presented here are centered on the potential of using the virtual learning environment for the feasibility of different teaching strategies, with a view to the better achievement of students in relation to the knowledge and practices that permeate comprehensive care.

The results showed that access to the virtual learning environment reflected both the number of materials accessed and mandatory tasks performed, and *quiz* attempts. The positive correlation between these variables reinforces the relevance of accessing the virtual learning environment as the main element of analysis in relation to the different resources accessed by the student remotely. Second, the fact that the two academic performance indicators are also positively correlated suggests the feedback of both, and that the outcome variables were legitimate in relation to the proposed object of study.

The hypothesis that students who used the virtual learning environment (*e-Disciplinas*) more often had better academic performance in a course on the comprehensiveness of health care in their first year of undergraduate course was confirmed in the present study. According to the considered outcomes, the students who had the highest final grade in the course were the ones who accessed the virtual environment the most. This result corroborates that of previous studies on the use of digital technologies in nursing education, which have shown the positive influence of such resources on the performance and learning of students in this area in relation to different themes.[7,13-18]

On the other hand, such results reflect the possible factors related to the use of the virtual learning environment, which, in fact, can potentially influence students' academic performance. In this sense, three main aspects stand out. The first concerns the diversification of available materials, which makes it possible to meet the demands of different learning styles for which students have a predilection.[19] For some students, visual and schematic resources can favor the assimilation of contents. For others, more traditional sources such as texts and exercises play the same role. Also, regardless of the student's preference, the possibility of moving between one didactic resource and another can make learning more flexible and fluid.[8,13]

The second aspect concerns the security provided by the availability of materials from reliable sources. The professors ensured a certain sorting of the material to be made available, favoring students, especially in the first year, in relation to direct contact with scientifically grounded, relevant information, in fact, focused on the content addressed.[20]

How resources are made available in the virtual learning environment concurrently with on-site activities and in chronological order also provides a dynamic and coordinated systematization of the entire course, emphasizing essential content for assuming the proposed skills.[19]

Other meanings have been attributed to the successful use of this technology in nursing education. Specifically, in clinical teaching, the power of visual resources provided by the virtual learning environment is highlighted, reducing the *gap* between theory and practice.[2,4,17,18] Contextualizing this panorama to the theme of comprehensiveness of health care, this question is questioned, considering that the feasibility of audiovisual resources for this theme does not necessarily provide a glimpse of a nursing procedure itself. However, it can broaden the student's perspective on the subject, enabling a more fruitful reflective process through documentaries, interviews, and films. In any case, the relevance of visual resources is inferred as an important element of the virtual learning environment.

Regarding the final grade as an indicator of academic performance, the results suggest that both the participants who adhered to the *quiz* and those who had the highest number of correct answers obtained higher grades in the course, even in the case of an elective activity. The *quiz* is characterized as a review activity. When performing it, the students revisited content later covered in the tests and, certainly, became aware of possible materials that they should review in greater depth in their individual studies.

The importance of review activities has been highlighted by previous studies, which indicate that they help to understand the content and indicate to the student the points that need further study, alternative reasoning, and improvement.[10,13,21] Such activities help the students to take control of the teaching-learning process, as they enable them to validate acquired knowledge and, if necessary, restructure their own learning process.[10,13,21]

Another point to be highlighted in relation to the *quiz* is its playful character, given its proposal for scoring based on correct answers and the possibility of new attempts in a similar way to *games*. The

result of this study corroborates that of previous works, which highlight the potential of strategies with such characteristics in the teaching-learning process.[4,22] The *quiz* adds both a playful character and very objective criteria. This may have been decisive in relation to a more reflective theme than procedural, as in comprehensive health care.

It was also identified that students who took the *quiz* more than once had more correct answers, but not necessarily a better final grade in the course. A possible explanation for this result is the fact that students who took the *quiz* more than once became more familiar with the questions and/or had more time to reflect on the possible answers and may not necessarily have used the "errors" of the previous attempts as a motto for study and access to the materials and contents taught. This result points out the limits of the multiple-choice questions both in relation to the possible interpretation bias on the part of each student and the parameters of reliability and validity required for their elaboration.[9,22]

The *quiz* is a very important strategy, largely for its playful nature and for contributing to the diversification of materials available to students. In the case of the theme in question, such diversification adds complementarity to the multiple reflections necessary to encompass its complexity.

The completion of mandatory tasks was positively correlated with the final grade, and, in this regard, it is worth pointing out that these activities, when performed in their entirety, added up to one point in the final grade in the course, which would explain the fact that the students who performed these activities have obtained higher grades compared to those who did not perform them.

In general, the present study results corroborate the importance of using multiple resources in the virtual learning environment to support the teaching and learning process, especially in courses addressing complex themes, such as comprehensive healthcare with first-year students. Such outcomes reinforce its potential to encourage students to be more active and have access to teaching materials and diversified activities, increasing the chances of understanding the content and being responsible for planning such a process.[2,3,8] Besides, these re-

sults corroborate the assertion that different sources of knowledge and teaching strategies help in awakening a more critical, reflective, and investigative state, as well as in the development of skills that are more contextualized to the reality of the population[2,3,8] – aspects that are essential for teaching the theme in question.

The exclusive use of virtual technologies for teaching the health area is permeated by reservations, such as the impossibility of training practical skills and exercises related to manual dexterity and the different nuances of the interpersonal relationship; the limited interaction between students, other colleagues, and professors, essential for the development of skills for interdisciplinary teamwork; the possible lack of technological material resources on the part of some students; the little consideration of the specificities of each student and the feasibility of theoretical content dissociated from the context of practice and the world of work.[1,2,17] However, the use of the virtual learning environment, as long as it is based on good planning and made viable as one of the components of the curricular process, can improve the dissemination of content that is also more reflective and transversal, such as comprehensiveness, especially in first-year courses. The availability of resources through the virtual learning environment makes the content more attractive, providing students with different ways to improve their learning process[8,23]. It appears that this possibility operates to teach different themes.

Conclusion

The use of the virtual learning environment as support in a course on the comprehensiveness of health care proved to be beneficial for improving students' academic performance. The power of such a tool is highlighted at the expense of exclusively traditional methods. Through diversified resources, students certainly expand their repertoire of proactivity and access to information that contributes to the more effective construction of their knowledge. Also, the possibility of mixing entertainment and study makes the teaching-learning process more stimulating and effective,

being an ally for nursing education, especially in first-year courses. Choosing a method always implies selecting data and interpretations, with a certain spectrum limit, in terms of possible conclusions. In this sense, for future studies, the use of other designs is recommended, including the students' perception of using the virtual learning environment in the teaching process. Still, the parameters that the study suggests as decisive in relation to better student performance corroborate those of previous research on the use of a virtual learning environment for other themes. Therefore, additional studies are also needed to understand possible subjective factors, which may have some specificity regarding the most likely strategies to increase the assimilation of the content of certain themes.

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Collaborations

Ferreira DM, Oliveira JL, Barbosa NG, Lettiere-Viana A, Zanetti ACG, and Souza J contributed to the project design, data analysis and interpretation, article writing, relevant critical review of the intellectual content, and approval of the final version to be published.

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