



ORIGINAL ARTICLE

Neonatal resuscitation virtual training course: Use of an educational platform by medical students at a public university in Peru



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Abstract

Introduction: Satisfactory performance in Neonatal Resuscitation requires continuous training, and several technologies can enhance its scope. This study was carried out to evaluate the use of an educational platform by medical students in a Neonatal Resuscitation virtual course.

Materials and methods: Descriptive study with the data available on the Neonatal Resuscitation virtual course platform, evaluating the use of a population corresponding to the total number of undergraduate Medicine students from the Universidad Nacional Mayor de San Marcos (UNMSM) who enrolled as students to take the Paediatrics course in the last year of their studies during the years 2018 and 2019 in Lima, Peru.

Results: Data from 379 sixth-year medical students in the 2018-I, 2019-I, and 2019-II semesters were included. Students entered the virtual course an average of 23 days before taking their online exam, and the average theory review time in the virtual system was 120 min. Students with outstanding performance in their scores completed 2 virtual exams, but there was no difference in the other characteristics.

Conclusions: The sequence developed in the Neonatal Resuscitation virtual course, which begins with "learn, see, and practice", offers a greater capacity to retain the knowledge and skills acquired. The virtual offer of the theoretical component of Neonatal Resuscitation allows the use of innovative tools that make it possible to achieve a high performance of medical students when completing the virtual course of Neonatal Resuscitation.

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PALABRAS CLAVE

Asfixia neonatal;
Reanimación
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Educación médica;
Estudiantes de
medicina;
COVID-19

Curso virtual de entrenamiento en reanimación neonatal: Uso de una plataforma educativa por estudiantes de medicina en una Universidad pública del Perú

Resumen

Introducción: El desempeño satisfactorio en reanimación neonatal requiere entrenamiento continuo y diversas tecnologías pueden potenciar su alcance. Este estudio se realizó con el objetivo de evaluar el uso de una plataforma educativa por estudiantes de medicina en un curso virtual de Reanimación Neonatal.

Material y Métodos: Estudio descriptivo con los datos disponibles en la plataforma de cursos virtuales de Reanimación Neonatal, evaluando el uso de una población correspondiente al total de estudiantes de pregrado de Medicina de la Universidad Nacional Mayor de San Marcos (UNMSM) que se inscribieron como estudiantes para cursar el curso de Pediatría en el último año de sus estudios durante los años 2018 y 2019 en Lima, Perú.

Resultados: Se incluyeron datos de 379 estudiantes de 6to año de Medicina en los semestres 2018-I, 2019-I y 2019-II. Los estudiantes ingresaron al curso virtual un promedio de 23 días antes de realizar su examen en línea, y el tiempo promedio de revisión de teoría en el curso virtual fue de 120 minutos. Los estudiantes con desempeño sobresaliente es sus puntajes completaron dos exámenes virtuales, pero no hubo diferencia en las otras características.

Conclusiones: La secuencia desarrollada en el curso virtual de Reanimación Neonatal, que inicia con "aprender, ver y practicar", ofrece una mayor capacidad para retener los conocimientos y habilidades adquiridas. La oferta virtual del componente teórico de reanimación neonatal permite continuar con el uso de herramientas innovadoras que posibilitan lograr un alto desempeño de los estudiantes de medicina al completar el curso virtual de Reanimación Neonatal.

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Introduction

The simulation with scenarios improves the learning and performance of undergraduate and graduate students in health.¹⁻³ For training in Neonatal Resuscitation, frequent training practices at low doses have a better effect than sporadic exercises at high doses.⁴ Declining knowledge and skills acquired to perform successful Neonatal Resuscitation are significant barriers to successful training programs and could affect neonatal mortality in low- and middle-income countries.⁴ Likewise, continuous training and structured practice can help. However, more research is still needed to implement and evaluate strategies to improve retention and performance in the classroom and clinical care.⁵⁻⁷

The performance in Neonatal Resuscitation observed in undergraduate and even postgraduate health sciences students is not always satisfactory.^{8,9} In a study published in 2007 with 640 applicants for medical residency programs in Brazil, the interviewees' performance was relatively poor.⁸ In another study published in 2015, based on a small sample of health professionals and students from 8 countries in Latin America and the Caribbean,⁹ it was found that the quality of neonatal maternal care and the competence of the people evaluated require substantial attention.

At the Universidad Nacional Mayor de San Marcos, the Virtual Education Office (VEO-UNMSM) began its activities in 2008 to facilitate, develop, and supervise the use of the Virtual Classroom with projection to the academic community in general. The VEO-UNMSM implemented more than

3000 virtual classrooms at the undergraduate level and more than 800 in the School of General Studies, with more than 25 000 under- and postgraduate users from 14 faculties.¹⁰ However, in an evaluation carried out on 81 professors from the Faculty of Medicine in 2014 and 2015, it was observed that most UNMSM Medicine professors use Information and Communication Technologies (ICT) in their classes, although teachers also expressed a lack of training, particularly in the design of virtual classrooms.¹¹

Since 2018 until 2020, the curriculum for Paediatric undergraduate medical training at the Universidad Nacional Mayor de San Marcos has included teaching Neonatal Resuscitation theory through a virtual platform technologically based at the VEO-UNMSM. The practice of Neonatal Resuscitation is also carried out in workshops by professors specialised in Neonatology in 3 hospitals and a simulation centre in the central headquarters of the San Fernando School of Medicine. However, the use and performance of medical students who took these subjects in virtual classrooms are unknown.

In the current context, trainers and trainees require new strategies to prevent the spread of COVID-19. Distant training courses can comply with biosafety protocols through the use of information and communication technologies,¹² tele-simulation,¹³ or self-directed videos.¹⁴ These alternatives offer better possibilities to minimise the transmission of the virus but mainly to increase the opportunities of training a more significant number of participants in different geographical locations.

The objective of this study was to evaluate the use of virtual methodologies for teaching Neonatal Resuscitation during the years 2018–2019 during the undergraduate Paediatrics rotation, as well as to assess their possible contribution to improving access to quality teaching for medical students in their last year of training at UNMSM.

Material and methods

Evaluation instrument

The research was carried out with data registered in the virtual platform, coordinating with the computer support office and ensuring the anonymous analysis of the data. A data record prepared to avoid the personal identification of the participants was used. The de-identification process included the use of codes that allow anonymous analysis.

The reference population for the study corresponds to the total number of students of the Medicine career of the Universidad Nacional Mayor de San Marcos who studied the subject of Paediatrics in the last year of their training, during the years 2018 and 2019. According to the syllabus, the students were distributed in groups and venues according to surnames, in alphabetical order.

We performed a non-probability sampling for convenience. The inclusion criteria were: (1) To be enrolled in the Paediatrics undergraduate subject in 2018 and 2019; (2) do not be an exchange student; (3) to have taken the final theoretical exam of the virtual (online) and practical (in-person) modality course in their respective assigned hospital.

Evaluation of the virtual platform

In the subject's study plan, the theoretical component's qualification was established as a grade greater than or equal to 15 (approved) on a vigesimal scale or greater than or equal to 17 (outstanding) on the same scale. Up to 2 attempts are allowed to pass the online exam. The evaluation of the use of the virtual platform was carried out by counting the time registered in the course and the resulting grades. The assessment of the student's performance in the virtual system was carried out by measuring the record of time in the study and the resulting qualifications in theory (online evaluation) and the practical grade (qualified by their teachers, in person at their respective headquarters).

The online neonatal resuscitation exam was considered a prerequisite for practice, and it was completed after reviewing neonatal resuscitation theory and interactive exercises available in the virtual classroom. The theoretical information was presented in a successive sequence for learning, with stages called A, B, C, and D, where each step represents progressive difficulty levels in Neonatal Resuscitation. The online exam was a 20-question multiple-choice exam with only 1 possible answer. Students had up to 2 opportunities to pass with more than 75%.

The evaluation of the practice was a note consigned by each teacher to evaluate the performance of the group of students who were in-charge on the day of their training. A uniform practical evaluation was carried out on only some students, and each teacher evaluated their students in a

particular way because, in those years, there was no specific rubric for it.

Sample size

The population corresponds to the total number of UNMSM undergraduate Medicine students who enrolled as students to study Paediatrics in the last year of their careers. In total, 379 students enrolled between 2018 and 2019 participated.

Statistical analysis

Descriptive analysis included means and standard deviations for quantitative data or percentages and confidence intervals for categorical variables. The statistical significance criterion was 5%. Robust variance Poisson regression was performed to examine the prevalence associated with a high final student grade. A score greater than or equal to 17 on the vigesimal scale was considered outstanding. Poisson regression was used because it provides prevalence ratios as effect estimates and is suitable for analysing dichotomous outcomes in cross-sectional studies.¹⁵ The Stata version 17 statistical program was used for the analyses.¹⁶

Ethical considerations

Informed consent was not requested because the analysis was based on secured data registered on the educational platform. The project was evaluated and approved by the Faculty of Medicine Ethics Committee of the UNMSM (Act of evaluation, study code No. 0111).

All the procedures of this study preserved the integrity and fundamental rights of the people under investigation under the guidelines of good clinical practices and ethics in biomedical research. The confidentiality of the data obtained is guaranteed.

General objective

To evaluate the use of an educational platform and the performance of the last year of Medicine student in the virtual course of Neonatal Resuscitation.

Specific objectives:

- Evaluate the use of an educational platform by students in their last year of Medicine in the virtual course on Neonatal Resuscitation.
- Evaluate students' performance in their last year of Medicine in the virtual course on Neonatal Resuscitation.

Hypothesis:

- An educational platform allows the continued use of its didactic tools and high performance of the students of the last year of Medicine in developing the virtual course of Resuscitation.

Results

We analysed the data of the virtual Neonatal Resuscitation course carried out by 379 sixth-year students of Human Medicine at UNMSM between 2018 and 2019. In total, 219

men and 160 women enrolled to take their studies in the semesters 2018-II, 2019-I, and 2019-II.

During each semester, the students were distributed to carry out rotations of Paediatric visits (linked to the virtual course or not) in different hospital locations: 28 students carried out their paediatric rotation at the Instituto Nacional Materno Perinatal (INMP), 83 students at the Sergio Bernales National Hospital (HNSB), 107 students from the San Bartolomé National Hospital (HNSB), 80 students from the San Fernando School of Medicine (FMSF), and 81 from the National Institute of Child Health (INSN). [Table 1](#) shows the main characteristics of the participants distributed in each teaching location.

On average, students entered the Virtual Course around 12 days ($SD \pm 24$) before taking their first online exam; the average total theory review time in the Virtual Course was 78 ($SD \pm 124$) min per student. The median revision time of the theoretical aspects of the Virtual Course was 62 min for 157 students in the 2018-II semester, 49 min for 108 students in the 2019-I semester, and 46 min for 107 students in the 2019-II semester.

86% of the participants passed the online exam with a score greater than or equal to 15 on their first attempt. Only 47 students obtained a grade lower than 15 in their first exam (12%). The second exam was optionally taken by 158 students, including 46 of the 47 who failed the first. 99% of the students passed the second online exam, and only 2 students scored 13 on this exam. [Figs. 1 and 2](#) show the results obtained by the students who approved, distributed by semester, field, and number of attempts.

[Table 2](#) uses Poisson regression analysis and compares the crude and adjusted prevalence ratios. This table shows some characteristics of the students who obtained a final grade of 17 or more on the vigesimal scale (outstanding). The number of exams taken by the student is the only characteristic that is associated with a high grade ($P < .001$).

Discussion

The virtual training course in Neonatal Resuscitation was offered to 379 students in their last year of Medicine and

allowed their participation in the self-learning of theoretical components, which were later applied in the practical activity component in each hospital setting. The tools and information for learning were available online and could be reviewed according to each participant's personal dedication and information demands. The students studied the theoretical knowledge and were evaluated through virtual exams. Subsequently, the practical activities in each hospital site reinforced this training in Neonatal Resuscitation in person.

The course had restricted availability as an exclusive offer for UNMSM students with a valid enrolment code. However, during the course development, it was possible to include the participation of 2 rotating students, one from Bolivia and the other from Spain, and a student of scientific initiation. Still, to meet the inclusion criteria, the 3 participants' qualifications were excluded from the analysis.

Most of the students evaluated reached a high percentage of approval in the theoretical component during their first online exam after having developed the proposed activities sequentially in the Neonatal Resuscitation virtual course. The determined sequence establishes stages A, B, C, and D, where each presents progressive difficulty levels in Neonatal Resuscitation. Sequential learning is similar to the pedagogy applied in the American Academy of Paediatrics Neonatal Resuscitation Program.¹⁷ The sequence that begins with "learn, see, and practice" establishes a greater retention capacity of the acquired knowledge and skills.¹⁸

At UNMSM, some face-to-face practices at the beginning of the pandemic had to be quickly replaced by virtual activities. For this reason, it was beneficial for some of our teachers to have started this training in previous years. During the COVID-19 pandemic, social distancing and distance learning strategies have been implemented and evaluated in various parts of the world to continue Neonatal Resuscitation training.^{19,20} However, for Neonatal Resuscitation, it is still essential to practice manual skills under supervision in a controlled environment, such as in mannequin simulation centres.²¹

Neonatal Resuscitation training can be more effective if it reinforces knowledge with relevant practical activities and

Table 1 Characteristics of 379 participating students, according to the teaching setting.

Characteristics	INMP	HNSEB	HNSB	FMSF	INSN
	N (%)	N (%)	N (%)	N (%)	N (%)
	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD	Mean \pm SD
Male student	18 (64.3)	49 (59.0)	65 (60.8)	42 (52.5)	45 (55.6)
Female student	10 (35.7)	34 (41.0)	42 (39.2)	38 (47.5)	36 (44.4)
Days of access delay	42.9 \pm 34.4	45.5 \pm 33.2	45.2 \pm 36.2	49.3 \pm 34.9	47.3 \pm 36.1
Minutes of access	70.5 \pm 54.4	62.3 \pm 61.8	88.7 \pm 149	66.1 \pm 54.4	92.6 \pm 186
Days of total usage	40.2 \pm 77.8	20.2 \pm 45.3	22.5 \pm 33.6	20.3 \pm 45.1	24.2 \pm 52.2
Two attempts in exam	11 (39.3)	32 (39.0)	41 (38.3)	31 (38.8)	43 (53.8)
Score in theoretical exam	18.3 \pm 1.5	18.3 \pm 2.6	18.1 \pm 2.3	18.1 \pm 2.6	18.2 \pm 3.2
Score in practical exam	15.4 \pm 3.1	15.4 \pm 2.0	16.1 \pm 2.9	16.6 \pm 0.6	15.9 \pm 2.6
Final score \geq 15 (up to 20)	27 (96.4)	80 (96.4)	104 (97.2)	79 (98.8)	78 (96.3)
Final score \geq 17 (up to 20)	20 (71.4)	52 (62.6)	75 (70.1)	64 (80.0)	62 (76.5)

Source: Research project data based on information from office of virtual education.

Legend: INMP=National Perinatal Institute; HNSEB= Bernales Hospital; HNSB=Saint Bartolomé Hospital; FMSF=Faculty of Medicine; INSN= National Children's Health Institute.

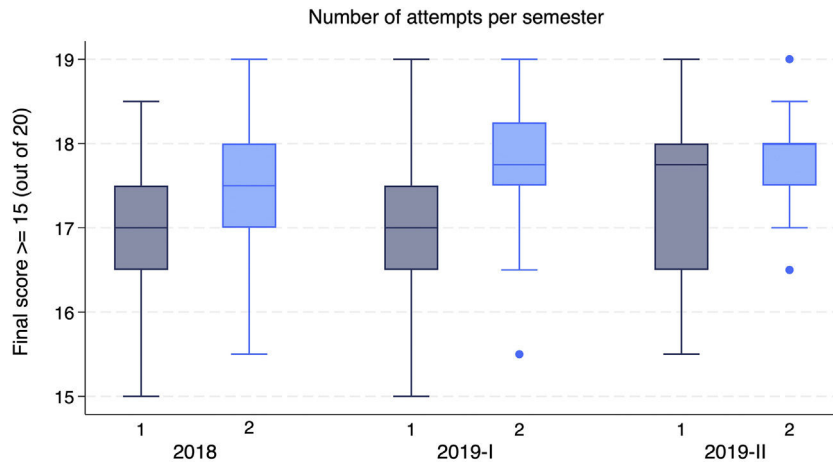


Fig. 1 Final passing score for 368 medical students distributed by semester (2018; 2019-I; 2019-II), and number of attempts (1 or 2).

continuous refresher learning.²² Fortunately, skills learned in a 1-day introductory course can stick around for up to 6 months after training.²³ Furthermore, the use of information and communication technologies can improve the implementation of Neonatal Resuscitation, increasing access to training for personnel who require it.¹² The activities carried out during the virtual Neonatal Resuscitation course showed the importance of having alternatives for distance training, which can be used by undergraduate students but can also be applied to health personnel with effective clinical activity.

Intending to review the use and effectiveness of remote simulation in health education, Yaser et al.²⁴ conducted a review in 2023 by searching 5 databases between 2000 and 2022. They included 29 articles and verified that more than half of the publications on remote simulation arose out of necessity during the COVID-19 pandemic. They verified that the participants accepted remote simulation as an educational modality for distance simulation due to their satisfactory learning experiences. However, it was not possible to

precisely define the effectiveness of learning by this teaching modality. The authors consider that it is still necessary to establish the conditions to obtain a better performance of remote simulation practices.

In a perspective paper published in 2023, Ahn et al.²⁵ offer insight to override common barriers identified and critical lessons learned in developing a cadre of remote facilitators. These authors suggest that the worldwide challenges for optimal remote facilitation include mastering videoconferencing platforms, establishing personal connections, and providing effective oversight of skills practice. Training facilitators to acquire competency with technological platforms may increase effective facilitation and optimise the capacity building of remote facilitators for the effective implementation of remote neonatal resuscitation training.

Teaching neonatal resuscitation is generally performed in face-to-face interaction, but distance education offers technological alternatives with exciting possibilities. Our study evaluated the use of virtual methodologies for the theoretical teaching of neonatal resuscitation to 379

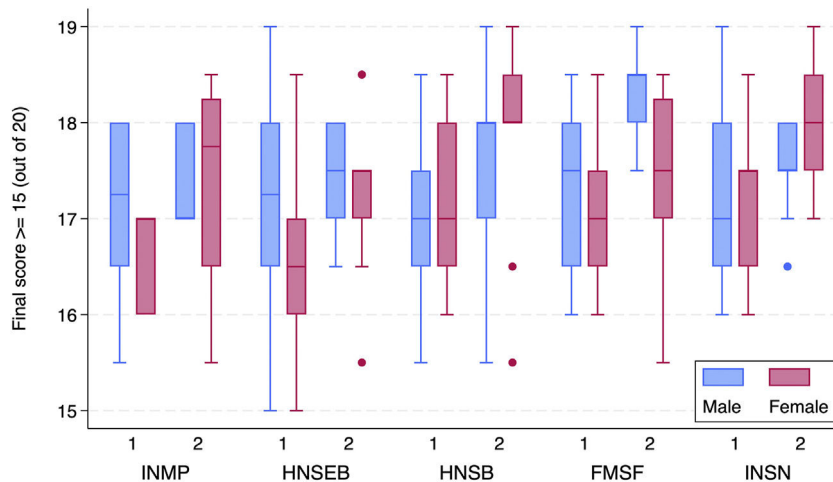


Fig. 2 Final passing score for 368 medical students distributed by hospital setting (INMP; HNSEB; HNSB; FMSF; INSN), and number of attempts (1 or 2). Legend: INMP=National Perinatal Institute; HNSEB=Bernales Hospital; HNSB=Saint Bartolomé Hospital; FMSF= Faculty of Medicine; INSN=National Children’s Health Institute.

Table 2 Factors associated to higher scores in neonatal resuscitation training using distance learning methods.^a

Characteristics	Score < 17 (up to 20)	Score ≥ 17 (up to 20)	Crude PR	P-value	Adjusted PR	P-value
Setting						
INMP	8 (7.6)	20 (7.3)	Reference		Reference	
HNSEB	31 (29.2)	52 (19.1)	0.88 (0.66; 1.17)	.371	0.88 (0.67; 1.16)	.379
HNSB	32 (30.2)	75 (27.5)	0.98 (0.75; 1.28)	.889	0.99 (0.76; 1.27)	.918
FMSF	16 (15.1)	64 (23.4)	1.12 (0.86; 1.45)	.391	1.12 (0.87; 1.44)	.385
INSN	19 (17.9)	62 (22.7)	1.07 (0.82; 1.40)	.607	1.02 (0.80; 1.32)	.852
Sex						
Male student	64 (60.4)	155 (56.8)	Reference		Reference	
Female student	42 (39.6)	118 (43.2)	1.04 (0.92; 1.18)	.521	0.97 (0.86; 1.10)	.673
Delayed start > 30d						
No	47 (44.3)	104 (38.1)	Reference		Reference	
Yes	59 (55.7)	169 (61.9)	1.08 (0.94; 1.23)	.276	1.03 (0.89; 1.18)	.710
Minutes of access > 60						
No	54 (50.9)	154 (56.4)	Reference		Reference	
Yes	52 (49.1)	119 (43.6)	0.94 (0.83; 1.07)	.342	0.94 (0.83; 1.06)	.280
Days of usage > 30d						
No	75 (70.8)	201 (73.6)	Reference		Reference	
Yes	31 (29.2)	72 (26.3)	0.96 (0.83; 1.11)	.582	0.99 (0.85; 1.17)	.962
Two attempts in exam						
No	86 (82.7)	133 (48.7)	Reference		Reference	
Yes	18 (17.3)	140 (51.3)	1.46 (1.29; 1.64)	<.001	1.46 (1.29; 1.65)	<.001

Source: Research project data based on information from office of virtual education.

Legend: PR=prevalence ratios; INMP=National Perinatal Institute; HNSEB=Bernales Hospital; HNSB=Saint Bartolomé Hospital; FMSF=Faculty of Medicine; INSN=National Children's Health Institute.

^a Data was analysed using a Poisson regression model with robust variance estimation.

students in their last year of medicine between 2018 and 2019. Although the practical activities of the course were face-to-face, it was observed that the theoretical teaching of virtual Neonatal Resuscitation offered alternatives to facilitate access to continuous training, which can be used even in conditions of social isolation, such as that observed with the COVID-19 pandemic.

We conclude that the continuous offer of the theoretical component in a virtual Neonatal Resuscitation course allows the use of didactic tools that offer a study sequence by levels of complexity, seeking to achieve outstanding performance in the last year of Medicine students in the Neonatal Resuscitation course.

This virtual course allows the student to train at their own pace, participating according to their expectations and needs to improve their performance in practice with simulators.

Authors' contributions

CAD, MR, and RS conceptualised, designed the methodology and conducted the research. CAD, BSCh, MR, EMOB, and RS analysed the data, wrote the initial draft, and wrote the final version. All authors reviewed the final version and assumed responsibility for the article.

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Ethics

Informed consent was not requested because the analysis was based on secured data registered on the educational platform. The project was evaluated and approved by the Faculty of Medicine Ethics Committee of the UNMSM (Act of evaluation, study code No. 0111).

Conflicts of interest

The authors declare no conflict of interest.

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