Construction and validation of a sepsis simulation scenario: a methodological study*

Construção e validação de um cenário de simulação sobre sepse: estudo metodológico

Construcción y validación de un escenario de simulación sobre la sepsis: estudio metodológico

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ABSTRACT

Objective: To build, validate and test a high-fidelity clinical simulation scenario for sepsis management. **Method:** Methodological study developed in three phases: construction of a simulation scenario using the framework Model of Nursing Training Simulation and protocols established by the Latin-American Sepsis Institute, content validation by nine judges, and scenario testing by two nurses from a hospital institution. Data analysis was carried out through Content Validity Index, with values > 0.90 among the judges being considered satisfactory. **Results:** The simulation scenario was observed to be appropriate and obtained an overall value > 0.90. However, some adjustments to the scenario and the test were performed concerning textual clarity, functionality, and the protocol's pertinence, following the judges' suggestions. **Conclusion:** The validated simulation scenario is expected to be a facilitator instrument for educators and professionals in the permanent/continued education nuclei of teaching and health institutions.

DESCRIPTORS

Simulation; Simulation Training; Patient Simulation; Sepsis; Education, Nursing; Models, Educational.

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INTRODUCTION

Sepsis is a complex syndrome with a high mortality rate. In Brazil, studies have shown that lethality to patients hospitalized in Intensive Care Units approached 55%[1]. Also, 62.4% of patients who were discharged after sepsis diagnosis died or were severely impaired due to sepsis sequelae in the immune system[2].

Studies have shown that nursing students and nurses present deficient knowledge on sepsis[3-4]. Involved professionals need to be cautious, since patient survival depends on early detection. Administration of the first antibiotic dose within the first hour of sepsis may reduce mortality risk in up to 80% in comparison to its administration within the first six hours, which presents a 40% survival rate[5]. Health training and education should thus aim at preparing professionals for risk-free assistance and guaranteeing patient safety.

Nursing training has been through diverse changes[6] and clinical simulation emerges as a promising strategy in the process of teaching and learning. The use of technologies that reproduce scenarios resembling those of practice involve active participation by students and professionals in controlled and realistic environments[7].

Clinical simulations enable the use of resources to provide training in psychomotor, cognitive, and affective skills, stimulating reflexive and critical thinking, clinical judgment, and decision making while avoiding real patients' exposure to danger[7-9]. It also improves knowledge, self-confidence, and learning satisfaction[10].

In Nursing, clinical judgment is an exclusive function of nurses and refers to the interpretation of patients' health demands, identification of priority diagnosis, decision making, improved intervention and reflection on their own attitudes[6,11]. Given the above, a clinical judgment model supported by literature review was developed. It encompasses four features: noticing, interpreting, responding, and reflecting[11].

After the development of the Clinical Judgement Model, an instrument, named Lasater Clinical Judgment Rubric (LCJR), was built to evaluate clinical judgment[12]. This instrument was validated with nursing students regarding the four aspects of clinical judgment proposed by the Clinical Judgement Model[11]. It provides the opportunity of evaluating eleven behaviors in clinical judgment: focused observation, recognizing deviations from expected patterns, information seeking, prioritizing data, making sense of data, calm confident manner, clear communication, well-planned intervention, technical skill, evaluation/self-analysis and commitment to improvement. The scores of the eleven behaviors of clinical judgment refer to the four possible levels of participant development: beginning, developing, accomplished or exemplary.

In Brazil, LCJR has been through a process of transcultural adaptation[13] and subsequent evaluation of its reliability and validity[14]. After this analysis, the instrument Lasater Clinical Judgment Rubric – Brazilian Version was considered satisfactory. These contributions were of utmost importance, for they provided facilitators with the possibility of using a reliable instrument to measure nursing clinical judgment.

Studies show that clinical judgment emerges during the undergraduate course and develop with professional experience and daily practice[6,15]. Other studies point that abilities inherent to the nurse start developing after one to two years of professional practice[16]. Training along with the possibility of reflection was also suggested to contribute to improved clinical judgment[15].

From this rationale, simulation is an efficient strategy for clinical judgment development. Scenarios must however provide that nurses experience realistic situations in a safe environment to subsequently reflect on their actions while not putting a real patient's life at risk.

In this sense, creating the scenario is an utterly important phase in simulation. Its amount of realism depends on the simulation's objective[17], laboratory infrastructure, available resources[7], action complexity[9] and fidelity level[17-18]. Its development requires time and skills. Thus, the availability of evaluated scenarios may contribute to the quality and experience of simulated practice[17,19].

Interest in simulation use has been increasing worldwide. Nevertheless, for contributions to be effective, facilitators are required to have capabilities of setting up and planning scenarios according to participants' knowledge level and the objectives they wish to accomplish[20].

Given this context, the present study had the objective of elaborating, validating, and testing a high-fidelity clinical simulation scenario for sepsis management aimed at nurses and available to be applied to nursing students.

METHOD

STUDY TYPE

This is a methodological study including the following phases: elaboration of a clinical simulation scenario and a test of knowledge on sepsis, content validation by judges, and scenario testing with nurses from a hospital institution.

SCENARIO

The elaboration of the simulation scenario departed from a literature review on sepsis, based on the best levels of evidence proposed by the Latin-American Sepsis Institute (ILAS) and the Surviving Sepsis Campaign (SSC)[21].

Suspicion of sepsis was defined as the signs of Systemic Inflammatory Response Syndrome (SIRS), which include hyperthermia > 37.8°C or hypothermia < 35°C; leukocytosis > 12,000, leucopenia < 4,000 or left deviation > 10%; tachycardia > 90 beats per minute; tachypnea > 20 respirations per minute and organic dysfunction[22].

Nurse decision making was considered to designate the actions proposed by ILAS and SSC named First hour Bundle: performing blood test, cultures, volemic resuscitation and antibiotic therapy[22-23].

The framework Simulation Model for Nursing Teaching/NLN was employed to elaborate the clinical simulation scenario. It comprises seven features described as follows[24]:

Context: this element is the simulation's point of departure, i.e., target public, simulation area, available resources, simulation objective and the participants' previous knowledge;

Background: in this phase, general and specific simulation objectives must be defined, as well as its expected duration and pedagogical framework to be employed;

Design: this element refers to the development of the scenario per se and must be based on the objectives and on competences/skills to be developed. Includes the scenario, its fidelity, complexity of problem resolution, the role of each team member and actors and the clues that lead to the expected objective, as well as briefing and debriefing;

Simulation experience: this phase is characterized by the simulation experience in an interactive, collaborative environment which is suitable for experimentation and centered on learning;

Facilitator and educational strategies: in this point, the simulation must promote a dynamic interaction between facilitators and participants. Facilitators are expected to demonstrate their skills, educational techniques and preparation;

Participant: facilitators must specify each individual's part in the simulated practice so as to avoid competition and strengthen motivation;

Outcomes: this phase refers to the results expected from simulated practice, which might be centered on participant, institution or quality of care provided to the patient.

Data collection

The data collection instrument was built in the program Microsoft Office Word® and included two parts. The first, aimed at characterizing judges, included their education, titration, years of education and experience with simulation or sepsis. The second part was elaborated to evaluate the distributed content in eighteen items related to: title, study material, study material availability, type of simulator, goals, duration of each simulation step, patient history, clues, fidelity, equipment and materials, actions expected in the simulation scenario based on the phases of clinical judgment and debriefing. There were also areas for possible comments and suggestions.

The sample was obtained by convenience through Lattes Platform for Brazil, available on the National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* – CNPq) website. Initially, eleven judges were invited to participate in this research, since for an acceptable agreement rate, i.e., equal or higher than 90%, authors suggest six or more judges[25].

The selected judges were contacted by email and invited to participate in the research as evaluators of the clinical simulation scenario. Judges with expertise on sepsis or simulation which agreed to participate in this research received an Informed Consent Form (ICF) signed by the researcher and the simulation scenario instrument.

The judges were instructed to sign and scan the ICF, while the simulation scenario instrument was evaluated on printed paper. When validation was finished, the instruments and ICFs were returned by email to the researcher.

The judges evaluated the instrument's content, assigning to it values from 1 (irrelevant) to 4 (extremely relevant). This phase took place in July 2018.

Nine judges answered and returned the evaluated instruments within thirty days. Regarding titration, judges included a master's candidate and eight PhDs. Six had previous experience with simulation, two with sepsis and one with both simulation and sepsis. The objectives of content evaluation were the criteria organization, textual clarity, coverage, and pertinence of the elements proposed in this scenario.

Testing the clinical simulation scenario

The clinical sepsis simulation scenario was tested by two nurses, randomly chosen for being part of the target public. One of them was responsible for the sector of institutional quality and the other for the Hospital Infection Control Service (HICS). Such nurses did not partake in the simulation development. They were personally invited by the researcher and, after accepting participation, the nurses were instructed on the test's proposal, and the date for their participation was scheduled. Sepsis study material was sent by email.

The objective of this phase was evaluating clarity of scenario description, simulation components concerning time and functionality adjustments, and the structure of debriefing. The researched adapted the instrument according to changes and suggestions by participants. This phase took place in August 2018.

Data treatment and analysis

The data produced by the judges were inserted into a Microsoft Office Excel® spreadsheet. To analyze both knowledge test and simulation scenario, content validity index (CVI) was employed. The items were represented by a Likert-type scale with scores from 1 to 4, corresponding to irrelevant and extremely relevant, respectively. The score was calculated by the sum of the agreement for items marked with "3" or "4" by the experts (IVC = agreement with scores "3" or "4" / number of questions x 100). The items that received score "1" or "2" were reviewed[25].

To consider the instrument valid, all judges' evaluations were compiled and the mean for the proportion of items they considered relevant was employed (CVI = number of agreements / total number of questions x 100). Values equal to or higher than 0.90 were considered an appropriate agreement index for this instrument[25].

The adjustments to the simulation scenario test deemed necessary by the nurses was first conducted on printed paper and then altered in the original version.

ETHICAL ASPECTS

This study was approved by Universidade Federal de São Carlos' Ethics Committee in Opinion n. 2.729.429 on June 21, 2018, in agreement with Resolution n.466/12 by the National Health Council.

RESULTS

The instrument for collecting data from the simulation scenario is shown in Table 1. The judges evaluated each item regarding its organization, clarity, pertinence, and coverage, assigning them a score ranging from 1 (irrelevant) to 4 (extremely relevant). The items which received score 1 or 2 were altered after the judges' suggestions.

Individual evaluation by the judges is shown in Table 2. The items which received suggestions or evaluation smaller than 90% were reviewed.

Table 1 – Judges' evaluation of simulation scenario organization, clarity, appearance, and pertinence and each item's CVI – São Carlos, SP, Brazil, 2018.

Evaluated items	Judges / Agreement								CVI (%)
	O		C		A		P		
	Yes	No	Yes	No	Yes	No	Yes	No	
Scenario title	9		7	2	9		9		94%
Previous study material	9		9		9		9		100%
Online material availability	7	2	7	2	8	1	8		83%
Simulation site – laboratory	9		9		9				100%
Kind of simulator – simulated patient	9		8	1	8	1	8		92%
Primary objectives	9		9		9		9		100%
Secondary objectives	8	1	7	2	8	1	8	1	86%
Simulation duration	9	1	9		9		9		100%
Patient history	8	1	8	1	8	1	8	1	89%
Provided clues	8	1	8	1	8	1	8	1	89%
Scenario fidelity – equipment and material	8	1	8	1	8	1	8	1	89%
Scenario fidelity – actors	9		9		9		9		100%
Briefing	7	2	7		7	2	7	2	78%
Actions performed by the nurse based on clinical judgment	9		9		9		9		100%

Table 2 – Individual judge evaluation regarding simulation scenario organization, clarity, appearance, and pertinence– São Carlos, SP, Brazil, 2018.

Judges	Organization	Clarity	Appearance	Pertinence
Judge 1	100%	100%	100%	100%
Judge 2	100%	100%	100%	100%
Judge 3	89%	78%	94%	94%
Judge 4	100%	100%	100%	100%
Judge 5	94%	94%	94%	94%
Judge 6	94%	94%	94%	94%
Judge 7	100%	100%	100%	100%
Judge 8	72%	61%	67%	72%
Judge 9	100%	100%	100%	100%

Figure 1 includes the compilation of the results of all judges' evaluations concerning each criterion, i.e., organization, clarity, pertinence, and coverage. The instrument was thus considered appropriate for application.
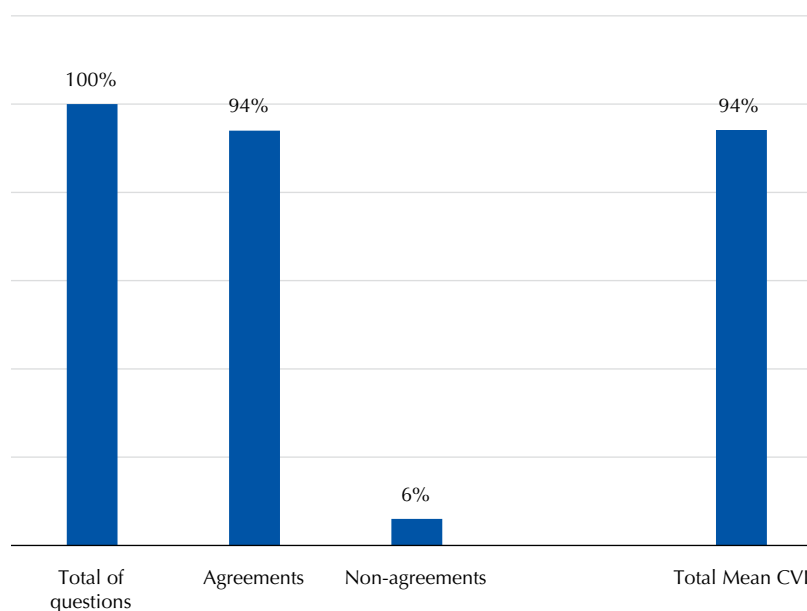

Figure 1 – Evaluation of the instrument for scenario simulation – São Carlos, SP, Brazil, 2018.

The results of the judges' evaluations were significant for modifying the simulation scenario. Text reviews and changes to some items led to the final version of the simulation scenario, as shown in Chart 1.

Chart 1 – Elements of the sepsis simulation scenario – São Carlos, SP, Brazil, 2018.

1. *CONTEXT*
Scenario title: Nurses' actions towards sepsis management
Public: Nursing students and nurses
Pre-simulation knowledge proposal Material to be employed - National and international literature, as well as the theoretical framework by Latin-American Sepsis Institute – ILAS. Discussion board: Social networks
Simulation modality: High-fidelity scenic simulation
Simulation site: First aid station scenario with three areas: nursing area, medical office and waiting room
Necessary material *Nursing area*: stretcher, gloves, alcohol gel, safety glasses, sphygmomanometer, stethoscope, thermometer, antibiotic, serum support, physiological serum, macro-drip infusion set, two-way infusion set connector, flexible catheter for venous puncture, micropore, cotton, gauze, pen, computer, room identification, glasses for exam and culture collection *Medical office*: Table, chair, medication prescription, pen, room identification and admission paperwork in the entrance *Waiting room*: Chairs and area identification
Type of simulator Actors: Nursing technique to aid in procedures pertinent to this category, the wife, the patient, and the physician Patient should have: identification wristband, moulage technique for identifying the operative wound with a bandage smeared with yellowish secretion.
Simulation proposal: Instructional
2. *BACKGROUND*
Objectives General • Precociously identifying sepsis risk and quick decision making Specific • Demonstrate clinical judgment for the recognition of sepsis through information collection and specific physical exam; • Interpreting results, suspecting sepsis and opening a protocol; • Prioritizing and supervising immediate treatment.

…continuation

Time
Prebriefing – 10 days
Briefing– 5 minutes
Scenario – 10 minutes
Debriefing – 30 minutes

3. DESIGN

Information contained in the Admission form:
Thirty-five years old patient with a record of controlled type 1 diabetes followed-up by an endocrinologist, taking regular insulin 10 UI after lunch and NPH insulin SC 15 UI in the morning and 10 UI in the evening. Admitted to the first aid station accompanied by wife who reports her husband was hospitalized for two days due to appendix surgery and was discharged three days ago. He has been experiencing abdominal pain and lowered urine volume since yesterday. He woke up today with fever, abdominal pain, accelerated respiration, operative wound secretion, accelerated heart rate and drowsy.
VS: BP: 80x50 mmHg (MBP 60 mmHg); RR – 25 irmp; Glycemia – 250 mg/dl; Temperature – 38ºC; HR – 125 bpm.
The patient must be classified as yellow and may wait for up to one hour.

Clues provided by actors and which are contained in the admission form:
Hypotension 80x50 mmHg (MBP 60 mmHg)
Tachypnea – 25 irmp
Hyperglycemia – 250 mg/dl
Fever – 38ºC
Oliguria – < 0.5 mL/kg/hour
Tachycardia – 125 bpm
Mental confusion - Glasgow 14

Medication prescription
1- PS 0.9% 2100ml EV clamp open now
2- Amoxicillin + clavulanic acid 1g solved in PS 100 ml EV now and every 8 hours or in accordance with the institutional protocol
3- Conducting blood exam and cultures

Fidelity
High-fidelity scenic simulation
Patient and wife must be professional actors to involve professionals emotionally during assistance

4. SIMULATION EXPERIENCE
Participants' report on debriefing or validated instruments

5. FACILITATOR AND EDUCATIONAL STRATEGIES

Briefing
Two nurses will be involved in the simulation scenario. One is responsible for the unit and the other is regarded as a *trainee*
The scenario is presented as follows: thirty-five years old patient accompanied by wife, has been through an at-risk admission and has been waiting for consultation in the waiting room for forty minutes. The physician is in an emergency and may be requested while on the scenario. If conducting exams is necessary, simply mention that the exams were conducted and which ones. If it is necessary to provide medication or measure VS, this may be requested to the nursing technician. You may not request help from outsiders, only from those in the scene. Talk louder so that everyone can hear. Show them the scenario, its equipment, its functionalities, the nursing technician, and the physician. Time for adaptation.

Debriefing
In this phase, it will be possible to identify one of the steps of clinical judgment, which is "**Reflecting**". The following questions may be helpful in this moment:
Emotional stage: How do you feel assisting this patient?
Descriptive stage: May you describe the clinical condition you have found?
Evaluative stage: Which positive actions did you perform?
Analytical stage: What would you do if you had another opportunity?
Conclusive stage: What have you learned from this experience in your clinical practice?

6. PARTICIPANT
Participants must execute a high-complexity action through the identification of the three aspects of clinical judgment "observing, interpreting and answering"

Observing:
Collecting information from the wife and the admission form

Interpreting:
Conducting a physical exam specific to the abdomen
Verifying VS values in the admission form
Associating the signs of tachycardia, mental confusion, reduced diuresis, fever, tachypnea, hyperglycemia and hypotension with SIRS manifestation and organic dysfunction
Raising sepsis suspicion

Responding
Opening sepsis protocol
Reporting to the physician
Conducting blood exam and cultures collection
Requesting antibiotic administration immediately after culture collection

7. OUTCOMES – the outcomes expected for the participant

Clinical judgment
Facilitator: the facilitator must follow each step of clinical judgment through a checklist composted of: investigating, interpreting and understanding data, prioritizing and planning actions, restarting with reflection on the practice
Participant: clinical judgment by the nurse may be evaluated through the instrument Lasater Clinical Judgment Rubric – Brazilian Version.

This study's limitations include the difficulties experienced by judges in providing an answer for the simulation scenario instrument before the deadline, which resulted in convenience sampling.

DISCUSSION

Realistic simulation is an innovative methodology in the health area that promotes integrating theory and practice in a safe environment, stimulating active engagement by its participants and improving the construction of competence and critical thinking[26].

Simulations must be elaborated as a project. Time spent in its development must thus be longer than that of its execution[17]. The simulation steps, such as projecting, testing, implementing, and evaluating, must be supported by organized and systematized tools to elucidate the goal to be achieved and the results expected from the learning situation.

Elaboration, validation, and test of the simulation scenario regarding sepsis may support further training for students and nurses regarding this theme. A study has shown that final year nursing students have little knowledge of sepsis. The authors say that future nurses need to know this syndrome to identify it early and intervene quickly[27], especially when it comes to public hospitals.

A study has shown that septic patients hospitalized in Brazilian public hospitals present higher mortality than those hospitalized in private hospitals. The reason for such is supposed to be related to late recognition. Thus, investing in training to improve sepsis recognition and early diagnosis must be a crucial goal for the improvement of care provided to patients with sepsis in public institutions[28].

The elaborated scenario was guided by the framework Nursing Teaching Simulation Model and was demonstrated to be appropriate in its construction process, corroborating other findings[19,29]. These structured and systematized scripts are a support basis for the development of this methodology and help facilitators, educators, and researchers in conducting the simulation.

Studies show that, when simulation is well-planned and meaningful to its participants, it raises their level of confidence and self-efficacy, reinforces knowledge, improves self-care skills, communication and interpersonal relations, developing critical thinking and clinical judgment while promoting empathy and reflection on one's own actions[20,29].

Scenario validation is essential for guaranteeing the quality of simulated practice[8,19,29], ensuring the accomplishment of a desired goal[19].

Although simulation is mostly developed with nursing students[6,20,26], this instrument was developed for simulation with nurses in an educational institution. It may nonetheless apply to nursing students.

Facilitators must be familiar with their target public to consider their level of knowledge and previous experiences.

The scenario test with nurses was shown to be appropriate concerning time. However, some changes regarding functionalities were reviewed and altered. The tests are important for the adjustments regarding materials and human resources as well as duration[19].

As contributions to Nursing and Health, the usage of a validated scenario on sepsis, aimed at quality education for students and nurses, was particularly remarkable.

CONCLUSION

The scenario named "Nurses' actions for sepsis management" was built from protocols based on the best levels of evidence, validated by sepsis and simulation experts, and tested with nurses. This research thus described the importance of these phases in building a simulation scenario for effective learning.

All suggestions from the judges were carefully analyzed and implemented according to the scenario objective, the target public, and the results to be achieved. The adapted simulation scenario was shown to be appropriate, obtaining a > 0.90 value from judges.

This instrument is expected to be a facilitator for educators and professionals in permanent/continued education centers in health institutions, aimed at training nurses and nursing students concerning sepsis management.

RESUMO

Objetivo: Construir, validar e testar um cenário de simulação clínica de alta fidelidade para o manejo da sepse. **Método:** Estudo metodológico desenvolvido em três fases: construção do cenário de simulação utilizando o *framework* Modelo de Simulação de Ensino em Enfermagem e os protocolos instituídos pelo Instituto Latino Americano de Sepse; validação do conteúdo por nove juízes; e o teste do cenário por dois enfermeiros de uma instituição hospitalar. A análise dos dados se deu pelo Índice de Validade de Conteúdo, considerando-se adequado um valor > 0,90 entre os juízes. **Resultados:** O cenário de simulação mostrou-se apropriado, obtendo valor geral > 0,90. No entanto, foram feitos alguns ajustes no cenário e no teste no que tange à clareza da redação, às funcionalidades e à pertinência de protocolos, conforme sugestão dos juízes. **Conclusão:** Espera-se que o cenário de simulação validado seja um instrumento facilitador para docentes e profissionais de núcleos de educação permanente/continuada de instituições de ensino e saúde.

DESCRITORES

Simulação; Treinamento por Simulação; Simulação de Paciente; Sepse; Educação em Enfermagem; Modelos Educacionais.

RESUMEN

Objetivo: Construir, validar y probar un escenario de simulación clínica de alta fidelidad para el manejo de la sepsis. **Método:** Estudio metodológico desarrollado en tres fases: construcción del escenario de simulación utilizando el *framework* del Modelo de Simulación de Enseñanza de Enfermería y los protocolos instituidos por el Instituto Latinoamericano de Sepsis; validación del contenido por nueve jueces; y prueba del escenario por dos enfermeras de una institución hospitalaria. Los datos fueron analizados por el Índice de Validez de Contenido, considerando un valor > 0,90 entre los jueces. **Resultados:** El escenario de la simulación fue apropiado, obteniendo un valor global > 0,90. Sin embargo, se hicieron algunos ajustes en el escenario y la prueba en cuanto a la claridad de la redacción, la funcionalidad

y la pertinencia de los protocolos, como sugirieron los jueces. **Conclusión:** Se espera que el escenario de simulación validado sea una herramienta facilitadora para los profesores y profesionales de los centros de educación permanente/continuada de las instituciones de educación y salud.

DESCRIPTORES

Simulación; Entrenamiento Simulado; Simulación de Paciente; Sepsis; Educação em Enfermería; Modelos Educacionales.

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