

## The Magical World of Thermoregulation: An Educational Project for Practical Nursing Students

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### Abstract

This project analyzes the application of an evidence based learning experience in collaboration with a Practical Nursing (PN) program on thermoregulation. The needs assessment ascertained that thermoregulation had been previously covered; however, it is a concept in which students continue to struggle. Therefore, the concept of variance in thermoregulation must be reviewed before graduation. The review activity that was developed featured an escape room simulation and online quiz. This learning experience integrated elements of constructivist and cognitive theories as well as a flipped classroom design. The post implementation evaluation indicated the design was effective in accomplishing objectives. Grasping this material enables skilled care of patients and the learning of future nursing students.

*Keywords:* cognitivism, constructivism, escape room, flipped classroom, practical nursing students, thermoregulation

### The Magical World of Thermoregulation: An Educational Project for Practical Nursing Students

An evidence based innovation education project was developed in collaboration with Practical Nursing (PN) faculty. This learning project was an in depth review of thermoregulation for PN students in their final semester. During the needs based assessment, current PN faculty stated that this is an area in which students struggle, thus essential for nursing students to understand prior to graduation.

Rapid nursing intervention in unstable thermoregulation situations is critical for optimal patient survival outcomes.

Accumulating climate changes are increasing the world's surface temperatures which heighten the severity of heatwaves. With this temperature intensification comes an inflated risk of heat related injury and mortality for the general population, although the elderly in particular are at higher risk. In addition, heat related illness is the leading cause of death among athletes (O'Conner & Casa, 2019). Swift recognition of signs and symptoms of an imbalance, combined with aggressive early mediation, is essential to lessen morbidity and mortality (Ruble et al., 2021). Hypothermia and hyperthermia related hospital health care costs covering one year were \$36 million and \$98 million, respectively (Schmeltz et al., 2016).

### Description of Innovation

Students had received a prior introductory lecture on thermoregulation in their first semester, but this project's recorded flipped classroom lecture leading up to a simulation was a more in depth review for them. Students watched the lecture with slides at home, via the learning management system, before arriving at the lab. The lab simulation activity was set up to strengthen their memory and retention of information. Cognitivism and constructivism were the driving learning theories for this project and linked new information to prior knowledge. The follow up online quiz evaluated knowledge of material learned.

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## Education Theories

For this project, students must review the more complex principles from the lecture and break that information down to maneuver through the lab simulation. Cognitivism is ideal for problem solving, where complex information must be broken into smaller parts. Instruction and memory are vital in cognitivism, and ideas presented should be meaningful to the learner (Clark, 2018). Constructivism requires the design of a learning environment that will allow students to feel supported and actively involved in their learning. In constructivism, the students work together while sharing knowledge and ideas to problem solve. Transfer of learning will occur if the learning process was meaningful and memorable (Schunk, 2020). Immediate feedback, such as the case with the escape room, promotes this type of learning. This learning experience incorporates the

two theories with multiple pedagogies to facilitate the learning objectives.

## Education Pedagogies

### *Flipped Classroom Lecture*

Knowledge was disseminated via a flipped classroom prerecorded lecture with PowerPoint slides. This technology was used for efficacy and retention of information. Using lectures provides students with a common core of content and clarifies confusing or intricate points (Bradshaw & Hultquist, 2017). Since the target audience had previous exposure to thermoregulation material, this strategy also welcomes questions that may arise (Bradshaw & Hultquist, 2017). Before coming to class, students listened to the prerecorded lecture while watching a coinciding PowerPoint on thermoregulation. This lecture explained the concept of thermoregulation, the different types of heat transfer, signs and symptoms seen with varying thermoregulation diagnoses, labs, risk factors for unstable thermoregulation, special populations, and nursing interventions. At the end of the lecture, a quick response (QR) code linked students to Google Forms with a *ticket to Disney* as proof that they watched the video and answered questions, indicating the student was ready for simulation. If they did not have a QR scanner, the link to the ticket was provided on the last PowerPoint slide which they could print out to bring to class. The lecture prepared students with the knowledge they would need to be successful in the simulation escape room.

Learning Objectives	Instructional Strategies	Assessment of Learning
<ul style="list-style-type: none"> <li>• Describe major risk factors for unstable thermoregulation (Understanding)</li> <li>• Recognize signs and symptoms of inadequate thermoregulation (Remembering)</li> <li>• Identify strategies to support thermoregulation (Analyzing)</li> <li>• Interpret patient situation with appropriate interventions (Evaluating)</li> <li>• Demonstrate effective teamwork and communication (Applying)</li> </ul>	<ul style="list-style-type: none"> <li>• Flipped classroom: Lecture and PowerPoint prior to students' arrival</li> <li>• Small group simulation for a hands on demonstration of material learned</li> <li>• Online quiz</li> </ul>	<ul style="list-style-type: none"> <li>• Formative assessment: online escape room format, <i>escape</i> to pass</li> <li>• Summative assessment online</li> </ul>

## Simulation

The students were divided into three equal groups. Groups were given 25 minutes to solve the clues and escape the room. Each group entered into the Disney World themed escape room in which a 60-year-old woman developed severe heatstroke while at the park with her family. During prebriefing, the room layout, instructions, and the patient scenario were given to students. Once in the room, students maneuvered through various escape room puzzles. This enabled them to recognize abnormal vital signs, identify signs and symptoms of heatstroke, answer questions regarding heat transfer, and identify interventions that would save the patient. Upon students synergistically solving all the clues,

the patient would be saved and the team would escape Disney World.

Adopting simulation as a teaching strategy in this clinical learning experience enabled students to build their self-confidence, knowledge, and communication skills and improve their clinical judgment. These results were found to be consistent with those described in Bradshaw and Hultquist (2017). According to the literature, when simulations are used in nursing education, students are less likely to make errors in the clinical setting. As a result, graduates can demonstrate more vital critical decision making skills in their nursing practice (Eyikara & Baykara, 2017).

Case Scenario for Simulation Hyperthermia Escape Room	
<b>Scenario Overview</b>	Setting: PN lab aka Disney World Simulation: 30 minutes Debriefing: 10 minutes
<b>Preparation for Simulation</b>	Explain how an escape room works Orient students to room set up Encourage students to get involved and think out loud in this safe and supportive learning environment
<b>Brief Case Summary</b>	PN students have gone to Disney World over spring break. They notice an elderly woman who stumbles and is off balance. As good and helpful students, they rush in to help. By utilizing subjective and objective health evaluation with critical thinking, they discover lineal clues that must all be solved until an ultimate escape.
<b>Example of Simulation Steps</b>	The first clue found is a strip of paper taped to the thermometer on which is written <i>keys to success</i> . By using the hint <i>key</i> , students find the framed picture hanging on the wall of a Disney key. Behind this picture is a key that opens the first locked box. Students continue attempting to solve clues before the 25-minute timer is complete. The final clue is a puzzle that appears blank. Once the puzzle is assembled, students are to recall the UV flashlight found previously. Using it on the puzzle identifies an acid/base value. With correct interpretation, students choose the balloon with the matching acid/base state and pop it. If it is the correct balloon, inside is a sign in which it is written, "Congratulations, you've saved Grandma and escaped Disney."
<b>Debriefing Questions</b>	What was happening in this scenario? How did you feel about this simulation? What were the signs and symptoms that helped you identify the condition? From the health assessment, what were the risk factors? What is the best way to care for someone with hyperthermia? Would that care differ if the patient were an infant or child? How did you work together as a team? Do you think clear communication was an important aspect of working as a team? Why?

## Assessment and Evaluation

Assessment and evaluation are excellent tools to identify how well students are learning and retaining information, enabling instructors to revise their teaching methods to meet their students' learning needs (Billings & Halstead, 2020). Evaluation of learning was determined with multiple methods. The first group to go through the escape room was the PN faculty as the pilot group. Based on their feedback, no changes were made in the escape room prior to the simulation for students.

Upon arrival at the school with their *ticket to Disney*, three groups of students alternated through the escape room. The time it took students to answer each clue was recorded to pinpoint areas of difficulty or confusion. No group struggled an unusual amount of time in any area, although when comparing the performance of students versus faculty, faculty took the most time to escape overall. The PN faculty appeared to collaborate more on their decisions, wanting to be assured of the answer before continuing. Debriefing questions were based on Promoting Excellence and Reflective Learning in Simulation (PEARLS) Healthcare Debriefing Tool. This debriefing strategy is a structured framework for learners to self-assess and identify gaps in knowledge. Studies show that simulation with systematized debriefing is necessary for maintaining the learned material (McNutt et al., 2021).

This learning plan included a formative evaluation via an online multiple choice escape room quiz. Multiple choice items can measure learning on several levels of cognitive processes (Billings & Halstead, 2019). Included in this quiz were several NextGen National Council Licensure Examination (NCLEX) questions of *Select All That Apply*. Choices had to be selected correctly to *escape*, thus it was a pass or fail instead of a grade. The learner had the opportunity for unlimited attempts to *escape* for three days after completing the simulation. The participants had a summative assessment element to fill out for feedback regarding the learning experience, in addition to evaluating the instructor, learning pedagogies, resources, and learning environment.

## Data Analysis

Each team solved the clues in less than the allotted time frame, which permitted them to *escape* and save the patient. Groups escaped in times ranging

from 13 to 18 minutes, out of the 25 minutes allotted. Student reactions were gauged, with the majority stating they felt the escape room was effective in cultivating collaboration, communication, teamwork, and competency. Students stated they “loved the escape room” and that they “learned better with the escape room than with a regular simulation.” They reported that it felt less stressful and more engaging than a regular simulation and improved their confidence.

Eighty-six percent of students escaped the online quiz in one attempt, while 14% attempted the quiz twice to escape. All comments regarding the learning project were positive. Students stated that it was fun, challenging and made them think. One participant mentioned working as a collaborative team while under pressure was the key to success. Further, one student remarked that they wanted to find each consecutive clue with the online escape room, which kept them motivated to continue and get the correct answer. The student verbalized it was a constructive way for her to remember the material while simultaneously working the problems. Faculty stated the innovation was an exciting and creative educational approach that they will incorporate more of in future lessons.

In the overall learning project, 91% of students felt the learning material provided them with a superior understanding of thermoregulation. Eighty-four percent felt they were better prepared to intervene for a patient with inadequate thermoregulation. The post learning project assessment denoted that 100% of students met the learning objectives. The subjective and objective data results indicated that this learning project was effective, with all participants demonstrating proficiency in the identified learning objectives.

## Implications of the Innovation

Future implications of this innovation would necessitate either shortening the time allowance of the escape room or adding additional clues to solve. The simulation showed that all groups completed the clues well before the time ran out, indicating the clock was not a competitor. This learning module should continually be evaluated for validity prior to use for future educational sessions. Current evidence based research should be assimilated into this learning project as technology and information evolve.

The practice of high stakes, high risk learning in safe venues such as an escape room builds critical thinking, communication, and cooperative problem solving skills. Novel avenues to learning may enhance memory and solidify knowledge.

### Summary

This learning experience fulfilled a missing component in the PN curriculum for an in depth review of thermoregulation. Through cognitivist and constructivist theory design, multiple teaching and learning pedagogies were integrated. Pedagogies, including a flipped classroom lecture with PowerPoint and

a simulation escape room, ensured learners of various educational needs mastered this material. The evaluation methods, both formative and summative, provided instructors with the assurance that students mastered the material and met objectives. Attainment of the information in the learning unit allowed PN students to identify and correctly react to inadequate thermoregulation situations while utilizing teamwork, communication, knowledge, and skills.

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### References

- Billings, D. M., & Halstead, J. A. (2019). *Teaching in nursing: A guide for faculty* (6th ed.). Elsevier.
- Bradshaw, M. J., & Hultquist, B. L. (2017). *Innovative teaching strategies in nursing and related health professions* (7th ed.). Jones & Bartlett.
- Clark, K. R. (2018). Learning theories: Cognitivism. *Radiologic Technology* 90(2), 180-182.
- Eyikara, E., & Baykara, Z. G. (2017). The importance of simulation in nursing education. *World Journal on Educational Technology: Current Issues*, 9(1), 2-7. <https://eric.ed.gov/?id=EJ1141174>
- McNutt, R., Tews, M. & Kleinheksel, A. (2021). Student performance during a simulated patient encounter has no impact on debriefer adherence to PEARLS debriefing model. *Medical Science Educator*, 31, 1141-1148. <https://doi.org/10.1007/s40670-021-01290-2>
- O'Conner, F., & Casa, D. (2019). Exertional heat illness in adolescents and adults: Epidemiology, thermoregulation, risk factors, and diagnosis. *UptoDate*. Retrieved February 28, 2022 from <https://www.uptodate.com/contents/exertional-heat-illness-in-adolescents-and-adults-epidemiology-thermoregulation-risk-factors-and-diagnosis>
- Ruble, C., Dresser, C., Giudice, C., Lemery, J., & Sorensen, C. (2021). Evidence-based heatstroke management in the emergency department. *Western Journal of Emergency Medicine*, 22(2), 186-195. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7972371/?tool=pmcentrez&report=abstract>
- Schmeltz, M., Petkova, E., & Gamble, C. (2016). Economic burden of hospitalizations for heat-related illnesses in the United States, 2001–2010. *International Journal of Environmental Research and Public Health*, 13(9). <https://doi.org/10.3390/ijerph13090894>
- Schunk, D. (2018). *Learning theories: An educational perspective*. (8th ed.). Pearson.

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### Author's Note

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