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Short Commentary

Designing Effective Scripts and Resources to Support Simulated Practice, Using Basic Life Support as an Exemplar

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Abstract

This is the third instalment in a series of papers featured in this journal, focusing on the application of mental simulation in nursing. This specific article addresses the pervasive issue of skill decay in Basic Life Support (BLS) training, proposing an innovative solution through the integration of mental simulation. Despite mandatory annual BLS updates for nurses, evidence suggests a decline in skills over time, posing risks to patient safety. Traditional methods, reliant on face-to-face sessions, may not sufficiently prevent skill decay, particularly in time-sensitive scenarios. The article advocates for mental simulation as a complementary and accessible approach to augment traditional BLS training. Focused on the vivid mental rehearsal of actions, mental simulation offers a promising avenue for nurses, seeking to reinforce correct techniques and deepen their understanding of BLS interventions. Guided by the physical, environment, task, timing, learning, emotion, perspective (PETTLEP) framework, the discussion navigates through the practical application of mental simulation. The framework serves as a model for crafting scenario scripts, emphasising each of the PETTLEP elements. Recommendations include the incorporation of progressive scripts aligned with learners' evolving knowledge, providing a nuanced approach to skill enhancement. Authenticity is emphasised through the integration of real experiences into scripts, adopting a first-person perspective, and incorporating sound effects. While acknowledging challenges such as empirical testing and individual differences, the paper concludes by highlighting the potential of mental simulation to bridge gaps in nursing education. In offering a practical and immersive learning experience, mental simulation emerges as a valuable tool for nurses aiming to optimise their BLS proficiency, ultimately contributing to enhanced patient safety.

Keywords: sudden cardiac arrest, cardiopulmonary resuscitation, education, nurses, patient safety

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1 INTRODUCTION

This is the third paper in a series of three published in this journal, examining the role of mental simulation in nursing. This article promotes the utilisation of mental simulation alongside conventional basic life support (BLS) teaching methodologies. The paper delineates a method grounded in evidence for developing a mental simulation tailored to learning BLS and life-support skills.

Mental simulation, also known as cognitive mental imagery or motor imagery, involves creating sensory experiences in one's imagination without physical movement. It is a quasi-sensory or quasi-perceptual experience that exists in the absence of stimuli and overt physical movement[1]. Mental simulation has been described as "seeing in the mind's eye and hearing through the mind's ear and so on"[2], and sports researchers in the past have described mental simulation as "movies of the mind"[3]. Mental simulation can augment current simulated teaching strategies, as it allows for self-directed, solitary, repetitive practice; nurses learn BLS using physical simulation but can use mental simulation to maintain and even further enhance skills[4]. Mental simulation research in healthcare has focused on surgical education and has shown some promising results for the acquisition of surgical skills[5,6]. Similar to simulated practice, the use of mental simulation incorporates a script that describes, in detail, the scenario to be imagined. However, the majority of research articles offer little explanation of the development of mental simulation scripts. The authors developed an evidence-based mental simulation script for use in their institution, and it is shared in this article.

Below, it will be demonstrated that mental simulation has been thoroughly examined in healthcare education. However, there is a scarcity of guidance on crafting effective mental simulation scripts tailored to healthcare professional education. This article seeks to fill this void by introducing an evidence-based framework for developing mental simulation scripts and related resources. For reasons outlined below, this article utilises a hospital-based cardiac arrest scenario as an exemplar.

2 METHODS

2.1 Addressing Skill Decay in BLS Training: Exploring the Potential of Mental Simulation

BLS education holds great importance for nurses in their practice. BLS training typically involves using training manikins in face-to-face sessions led by educators. The comprehensive scope of BLS includes recognising and assessing cardiac arrest, utilising automated defibrillation, managing foreign-body airway obstructions, and implementing the recovery position[7]. BLS is administered to the patient until advanced life support (ALS) measures can be applied. ALS procedures involve life-saving procedures and skills that go beyond the basic, aimed at urgent treatment and reversing the causes of cardiac arrest[8].

In the United Kingdom, nurses are mandated to undergo annual BLS training and updates. However, evidence suggests that these yearly updates may not sufficiently prevent skill decay. A comparative study by Roel and Bjørk[9], which examined two groups of nurses, revealed a significant decline in BLS skills over time in the absence of further educational interventions ($P<0.001$). This finding implies that BLS learning may not progress beyond the "declarative learning" stage.

Declarative knowledge is explicit and encompasses the acquisition, retention, and retrieval of skills and knowledge and is a conscious recollection of the required steps[10]. The time between annual practice sessions can lead to substantial memory trace decline[11], which can lead to increased response times, decreased retention of knowledge and reduced accuracy[12]. Over time, without rehearsal, the neural networks associated with BLS skills can significantly or entirely lose the related information. This phenomenon is known as "catastrophic memory failure"[13]. Given the time-critical nature of BLS delivery[14], catastrophic memory failure poses significant risks to patient safety.

To mitigate skill decay, increasing the frequency of simulated training may be beneficial. However, additional simulated training requires substantial resources. Therefore, it is prudent to explore less resource-intensive techniques for nursing education. One promising alternative approach is mental simulation, which offers a potential solution.

2.2 Leveraging Mental Simulation for Enhanced BLS Skill Acquisition: A Practical Guide for Nurse Educators

Mental simulation can play a crucial role in enhancing learning and performance in BLS skills by complementing physical practice. Mental simulation can activate the same neural networks involved in actual motor execution, creating functional equivalence (FE) between the two processes[15]. By visualising and mentally simulating BLS actions, such as chest compressions, airway management, and defibrillator use, learners can reinforce their understanding of the correct techniques. White et al suggest that Mental simulation allows nurses to mentally rehearse and refine their actions, enhancing their self-belief and readiness to respond in real-life emergency situations[16]. Additionally, mental simulation can help learners develop a deeper understanding of the sequential and simultaneous aspects of BLS interventions, improving their ability to integrate various skills and respond efficiently[16]. By combining mental simulation with physical practice, nurses can optimise their learning experience and enhance their overall proficiency in delivering effective BLS interventions. This section offers an overview of mental simulation.

There is increased recognition of the benefits of incorporating mental simulation into the learning process, inspired by its successful application in enhancing fine motor skills in novice and elite sports. Recent meta-analyses conducted by Toth[17] and colleagues and Lindsay[18] and team have provided compelling evidence of significant performance improvements through a combination of mental simulation and physical practice. By engaging in mental simulation of actions, nurses can reinforce their understanding of correct techniques, refine their motor skills, and improve their overall performance. The integration of mental simulation with physical practice offers nurses a comprehensive approach to enhance their learning of BLS skills.

Toth and team discovered that the integration of mental simulation and physical practice resulted in a noteworthy effect size of r=0.240 (P<0.001), indicating a substantial enhancement in performance[17]. Similarly, Lindsay et al.[18] achieved comparable results, reporting an overall effect size of g=0.476 (P<0.05) for motor skills performance. These studies concluded that mental simulation programs have a positive impact on the performance of both novice and skilled learners. Novice learners exhibited an effect size of g=0.912 (95% CI [0.600-1.222], P<0.001), while skilled learners demonstrated an effect size of g=0.567 (95% CI [0.329-0.805], P<0.001). Consequently, we see the potential for mental simulation as a valuable complement to simulated BLS education for improving performance.

Mental simulation techniques are specifically designed for self-directed preparation, empowering learners to mentally rehearse scenarios and actions independently of teachers. Unlike traditional classroom activities, mental simulation offers a unique approach. Detailed scenario scripts play a vital role in mental simulation, serving as a framework to vividly describe the scene and actions that need to be learned[16]. These scripts can be presented in written or audio format and can be accessed on smart devises, providing nurses with structured guidance for their mental rehearsals.

Studies exploring mental simulation often lack detailed descriptions of script design (for example, Fountouki et al.[19]). This article aims to address this gap by providing a comprehensive BLS mental simulation script and accompanying resources along with a justification for the design. The goal is to present this article as a practical guide for healthcare professional educators who might consider incorporating mental simulation into their teaching practice. The upcoming section will explore how mental simulation effectively supports the learning experience, providing valuable insights for healthcare educators.

2.3 Enhancing Mental Simulation Vividness for BLS Training: Applying the Physical, Environment, Task, Timing, Learning, Emotion, Perspective (PETTLEP) Framework to Script Design

PETTLEP is an acronym that stands for physical, environment, task, timing, learning, emotion, and perspective. PETTLEP is a framework that was developed in the seminal work by Holmes and Collins[15] to enhance the effectiveness of motor skill acquisition and performance in sports and physical activities. The PETTLEP model provides a framework for optimising training and performance by considering various factors that impact skill development and execution.

The "simulation theory of action" forms the foundation of mental simulation. The simulation theory of action suggests that mentally imagining a motor action activates similar neural networks as performing the actual task, although there are differences between imagined and actual actions, there are overlapping neural activations[20]. Neuroimaging studies have confirmed the functional equivalence (FE) between mental simulation and actual motor execution is similar in terms of functional neuroanatomy[21,22]. This means that imagining a task can to some degree, have a analogous impact on learning as physically performing it, as they share neural and behavioural similarities[23]. Therefore, functionally equivalent mental simulation can lead to increased neuroplasticity[21], which suggests that imagining a task can contribute to learning, although perhaps to a lesser extent compared to physical execution[24].

The effectiveness of learning through mental simulation depends on the vividness of the evoked mental images. Higher vividness leads to greater FE and increased learning likelihood[15]. To promote vivid mental simulations, it is important to design detailed scripts that provide maximum task-related information. This requires the use of a framework to increase detail and potentially increase vividness. The PETTLEP framework is an evidence-based approach to script design, emphasising seven key features that enhance the vividness of mental simulations. These features involve describing physical aspects, depicting the task environment, ensuring task relevance to learners, considering timing equivalence, incorporating progressive learning stages which become more advanced as learning takes place, describing associated emotions, and selecting the simulation perspective (first- or third-person). The PETTLEP framework serves as a model for developing mental simulation scripts and is grounded in neuroscience research and theoretical principles[15], partly described above.

In the upcoming sections, we will explore how the PETTLEP framework was employed to create a scenario script and accompanying resources for BLS training.

2.4 Maximizing Learning and Integration: Incorporating Progressive Scripts for BLS Training

First, it is important to note that these scripts are not intended to replace physical practice but rather to be used in conjunction with their BLS training sessions. In this case, two scripts were developed, both centred around the same scenario. These scripts were designed to progressively advance from a basic life-support scenario to a more complex script depicting a full cardiac arrest scenario. The intention behind this progression aligns with the 'learning' aspect of the PETT**L**EP framework[15]. As one acquires more knowledge and skills, the script content becomes more challenging, facilitating deeper learning (the scripts and resources highlighted in this article can be acquired using this link https://shura.shu.ac.uk/30491/). The author's institute recommends that nurses access the resource regularly, with at least one set of mental simulation session (detailed below) between annual physical practice sessions.

The authors recommended utilising the basic and advanced scripts for approximately[17] 10-minutes, three times per week, over a period of four weeks (two weeks on each script). This recommendation is partly based on the findings of Schuster et al.'s[25] meta-analysis, which identified the optimal practices for effective mental simulation learning. The meta-analysis indicated that an average duration of 17 minutes per session, three times a week, with a total of 34 mental simulation sessions, will yield positive performance results. Considering the practicality of nurses undertaking 34 sessions, we pragmatically recommend 12 mental simulation sessions so that nurses would be able to fit the learning around their busy work-life schedule- we take the view that some learning is better than none, although 12 sessions has not currently been empirically tested for learning BLS skills. Nonetheless, these mental simulation sessions serve as valuable opportunities to reinforce learning, improve performance, and develop a stronger foundation in providing effective patient care in cardiac arrest.

2.5 Enhancing Realism and Engagement in Mental Simulation Scripts: Incorporating Nurse Experiences for Authentic BLS Learning

The design of these scripts involved three key elements: 1) the authors themselves, 2) current BLS and ALS algorithms and guidelines, and 3) nurse (end user) interviews. According to Holmes and Collins[15], mental simulation should be personalised and involve the performer in generating the motor image content (scripts) through multisensory involvement. However, in the context of cardiac arrest, personalisation of mental simulation scripts can be very challenging for nurses with limited or no cardiac arrest involvement, as they lack experience and therefore memories and images to draw from during the mental simulation.

To overcome this obstacle, the authors conducted interviews with four nurses who had prior cardiac arrest experiences. These interviews aimed to gather comprehensive information about various aspects of their experiences, including the emotions they felt, the physical stress experienced during cardiopulmonary resuscitation (CPR), the available equipment, and memorable sounds. The rich descriptions obtained from these interviews formed the basis of the narrative within the PETTLEP framework and were integrated into the mental simulation script, along with the guidelines and the authors' expertise (see Table 1 for more detail of each PETTELP aspect). The intention of this approach was to create an authentic mental simulation experience that generates relatable and vivid mental images, enhancing the sense of realism for individuals. By increasing vividness, the expectation was to also increase the FE of the mental simulation experience[15]. The mental simulation scripts are designed to incorporate the insights and experiences of nurses who have encountered cardiac arrest situations, providing meaningful and relatable learning opportunities. The rationale behind this approach is that by feeling a connection to the scenarios described in the scripts, nurses can engage in a more immersive and effective learning experience that aligns with their training and guidelines.

2.5.1 First-person Perspective

The mental simulation script was specifically designed to encourage the learner to adopt a first-person perspective (PETTLE**P**). By incorporating a first-person perspective into the scenario, the aim was to enhance the vividness of the actual experience. Schuster[25] and the team's systematic review support the notion that a first-person perspective yields a more effective behavioural outcome. This is because a first-person perspective has a stronger FE to the actual task.

2.5.2 Timing

The element of Timing (PET**T**LEP) emphasises the importance of temporal accuracy in mental simulation resources, aligning with the real-time execution speed of the learned skill. Athletes, and in this case nurses, prefer to employ images that unfold at real-time speed to enhance their performance[26] Considering the time-sensitive nature of cardiac arrest, the mental simulation script was designed to adhere closely to PETTLEP's FE philosophy. The script narrative was recorded in real time, following the 2-minute cycles required for CPR in ALS guidelines. To enhance the sense of temporal accuracy, a metronome set at 120 bpm was incorporated into the script's sound, as summarised in Table 1 and can be heard in the downloadable resource. The following sections detail the recording process and the integration of sound effects to enhance the overall experience.

2.5.3 Audio Narration of the Script

The mental simulation script utilised a narrated approach, with a voice actor guiding the learner through the scenario. The use of affective and descriptive narration is known to evoke visual images and elicit emotional arousal, resembling a real-life cardiac arrest experience[27]. The narration was carefully crafted to facilitate a communication-induced mental simulation process, aiming to create a vivid mental "theatre of the mind" and paint pictures in the imagination of the nurses[28].

Table 1. Design Framework for the Mental Simulation Protocol

Mental Simulation Protocol Element	Description
Physical demands	There are high physical demands from undertaking CPR. During CPR, individuals experience physical demands such as heavy arms, increased heart rate, and tactile sensations like cool and clammy patient chests with spongier and bouncier textures than expected, as described by nurses in interview.
Emotional	The advanced script intensifies the emotional description, aiming to replicate a realistic cardiac arrest scenario for nurses. This "stress exposure training" intends to desensitize nurses to the stress associated with cardiac arrest. Emotions such as feeling flooded with adrenaline and the initial desire to freeze are extracted from healthcare professional interviews
Task	The task is described using the expertise of the healthcare professional experts and the BLS and ALS algorithms and literature.
Timing	The mental simulation script was evoked and 'run' in real-time in two-minute cycles
Learning progression	Stage 1 of the protocol involves a basic audio-guided mental simulation script, aligned with PETTLEP, run for a maximum of 2 weeks. Nurses have the flexibility to progress to the advanced script independently or return to the basic script as needed. Stage 2 consists of an advanced audio-guided mental simulation script, based on PETTLEP, for the remaining four weeks. While nurses can revert to the basic script, if necessary, they are encouraged to engage with both scripts once they reach the advanced stage. The advanced script intensifies the emotional description and aims to replicate a complete cardiac arrest scenario. Both scripts can also be used one after the other, if desired.
Environment (through point of view film of a cardiac arrest)	The film, recorded from a first-person perspective, was incorporated into the mental simulation protocol to help participants create vivid mental images of an environment. The video provides nurses with a visual representation of a cardiac arrest setting, including a simulated patient, medical team, and equipment. To enhance realism, sound effects such as oxygen flow, emergency alarms, defibrillator activation, and bed adjustments were included, as they added face validity to the simulation.
Perspective	Nurses are asked to undertake mental simulation using a first-person perspective. It has been described as seeing the event from the visual perspective you had when the event was originally occurring- i.e., through your own eyes.

2.5.4 Sound Effects

While sound effects are not explicitly included in the PETTLEP framework, they were incorporated into the mental simulation scripts by drawing from the simulation literature. Authentic sound effects, such as oxygen flow, the patient's bed dropping flat, and defibrillator sounds, were recorded and added to enhance the vividness of the mental images. Sound effects play a significant role as learners engage in auditory processing and rely on sensory and perceptual skills acquired through previous experiences. These effects provide iconic meaning to the narrative, triggering emotional and meaningful images in conjunction with the script's narration. Sound has the ability to encode, process, and evoke real-world experiences in one's memory[29].

The incorporation of sound effects aligns with the concept of "auditory fidelity", where the senses interact, and auditory stimuli can influence the visual scene. Adding background noise in simulation can increase immersion and authenticity and induce escalating stress levels akin to real practice[30]. Furthermore, the connection between sound and emotion (P**E**TTLEP) can be strong, as individuals may develop heightened emotional associations with the industrial sounds of a cardiac arrest scenario[31]. The addition of audio to the narration aims to evoke increased emotional arousal among participants[32], contributing to the overall immersive experience of the mental simulation. Sound effects such as oxygen flow, the sound of defibrillator, background ward noises were added. In summary, the inclusion of sound effects in the mental simulation scripts was intended to enhance emotional engagement and increase the participants' connection to the simulated cardiac arrest scenario.

3 RESULTS

The mental simulation script was part of a comprehensive set of broader resources aimed at enhancing the vividness of mental images and increasing FE. These resources included usage instructions, basic and advanced scripts, a first-person perspective film depicting a cardiac arrest scenario, BLS and ALS algorithms, a glossary of terms, and a patient handover script (and again the resource can be found here: https://shura.shu.ac.uk/30491/). Holmes and Collins[15] suggest that supporting resources are often necessary to facilitate the evocation of vivid images during mental simulation exercises.

To address the environmental aspect of P**E**TTLEP, which emphasises imagining the task in the actual execution environment, we utilised a point-of-view film for the learner to watch as when they needed to aid in evoking vivid images. This film aimed to replicate real-world and mental simulation experiences, allowing learners to fill in any gaps in their own, often limited experiences. Studies with rhythmic gymnasts have demonstrated that video observation before mental simulation practice significantly enhances vividness[33]. All the provided resources were designed to support learners in creating vivid images.

It is recommended that learners initially utilise the first-person video to establish an immersive experience, particularly if they have limited exposure to cardiac arrest scenarios. However, it is important to note that learners will likely draw from multiple sources, including audio-visual media and real-world encounters, piecing together different experiences like a jigsaw puzzle to construct a more comprehensive mental scene[16]. The broader set of resources is intended for self-directed use by nurses, allowing them to engage in mental simulation exercises according to their own needs and preferences.

4 DISCUSSION

Challenges and considerations in the empirical testing and application of mental simulation.

4.1 Empirical Testing

While many mental simulation scripts have been empirically tested, this script has yet to be quantitatively tested. However, this script formed the basis of the qualitative research by White and team[16].

4.2 Skill Transfer

While mental simulation has shown potential for enhancing skill acquisition and performance, the extent to which these skills can be effectively transferred to real-world scenarios and patient care remains an important consideration.

4.3 Individual Differences

The effectiveness of mental simulation may vary among individuals due to differences in cognitive abilities and previous experiences. Factors such as motivation and engagement levels can also influence the outcomes of mental simulation training[16].

4.4 Resource Requirements

The implementation of mental simulation may require additional resources, such as audio narration and sound effects, which could pose logistical challenges and financial constraints for educational institutions or healthcare settings. However, this would be a fraction of the cost of using physical simulated practice.

4.5 Ethical Considerations

The use of mental simulation scripts based on authentic experiences of nurses with cardiac arrest raises ethical concerns regarding the potential emotional distress or triggering of traumatic memories in participants. Proper safeguards and support systems, in the form of debriefing and sign-posting to support should be in place to address these concerns.

4.6 Long-term Retention

While mental simulation has shown short-term benefits in skill retention, its long-term effectiveness and the durability of acquired skills over time needs further investigation.

4.7 Future Research Directions

This article does not extensively discuss future research directions or potential areas for improvement and exploration within the field of mental simulation in simulation and BLS education. Identifying and addressing these gaps would further enhance the knowledge and practical application of mental simulation techniques.

5 CONCLUSION

Mental simulation offers a promising approach to reinforce BLS skills by allowing nurses to engage in self-directed, repetitive practice without the need for physical resources. By visualising and mentally rehearsing BLS actions, nurses can enhance their understanding and retention of correct techniques, thus improving their readiness to respond in real-life emergency situations. The integration of mental simulation with physical practice has been shown to significantly enhance performance, offering a comprehensive approach to BLS education.

This article provides practical insights for nurse educators to design mental simulation so they might incorporate it into BLS training. The paper presents an evidence-based design principles for creating mental simulation scripts using the PETTLEP framework, ensuring maximum vividness and engagement. By progressively advancing the scripts and incorporating authentic nurse experiences to enhance the realism and effectiveness of mental simulation exercises.

While this article highlights the potential of mental simulation in BLS education, it also acknowledges various challenges and considerations in its empirical testing and application. Future research is needed to further explore the long-term effectiveness of mental simulation, individual differences in learning outcomes, and ethical considerations surrounding its implementation. Mental simulation holds great promise as a complementary approach to traditional BLS training methods, offering nurses a valuable tool to maintain and enhance their life-saving skills in patient care scenarios. Through continued research and refinement, mental simulation has the potential to revolutionise nurse education and improve patient outcomes in critical situations.

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Conflicts of Interest

The authors declared no conflict of interest.

Author Contribution

White N was responsible for identifying research directions and providing knowledge. Garner I was responsible for improving the manuscript. Rumbold J was responsible for data analysis and article editing. All authors played integral roles in contributing to its development and content.

Abbreviation List

ALS, advanced life support
BLS, basic life support
CPR, cardiopulmonary resuscitation
FE, functional equivalence
PETTLEP, physical, environment, task, timing, learning, emotion, perspective

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