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ORIGINAL PAPER

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Professional Mental Rehearsal: the Power of "Imagination" in Nursing Skills Training

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ABSTRACT

Background: Mental rehearsal is a form of training used by nurse educators to enhance the performance of clinical skills. The use of imagination may facilitate cognitive and affective modification and subsequently may even reduce extraneous cognitive load.

Objective: The aim of the study was to investigate the efficacy of mental rehearsal in cardiopulmonary resuscitation training of nursing students. **Methods:** This is a comparative study with a random sample of 52 Nurse-Assistant students who were randomly divided into two groups. A 10-minute educational video on CPR and defibrillation was shown to both groups with the experimental group having additional time to be coached on mental rehearsal. Student performance was subsequently timed and errors/overall performance recorded. Descriptive statistics and Mann-Whitney test was used for group comparisons analysis. **Results:** Students in the control group needed 8.5 minutes on average as compared to 6.2 minutes for the experimental group to complete cardiopulmonary resuscitation training. This equals to a difference of 2.5 minutes faster time for the experimental group ($p < 0.001$). For overall mistakes the mental rehearsal group had 1.3 fewer mistakes on average ($p = 0.003$). In terms of mistakes when executing cardiopulmonary resuscitation training there were 0.9 fewer mistakes in the experimental group ($p = 0.021$). **Conclusion:** The use of mental rehearsal might be the first step in improving the teaching of nursing skills. Differences in skill acquisition in favor of mental rehearsal are important, especially when this technique is used in the teaching of life-saving skills such as cardiopulmonary resuscitation and the use of defibrillate. **Keywords:** Nursing, Mental Rehearsal, Cardiopulmonary Resuscitation, Defibrillate.

1. BACKGROUND

Mental rehearsal is a form of training used by nurse educators to enhance the performance of clinical skills. Inherent to mental rehearsal is the employment of imagination. Along these lines, the use of imagination may facilitate cognitive and affective modification and subsequently may even reduce extraneous cognitive load (1). Furthermore, the use of mental rehearsal strategies in the teaching of skills may improve students' performance and reduce their performance stress levels (2).

Man's higher intellectual and psychological processes are based on billions of neurons within the brain, which enable reasoning. Numerous mental and emotional functions occur, including the process of imagination, which can be used in a variety of situations. Every day, people activate their imagination, creating widely variable scenarios in their minds; thoughts both positive and negative, are being transformed into images, sometimes vague and others more specific and some with a flow and ending, resembling a well-set theatrical performance. Imagination manifests itself as a representational function of consciousness, and has become a main interest in classical psychology research and occupies a leading position in the humanities and neurosciences. The mental representation of a "reality within fantasy" has been studied for decades and its effect on a multitude of everyday conditions has been supported. The theories that have been developed to interpret the function of mental imagery are the following:

- Psycho-muscular theory in which fantastic events or behaviours produce neuromuscular

reactions analogous to those of an actual experience. The images produced in the brain convey muscle impulses as if a real skill was performed.

- Symbolic learning is when mental practice creates a kinetic pattern in the central nervous system. The use of mental practice performs better on cognitive skills than on motor skills.

Psychological skill is mental imagery contributing to the "clearing" of psychological stress. As a result, it helps to improve concentration, reduce stress, increase self-esteem, and improve learning skills (3).

There are two types of mental imagery, the 'virtual' and the 'esoteric'. The type of imagination that characterizes most adults is the 'esoteric' which is defined as the creation of an image when asked for accordingly. Yet, in this context, each individual will have a different mental image depending on their experiences and lived memories. For many, the mental image created is an inner thought, which serves as an actual image, that is, to be able to look at what they are thinking of. Mental images and active imagination are closely linked to the mechanism of perception. Training in the use of mental imagery greatly improves memory. It seems that under special circumstances people can use a type of virtual representation to solve a problem. Research has shown that mental imagery plays a very important and central role in memory, thoughts and motivations. Its value lies mainly in productive thinking which also constitutes the semantic background of language. According to the psychosomatic approach, mental imagery is the mental work that uses and activates the senses (4).

Mental imaging has been studied in the field of medical education and mainly in the acquisition of surgical skills. Yasemidou et al. (2018) studied the effect of a 25 minute mental training session on specialist medical practitioners prior to performing a cholecystectomy on a simulator (5). The team that performed the brain imaging performed better on similar surgical procedures than the control group who simply watched a training video before performing the procedure. This study also argued that the practice of mental practice works even better when training is accompanied by the use of 3D models.

In this context, four types of mental training can be distinguished.

- External observation training: the trainee is watching a model that performs the action to be learned.
- Sub-vocal training: The trainee calls up a clear visual image of the action through external or internal self-talk.
- Internal observation training: The trainee visualizes himself or another person (as an external observer) performing the action he/she wants to practice.
- Ideo-motoric training: The trainee forms a mental picture of the action from an internal perspective. He/she visualizes him/herself executing the action and tries to 'feel' it, including as many sensory aspects of the process as possible (6).

Mental rehearsal has also been applied when learning nursing skills are being taught. Almost three decades ago, the pioneering study of Bucher (1993) applied mental rehearsal, physical practice or a combination of the two when training students on the handling of sterile gloves. As an

outcome of her study, students performed better when the physical practice of the skill was combined with mental rehearsal (7). High competency skills in nursing are associated with fine psychomotor capabilities combined with best practice. Along these lines, Immenroth et al., (2007) explored the interactive effects of imagery skills and various combinations of physical and mental practice on the application and removal of sterile gloves by student nurses (8). The findings showed that the addition of mental rehearsal to ordinary physical practice facilitated skill acquisition and improved overall students' performance.

Emergency medical care and rescue services can be particularly stressful. Educational techniques that include breathing control, positive self-talk, and mental imagery all help reduce stress and improve care performance (9). The first study to show the positive effect of mental training on wound healing was conducted by Lorello et al., (2016) and his research involved two teams of physicians trained in the treatment of trauma (10). One group performed mental training for twenty minutes in addition to basic training while the control group only had basic training. Both groups were consequently asked to provide first aid to deal with trauma in simulated conditions. The experimental group physicians showed greater readiness and coordination than the control group.

Sanders et al, (2004) tested the effects of varying the amount of physical practice and mental imagery rehearsal on learning basic surgical procedures (11). Second year medical students were randomised into three groups. The first physically practiced suturing a pig's trotter, the second group had two sessions of physical practice and one of mental imagery rehearsal and the third group had one session of physical practice and two of imagery rehearsal. All students then performed surgery on a live rabbit under approved conditions. The results showed that physical practice followed by mental imagery rehearsal was statistically equal to additional physical practice. Hence, the authors claim that physical practice followed by mental imagery rehearsal may be a cost-effective teaching method.

Hall (2002) in his critical review explored the possible role of skill rehearsal during surgical skills acquisition (12). His findings suggest that imaginary skill rehearsal can complement and augment the more customary forms of teaching practice. Furthermore, he concluded that imagery practice is a potentially effective mechanism for the learning of such skills.

2. OBJECTIVE

The purpose of this study is to investigate the efficacy of mental rehearsal in cardiopulmonary resuscitation (CPR) training of nursing students. The alternative research hypothesis was that mental rehearsing has an effect on CPR education for nurse students and the null hypothesis, that mental rehearsing does not contribute to CPR education.

3. MATERIAL AND METHODS

A random sample consisting of 52 students following a two-year Nursing Assistant Diploma course was selected. All participants were attending the first year of their studies. Students who presented with transient pain or muscu-

loskeletal injury that could be a hindrance to the performance of the skill were excluded from the study. Data was collected between October –November 2019. All measures necessary were taken to secure participants' anonymity and data confidentiality. Approval to commence this study was obtained from the International Hellenic University's Nursing Department corresponding Research Ethics Committee (15/06/HPR/43, 20/7/2019). All participants had to confirm their willingness to partake before continuing to the completion of the questionnaire.

The students were randomly divided into two groups of 26 individuals each, i.e. the experimental and control group. In each group, 13 pairs of students were also randomly assigned. Students entered the training room in two pairs (one from each group). A 10 minute educational video on the training of CPR and the use of the automatic external defibrillator was shown to them twice. The control group was then summoned to perform the procedure immediately, while the second group was withdrawn to a different location where they had to recall the procedure as many times as possible for 20 minutes. Upon completion of the procedure by the control pair, the retired couple returned to the site for visual presentation. After this process, two new couples came in to watch the video which acted as a standardized teaching method. Notes were not allowed during the visual presentation, but students had the opportunity to talk to each other in order to recall any information they had missed.

In all pairs, one student performed CPR and the other performed the defibrillation. The choice of each individual skill was random and the experimental couple did not know in advance what part of the process they would be asked to perform. Students were given time to think prior to proceeding with application of the two skills taught. The rescue scenario involved 2 full cycles of CPR until defibrillation began.

As the process was time-consuming, the students came in groups of pairs distributed over 3 days. The training site was a private space for researchers and was used by the American Heart Association's "CPR anytime" training program, which is accompanied by a training program (mini Ann), training DVD, and rescue protocol.

The technique was supplemented by researchers with training in the automatic external defibrillator, which was provided by a private physician for the research training needs. An electronic clock was used to record the students' performance, as well as a CPR schematic form to record student errors and overall performance.

Descriptive statistics and the Mann-Whitney test was used for group comparisons at significance level $\alpha=0.05$ ($p \leq 0.05$). Confidence intervals around

mean and median values were computed with the Bootstrap method (utilizing 1000 samples). The observed significance level in Mann-Whitney tests was computed with the Monte Carlo simulation method, utilizing 10,000 samples (13). This method leads to valid inferential conclusions even in cases where the methodological assumptions of the test are not satisfied (e.g. random samples, independent measurements, large samples, symmetrical distributions and absence of "heavy" outliers).

4. RESULTS

Data analysis showed that there was a similar gender mix in both control and experimental groups. Further data analysis shows that group performance for the control group (Table1) was as follows: in terms of executing the skill, student pairs needed 8.5 minutes on average, the median was 8 min and range 6-10 min. As for mistakes during the student pair performance, there were 5.5 mistakes on average. CPR mistakes were 2.4 on average and ranged from 1-5, while mistakes in performing defibrillation were higher, i.e, 3.2 on average, range 3-4. As for the experimental group, their performance showed that in terms of executing the skill, student pairs needed 6.2 minutes on average, the median was 6 min and range 5-8 min. As for mistakes during the student pair performance, there were 54 mistakes in total, with 4.2 mistakes on average. CPR mistakes for each pair were 1.5 on average and ranged from 1-2, while mistakes in performing defibrillation were higher, i.e, 2.6 on average, range 1-4. Confidence Intervals around the mean and median values of differences in control and experimental groups can be found in Table 2.

Group	Statistics*	Time (minutes)	Overall Mistakes	CPR Mistakes	Defibrillation Mistakes
Control	Min	6	4	1	3
	Median	8	5	2	3
	Max	11	8	5	4
	Mean	8.5	5.5	2.4	3.2
	SE	0.4	0.3	0.3	0.1
	SD	1.4	1.2	1.0	0.4
Experimental	Min	5	2	1	1
	Median	6	4	2	3
	Max	8	6	2	4
	Mean	6.2	4.2	1.5	2.6
	SE	0.3	0.3	0.1	0.2
	SD	1.1	1.0	0.5	0.8
Mann-Whitney test	Z-value	-3.545	-2.866	-2.429	-2.140
	p-value	<0.001	0.003	0.021	0.028
Total	Min	5	2	1	1
	Median	7	5	2	3
	Max	11	8	5	4
	Mean	7.3	4.8	2.0	2.9
	SE	0.3	0.3	0.2	0.1
	SD	1.7	1.3	0.9	0.7

*Min: Minimum value, Max: Maximum value, SE: Standard Error of Mean, SD: Standard Deviation

Table 1. Comparison of control and experimental group performance

Group	Statistics*	Time (minutes) 95% CI*	Overall Mistakes 95% CI*	CPR Mistakes 95% CI*	Defibrillation Mistakes 95% CI*
Control	Median	7.5-9.0	5.0-6.0	2.0-3.0	3.0-3.0
	Mean	7.7-9.2	4.9-6.2	1.8-2.9	3.0-3.4
Experimental	Median	5.0-7.0	4.0-5.0	1.0-2.0	2.0-3.0
	Mean	5.6-6.8	3.6-4.7	1.3-1.8	2.2-3.0

*95% Bootstrap Confidence Intervals

Table 2. 95% Confidence Intervals around the mean and median values of differences in control and experimental groups

Statistics	Time (minutes)	Overall Mistakes	CPR Mistakes	Defibrillation Mistakes
Mean Group	2.5	1.3	0.9	0.6
Differences (E vs C)	95% CI*: (1.4 - 3.2)	95% CI*: (0.5 - 2.2)	95% CI*: (0.3 - 1.5)	95% CI*: (0.1 - 1.0)
Relative Difference	27%	23.7%	37.5%	18.8%

*95% Bootstrap Confidence Intervals

Table 3. Absolute and relative differences between Experimental (E) and Control (C) Group

Results also show that in terms of time needed to execute a full and successful CPR cycle, students in the control group needed 8.5 minutes on average as compared to 6 minutes for the experimental group. This equals to 2.5 minutes, (95% 1.4-3.2) indicating that the mental rehearsal group was faster on acquiring the skill accurately. Absolute and relative differences between experimental and control group can be found in Table 3. As for overall mistakes, again there was a positive difference in favor of the mental rehearsal group which had 1.3 (95% CI 0.5-2.2) fewer mistakes on average (Table 3). In addition, in terms of mistakes when executing CPR there were 0.9 (95% CI 0.3-1.5) fewer mistakes in the experimental group. Although small, this difference was shown to be statistically significant. Finally, defibrillation mistakes were again lower in the experimental group with a small but statistically significant benefit of 0.6 (95% CI 0.1-1.0) fewer mistakes on average.

5. DISCUSSION

During the past half century, skill acquisition in nurse training is largely based on a theoretical model by Gentile (1972), which provides a 'blueprint' for the teaching of skill transference (14). It involves demonstration of a skill by the nurse tutor, followed by analysis by the student into its component parts then followed by practical application of the skill. Yet, more recent research has stressed the relevance of including mental rehearsal as an integrated component of skill acquisition (15).

A range of diverse clinical skills has been recognised as a focal feature of the pre-registration nursing curriculum worldwide. Ways to achieve these skills are still under scrutiny as even highly experienced nurses find it hard from time to time to execute their skills in challenging circumstances. For the student nurse, the acquisition of clinical confidence in executing skills needs to be achieved in safe and controlled educational environments. The safest is to practice initially within the realm of fantasy, then to be guided by clinical experts in safe and controlled environments under their direction and supervision, followed by exposure to actual skill practice. However, this initial fantasy phase, is usually omitted as the emphasis is on traditional apprenticeship learning and classroom lectures. Yet, according to Woolley & Jarvis (2006) the mental rehearsal model not only prepares the students better for the time spent in the practice setting, but also lays the foundation for the development of a clinically competent and confident practitioner with the requisite physical and cognitive skills necessary (16).

Along these lines, our findings showed an improved per-

formance for the mental rehearsal group, which, in terms of executing the skill, needed less time on average, to execute the new skill correctly. Furthermore, their mistakes during pair performance were reduced compared to the control group. Overall, our results showed small but highly significant benefits in terms of fewer mistakes for the mental rehearsal group. This finding suggests that mental rehearsal can improve the learning capacity and the preparedness of students learning how to perform Basic Life support.

Furthermore, the experimental group was relatively quicker when executing the tasks in question. This again, suggests not only better understanding, but by extension, better comprehension of the educational material, improved self-confidence and overall general efficiency in task acquisition.

Furthermore, although these results refer to only minutes in improvement of speed in accomplishing the tasks assigned, this has considerable importance when dealing with the two life saving skills i.e. CPR and defibrillation whereby every second counts. In turn this emphasizes the need for teaching mental rehearsal skills to nurse tutors for the benefit of their students especially when applied to skill acquisition concerning life threatening situations.

Our findings endorse that motor imagery of clinical skills, affects the speed and accuracy of acquiring motor skills. This has been also shown Sobierajewicz et al., (2017) who examined the specificity of motor imagery on the learning of a fine hand motor skill by employing a modified discrete sequence production task (17). Their findings suggested that motor imagery does resemble motor execution in the case of a fine hand motor skill and therefore could be employed as a highly effective educational tool. Furthermore, Eaton and Evans (1986), in their pioneering work used an experimental design on a sample of 60 nursing students and found that students scored to be with high or low imagination showed a significant improvement in their imagery ability after the use of imaging exercises with the greatest response for those of low imagination (18).

In addition, Ignacio et al., (2017) used a sophisticated mental rehearsal strategy in simulation training on clinical deterioration (19). The study compared two groups of nurse students, i.e. one with a conventional approach using a mnemonic strategy with mannequin simulation, and another which used mental rehearsal. Results suggested that although there were not great differences in the performance of both groups, mental rehearsing benefited the learning process and overall showed value in health professionals' training.

Yet, there are limitations to the potential benefits of mental rehearsal. A study by Ignacio et al, (2016) on a group of 18 senior nursing students has shown that although mental rehearsal strategy can be valuable for improving performance in managing patients who are deteriorating, its role in reducing stress, remains questionable (20).

As for patients, the value of mental rehearsal in terms of facilitating the rehabilitation process by practicing men-

tally various motor tasks prior to the actual activity can also be of benefit. A study by Jackson et al., (2001) on patients with central nervous system damage showed some therapeutic benefit on their performance of motor functions (21).

In terms of its practical applicability, mental rehearsal is far cheaper and simpler when compared to simulation or similar educational tools. Thus, a combination of mental rehearsal with physical practice may be a good alternative to situations whereby expensive equipment or processes cannot be employed.

6. CONCLUSION

The practice of mental imagery has been suggested to assist the acquisition of psychomotor skills in several fields including nursing education whereby the traditional 'show and practice' dominates.

As nurse students need to learn many psychomotor skills quickly and efficiently, the use of mental rehearsal as shown in this study might be the first step in improving the teaching of nursing skills. A further benefit of mental rehearsal is its cost-effectiveness and its relative ease of use as it does not require equipment or other resources, except one's imagination!

Differences in skill acquisition in favor of mental rehearsal are important, especially when this technique is used in the teaching of life-saving skills such as CPR and the use of defibrillators whereby increased speed and accuracy are of vital importance.

- **Participant Consent Form:** All participants were informed about subject of the study.
- **Author's contribution:** Study design: DT, SK, TP. Data collection: DT, AF, SK. Data analysis: AF, TP, ZK. Study supervision: AF, MM, GT. Manuscript writing: ZK, MM, GT. Critical revisions for important intellectual content: DT, AF. Final proofreading was made by the first author.
- **Conflicts of interest:** There are no conflicts of interest.
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