Role of Overlearning in Skill Retention of Cardiac First Response Course

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ABSTRACT

Objectives: To assess the effect of over-learning, on retention of skill, in final year students of Punjab Medical college after completing Cardiac First Response (CFR) course. **Study Design:** Quasi experimental study. **Place and Duration of Study:** Punjab Medical College, Faisalabad during 2014. **Methodology:** The study used a quasi-experimental design to compare the final year student's of Punjab Medical College having 60 students in over-learning and the same number in the control group. Experimental group practiced the skills for additional 2 hours amounting to 50% overlearning. Both groups completed same MCQ and skills tests after six weeks. Data were analyzed using SPSS version 15 and independent t test was performed for comparison of means of both skill test results. **Data Analysis**: Analyzed by using statistical software SPSS version 20. **Results:** In 1st time test the MCQ scores mean was 22.8 (n=60) and 21.92 (n=60) for the experimental group and control group respectively. Test after six weeks (2nd time) resulted in score means of 19.20 (n=50) and 16.15 (n=53) for these groups with p value=.000. The total mean score of the experimental groups' adult skill set was 101.42 (n=50) and that in control group was 97.79 (n=53) with p value=. 008 in the 2nd time test. Important skills like chest compressions showed better retention in the experimental group. **Conclusion:** Over-learning helps in better retention of procedural skills of CFR course after six weeks of nonuse.

Keywords: Skill retention, Overlearning, Cardiopulmonary resuscitation (CPR), Cardiac First response course (CFR), Medical Students

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INTRODUCTION

With the advancement in knowledge on heart diseases and cardiac arrest it became clear in early 1960s that cardiac arrest is reversible in most victims. Further research revealed that reversal of cardiac arrest was possible with availability of emergency team personnel trained in Cardiopulmonary Resuscitation (CPR) and use of defibrillator.[1]

The timing of treatment is a crucial factor in resuscitation and reversal of cardiac arrest is only successful in patients who received the treatment in a short time.

Cardiac First Response Course (CFR) has been developed by Pre-Hospital Emergency Care Council (PHECC), Ireland in 2011 as a version of Life support course similar in Basic Life Support course developed by the American Heart Association (AHA). CFR is a procedural task similar to CPR that consists of multiple decision-making points.[2]

The courses of life support are generally valid for two years before refresher training is required. Educators have been questioning whether this training proves effective throughout two years? According to literature the skills of life support courses tend to decay soon after completion of training.[3,4] There is clear indication of further research in identifying cost effective ways of retaining the lifesaving skills.[5]

Skill decay and retention is widely researched area and a large number of reviews have been conducted in this field. Arthur & Bennet[6] divide the influencing factors into two main categories

namely methodological factors and task related factors. Methodological factors are amenable to modification during training. Examples include degree of overlearning, conditions of retrieval, evaluation criteria and method of testing. On the other hand, task related factors are inherent to the task and thus carry ability to resist change by the researcher or trainer. Examples of these characteristics contain closed loop vs open loop; physical vs cognitive and natural vs artificial tasks.

A number of methods are proposed in literature to prevent skills decay. Multiple studies are consistent with the finding that overlearning is a dominating strategy in helping retention of knowledge and skills after successful training.[7] However, later work showed diminished effect of overlearning over time.[8] Nevertheless, in another study, Rohrer and Pashler[9] recommend opposite approaches for different kinds of tasks. On one side they take overlearning as inefficient way of long term retention and on other side they deem overlearning as necessary strategy for emergency routines in which error free outcome is required.

Another important dimension that has been put forward by Kim, Ritter & Kaubek[10] in the form of integrated theory for improved skill acquisition and retention, describing three stages of learning. These stages are called declarative, mixed and procedural. According to this theory, learning and forgetting rates are different for different stages of learning and thus explains the contradictions in previous work. Learners can move

their knowledge into third stage resulting in proceduralisation of skills making the acquired knowledge immune to decay. Gorgievski[11] compared massed distribution and cumulative distribution of homework in contribution to final score in examination in the subject of mathematics and there was no statistical difference in mean score of both groups.

Spaced or distributed practice looks promising in the light of literature but is not possible in our institutional setting due to parallel commitments of instructors and poor show on the part of students if required to attend the session spread over several weeks. Overlearning which has shown to enhance retention was considered as an alternate method as it is possible to engage the students for extended period of time by increasing time of session.

This study was designed to assess the effect of over-learning in CFR training in Punjab Medical College final year students to explore a way of increasing retention and preventing decay of skill in them.

METHODOLOGY
Study Design: Quasi experimental study.
Place of Study: Punjab Medical College, Faisalabad.
Duration of Study: One Year, 2014.
Operational Definitions;
These operational definitions are taken from the literature review about skill retention and overlearning as applied to CFR course with particular reference to the context of the study, but, strictly within the boundaries of available evidence.
Competency Level in CFR Skills: The skill level achieved and certified with documentation by licensed instructor as satisfactory (Grade A while grade B is unsatisfactory). (See appendix A)
Over-learning: Deliberate overtraining on a task after passing a set criterion. (For this study it is practice of skills after achieving grade A).
Degree of Overlearning: The amount of overlearning expressed as a percentage in relationship to the number of trials initially required to reach criterion. A 50% degree of overlearning means half the number of trials while 100% means equal number of trials.[12]
Retention Interval: It is the time elapsed between 1st test (immediately after completion of training) and 2nd test (after retention interval) conducted to assess the retention.
Intervention group: students undergoing 50% overlearning after achieving grade A in CFR course
Control group: students doing no overlearning
Research Question:
Does 50% over-learning of procedural skills in Cardiac First Response course minimize decay in final year MBBS students assessed six weeks after the course?
Research Objectives:
The objectives of this research are to:
- Examine the impact of over learning on CFR skills retention.

- Determine if gender has any influence in retention benefit of overlearning.

Hypothesis: Students in the intervention group (undergoing 50% overlearning) will demonstrate higher skill retention than the control group.
Subjects:
Final year MBBS Students. Total number of participating students was 120. Out of these 60 volunteering students were included in experimental group.
Ethical approval:
Ethical approvals were obtained from the review boards of Punjab Medical College and Aga Khan University.

Research Design:
Quasi-experimental study.
Intervention: The experimental groups were given additional two hours-time for skill overlearning after successful completion of course. This consisted of 50% of original procedural skill practice required to achieve competency level in comparison to the control

Data collection methods:
All students were tested just after completion of the course by an MCQ examination (single best type) and a skills test using two checklists included in the protocol of the CFR (Appendix 3, 4) by one assessor to complete the requirement of certification. Another assessor assessed the students using another form that used the same items as in the checklist but replacing the checklist with a rating scale. This rating scale was used for the purpose of the study to identify differences in the level of performance.
Second time same test of each batch was administered after six weeks of first assessment respectively, with the same assessor. Same MCQs were administered for the second time test, however only one assessor was required to administer the rating scales used for the study purpose.
Instrument: The validated checklists devised and used by the course developers in Ireland, were modified using the Dreyfus Model and the two levels of performance in the original checklist were converted into seven-point adjectival scales[13] (see appendix B & C).

Data analysis process
SPSS version 15 was used for data entry and analysis. Independent t test was used to compare the within and between group differences in performance of the experimental and control groups as well as any difference on account of gender.

RESULTS
The experimental (overlearning) group included 17 males and 43 female students, while of the sixty students in the control group there were 27 males and 33 female students. Both groups were divided into two equal batches having 30 students in each batch.

Table 1   Distribution of students in tests

GENDER	Time 1			Time 2		
	Overlearning Group	Control Group	Total			Total
Male	17 28.3%	33 55.0%	50 41.7%	11 22.0%	29 54.7%	40 38.8%
Female	43 71.7%	27 45.0%	70 58.3%	39 78.8%	24 45.3%	63 61.2%
Total	60	60	120	50	53	103

The training was completed for every batch a week apart. Assessment of the groups was carried by same assessors after six weeks of the original training for each group. The number of students showing up for 2nd time test was less than the assigned number in both the groups.

No statistically significant difference was observed in the MCQ score of the two groups on first administration of the test (p value = .539), however statistically significant difference was observed in the test scores when administered after six weeks (p value=.000) (Table 2). In comparison, of gender performance there was an no difference between both genders (Table 3).

Table 2: MCQ test results of 1st and 2nd administration of the test & Independent t-test for equality of means

Group Statistics				Independent sample test
GROUP	N	Mean ±Std. Deviation		t-test for Equality of p-value
MCQ score (test time 1) Overlearning Group Control group	60 60	22.08±1.43 21.92±1.53		.539
MCQ score (test time 2) Overlearning Group Control group	50 53	19.20±1.37 16.15±2.67		0.000

Table 3: Gender wise results of MCQ test of 1st and 2nd administration of the test &Independent t-test for equality of means

Group Statistics				Independent sample test
GENDER	n	Mean ±Std. Deviation	Std. Error Mean	t-test for Equality of p-value
1st test MCQ score Male Female	17 43	22.71±1.31 21.84±1.41	.32 .22	.033
2nd test MCQ score Male Female	11 39	19.45±.93 19.13±1.47	.28 .24	.491

Although in the second administration of the test the over learning group scored higher in almost all skills, significant difference was observed in the scores on 7 out of 20 skills on the adult check list. In infant skill checklist the Overlearning group scored significantly higher in only three skills.

Table 4: Test scores of groups (Adult Check list)

Group statistics			
	Group	Mean ±SD (Time 1)	Mean±SD (Time 2)
Safety	Over Learning Control group	5.43±.79 5.25±.77	5.74±.44 5.68±.47
Standard precaution	Over Learning Control group	5.37±.80 5.05±1.03	5.74±.44 5.79±.41
Patient Response	Over Learning Control group	5.37±.80 5.20±.80	5.84±.37** 5.45±.50
AED	Over Learning Control group	5.38±.85 5.07±.94	5.70±.46** 5.34±.48
Scan the chest	Over Learning Control group	5.27±.97 5.12±.88	5.76±.43** 5.45±.50
Call the emergency services	Over Learning Control group	5.23±.93 5.17±.85	5.12±.33** 5.57±.50
Carotid pulse	Over Learning Control group	5.22±.94 4.97±1.10	5.66±.48 5.75±.87
Chest compressions	Over Learning Control group	5.13±1.16 4.88±1.08	5.62±.49 5.68±.47
30 compressions	Over Learning Control group	4.93±1.06 4.90±.97	4.04±2.58** 5.36±.48
Compression depth	Over Learning Control group	4.80±1.41 4.97±.96	5.70±.46** 5.30±.46
OPA	Over Learning Control group	4.98±1.27 4.88±1.26	5.46±1.22 4.94±1.50
Face mask	Over Learning Control group	5.00±1.18 4.90±1.20	5.60±.49 4.98±1.69
Continues cycle of 30 Compressions	Over Learning Control group	4.87±1.13 4.78±1.17	5.36±.92 5.30±.46
Turns on the AED	Over Learning Control group	5.22±1.30 4.92±1.45	4.82±1.86 5.09±1.11
Clear the patient chest	Over Learning Control group	5.22±1.14 4.87±1.31	4.66±2.11 4.83±1.64
Puts right and left pads	Over Learning Control group	5.13±1.02 4.80±1.40	5.26±1.63 5.11±1.12
Warn the people	Over Learning Control group	5.15±.99 4.90±1.15	5.32±1.20** 4.21±2.21

	Group	Mean ±Std. Deviation Time 1	Mean±Std. Deviation Time 2
Delivers shock	Over Learning	5.32±.95	5.44±.50*
	Control group	5.00±1.19	4.81±1.63
Restarts CPR	Over Learning	5.12±1.03	5.26±1.19
	Control group	4.88±1.17	4.77±1.78
Follow the AED	Over Learning	4.88±1.50	5.10±1.59**
	Control group	4.87±1.31	3.34±2.65
Total score	Over Learning	102.95±17.06	101.42±7.43**
	Control group	99.23±18.18	97.79±6.09
Cycle 1 time	Over Learning	18.02±2.08	17.96±.40
	Control group	18.33±1.24	17.89±.95
Cycle 2 time	Over Learning	17.88±1.38	16.98±.84**
	Control group	18.32±1.48	18.06±1.25
* p value < .05 **P value < .01			

Table 5: Test of groups (Infant Check list)

Group statistics			
	Group	Mean ±Std. Deviation Time 1	Mean±Std. Deviation Time 2
Safety	Over Learning	5.75±.47	5.46±.50**
	Control group	5.12±.83	5.74±.45
Standard precaution	Over Learning	5.77±.46	4.94±1.54**
	Control group	5.13±.87	3.57±2.83
Patient Response	Over Learning	5.73±.45	5.28±.90
	Control group	5.17±.89	5.21±1.15
Shout for help	Over Learning	5.32±.95	5.34±.48
	Control group	4.95±1.03	5.40±.49
Insert OPA	Over Learning	5.02±1.27	4.94±1.54
	Control group	4.98±.79	4.28±2.12
Open the airway	Over Learning	5.38±.74	5.36±.48
	Control group	5.03±.82	5.26±.45
Give two effective breaths	Over Learning	5.38±.78	5.34±.95
	Control group	5.07±.80	5.42±.50
Brachial pulse	Over Learning	5.27±.99	4.72±1.44**
	Control group	5.12±.76	3.11±2.67
Chest compressions	Over Learning	5.20±1.23	4.90±1.05
	Control	4.92±1.08	4.58±1.51

	Group	Time 1	Time 2
	Control group		
Deliver 30 Compression	Over Learning	5.10±1.22	5.10±.30
	Control group	4.85±1.04	5.23±.42
Ensures accuracy	Over Learning	4.93±1.60	4.78±1.25
	Control group	4.97±1.18	4.60±1.70
Continue cycle	Over Learning	5.05±1.23	4.50±1.88
	Control group	4.82±1.05	4.26±2.25
Call for help	Over Learning	5.18±1.13	4.06±2.21
	Control group	5.02±1.00	3.64±2.67
Total score	Over Learning	65.65±11.47	64.34±5.30**
	Control group	64.83±10.13	60.23±9.57
Cycle 1 time	Over Learning	17.07±1.66	17.94±.24
	Control group	18.13±1.29	18.00±.62
Cycle 2 time	Over Learning	17.40±1.43	16.50±.97**
	Control group	18.32±1.27	17.72±.45
* p value < .05 **P value < .01			

Figure 1 shows difference in adult skills in test administered at time 1 as regards total score in both groups and this difference is again present in test administered at time 2 with little more magnitude. In Infant skills test the total score is almost same at time 1, for both groups, but it is different in the time 2 test, showing better retention in over-learning group
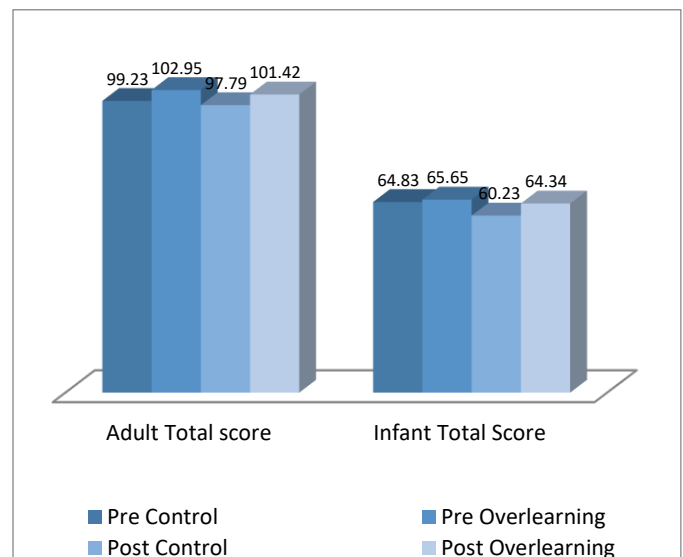

Figure 1: Comparison of Total Score

DISCUSSION

This study was conducted to assess the effect of over-learning in medical students after completing cardiac first response course. Six weeks duration was selected on the basis that most of the studies that have reported overlearning had used shorter retention interval i.e less than four weeks.[7]

Over-learning in CFR course can be termed as duration based as against criterion based. In this training, there is a predetermined duration of the practice of the skills and that ensures equal "study" time. However, the test is performed at the end of training to see if all the participants have achieved the desired competency level. The effect of over-learning is dependent on the task variability.[14] The findings in work on complex skills it is worthwhile to note that complex procedural skills have been shown to last for one year.[15]

The checklists used to assess the skills for adults and infants consist of 20 and 13 components respectively. These components belong to different task categories if classified into cognitive and psychomotor domains. The score marks a relatively inconsistent pattern (Figure 1) as regards different components with, of course, overall tendency of better retention in overlearning group. In some components, e.g. Calling emergency services; Delivering 30 compressions and; Turning on AED, the control group had better score on the second administration of the test, with good retention in both the groups. This could be attributed to assessment error as the rest of the skills show a consistent pattern.

In all the lifesaving skill courses, chest compressions have been considered as the most important skill which really determines the quality of the procedure, thus vital for saving the victim of cardiac arrest (2010 CPR and ECC guidelines). Better long-term survival has been seen to be associated with CPR with chest compression alone.[16] In our study, It has been particularly noted that skill associated with depth of chest compression is well retained in the overlearning group (p value=.000). It is consistent with finding in another study on medical doctors showing that the compression skills were well preserved as opposed to non-compression skills which were poor after six months of retention interval.[17] This difference is not seen in infant check list. The possible reason for low compression depth in infants may be the over careful attitude of students towards them fearing any damage to the chest of infants.

The scores when compared for gender differences in both administrations of the MCQ as well as check lists for adults and infants did not show any difference. This could be explained on the basis of student selection in public sector medical colleges which is totally based on the scores on admission test and pre-medical schooling and hence the near equal ability of both gender groups.

Limitations of the Study:

There are quite a number of limitations in this study. Primarily, sample was small and subjects were from a public sector medical college only, therefore, findings cannot be generalized. Further limitations included lack of randomization; unknown level of skills acquisition beyond satisfactory level; possible rater bias and peculiar combination of sub-tasks.

CONCLUSION

Our research proved that overall CFR course skills retention is significant in overlearning group as compared to control group after six weeks of retention interval. The results of our study resolve the overt paradox in previous studies conducted in this area. Multiple reviews found in the literature found less attention on long term retention procedural skills. This study is beginning of exploration of effect of overlearning, which looks a feasible and economical strategy for enhancement of long term retention of procedural skills maintained after six weeks interval and with this clarification further prospective, randomized studies can be initiated. In this way there is expected evolution of economical training models with adequate retention of high stake skills.

REFERENCES

1. Crockett P, Droppert B, Higgins S, Richards RK (eds). Defibrillation: What you should know. Physio-Control. Corporation; Redmond, Washington, 1996:6.

2. Kim, JW, Koubeck R J, Ritter FE. Investigation of procedural skills degradation from different modalities. In proceedings of the 8th International conference on Cognitive Modeling. Ann Arbor, Michigun, USA. 2007. Retrieved from http// act-r.psy.cmu.edu/?post_type=publication&p=14224

3. Mckenna SP, Glendon A I. Occupational first aid training: cardiopulmonary resuscitation (CPR) skills. Journal of Occupational Psychology 1985; (58):109-17.

4. Gilmore CM, Rae TD, Becker LJ, Eisenber MS. Three-phase model of cardiac arrest: Time2006-dependent benefit of bystander cardiopulmonary resuscitation. Amer J Cardiology 2006;98:497-9.

5. Anderson GS, Gaetz M, Statz C. CPR Skill Retention of First Aid Attendants within the Workplace. Prehosp Disaster Med. 2012;27(4):312-8.

6. Arthur W, Bennett W, Stanush L, McNelly L. Factors that influence skill decay and retention: A quantitative review and analysis. Human Performance. 1998;11:57-101.

7. Driskell J, Copper C, Willis R. Effect of Over-learning on Retention. Journal of Applied Psychology. 1998;77(5):615-22.

8. Rohrer D, Taylor K. The effects of overlearning and distributed practice on the retention of mathematics knowledge. Applied Cognitive Psychol. 2006;20:1209–24.

9. Pashler H, Rohrer D, Cepeda NJ, Carpenter SK. Enhancing learning and retarding forgetting: choices and consequences. Psychonomic bulletin and review. 2007;14(2):187-93.

10. Kim JW, Ritter F E, Koubek R J. An integrated theory for improved skill acquisition and retention in the three stages of learning. Theoretical issues in Ergonomics Science. 2013;14(1):22-37.

11. Gorgievski N. The impact of the spacing effect on overlearning on student performance in calculus. (unpublished doctoral thesis). University of Connecticut, USA. 2011

12. Oxendine JB. "Psychology of Motor Learning", New York: Appleton-Century-Crofts. 1968.

13. Streiner D L, Norman G R. Health Measurement Scales: A practical guide to their development and use. Oxford University Press, New York. 2006

14. Mumford et al. Measuring occupational difficulty: A construct validation against training criteria. J Applied Psychol 1987;72(4):578-87.
15. Boet S, et al. Complex procedural skills are retained for a minimum of 1 yr after a single high-fidelty simulation training session. Br J Anaesth. 2011;107(4):533-9.
16. Dumas F et al. Chest compression alone cardiopulmonary resuscitation is associated with better long-term survival compared with standard cardiopulmonary resuscitation. Circulation. 2013;127(4):435-41.
17. Na JU, Sim MS, Jo IJ, Song HG, Song KJ. Basic life support skill retention of medical interns and the effect. Emerg Med J 2012; 29(10): 833-7.

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