

Learning Basic Life Support (BLS) with task cards : comparison of four reciprocal learning settings

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Abstract : *Background :* Research emphasises the need for instructional methods and tools which can improve BLS performance or reduce instructional time.

Aim : To evaluate the efficiency of four 20 min reciprocal learning settings with task cards for acquiring BLS.

Methods and materials : 72 university students were paired and randomised into four groups to learn BLS in 20 min with task cards. Groups differed in the implementation of two instructional variables, namely role switching and role definition. BLS performance was measured before (baseline), immediately after (intervention) and 2 weeks later (retention).

Results : At intervention and retention, all groups achieved between 71 and 81% of the maximum total BLS score. At retention significantly more students from the group where role switching and role definition were implemented performed the complete BLS sequence.

Conclusion : This study demonstrated that implementing role switching and role definition in a reciprocal learning setting with task cards fosters BLS skill retention.

Key words : Basic Life Support ; education ; resuscitation ; cardiopulmonary resuscitation ; training.

INTRODUCTION

Basic Life Support (BLS) is a crucial part of the "Chain of Survival" where each link influences survival : early access, early BLS, early defibrillation and early advanced cardiac life support (ALS). Since the majority of cardiac arrests are witnessed (1), bystander cardiopulmonary resuscitation (CPR) has been shown to be an important predictor of increased survival to hospital discharge (2, 3). Research indicated that when bystander BLS is initiated the survival rate is doubled (4, 5).

Because of this importance BLS courses became widely implemented in hospitals, lifeguard training, school curricula and several lay organisations. Often these BLS courses are classroom-based and consequently instructor intensive, time-consuming and costly. Additionally, objective testing of skill acquisition and skill retention has given disappointing results (6, 7). Consequently, researchers

have emphasised the need for instructional methods which can raise the level of BLS performance or reduce instructional time while preserving performance level over time (8, 9). This has led to the development of new instructional methods and tools such as Video-, DVD- and CD-ROM-based self training, interactive computer training with and without instructor, etcetera (10-13). Despite the promising results of these innovative instructional methods and tools, some problems arise. Firstly, results obtained from the research mentioned above are limited to the specific learning setting and specific target group addressed in those studies. Consequently, it is difficult to generalise these research findings. Also, it is dangerous to compare different teaching methods for BLS without taking into account the characteristics of learners and without investigating how a present setting in itself could be enhanced. For example, comparing a BLS video for self-instruction with traditional classroom instruction can be problematic when the video is not designed based on multimedia research taking into account how people learn from video. In this case, self-instruction using video is an inferior learning setting because of the inadequate design of the video. Future research should therefore primarily focus on optimizing existing teaching methods within a specific target group. Secondly, a lot of BLS courses are severely limited in financial resources, which makes it impossible to integrate some of the investigated, expensive instructional methods and tools in every day BLS courses. Thirdly, a typical BLS course is still classroom-based, with students sharing one manikin.

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Therefore, it would be significant to optimise this learning setting. In this article, four reciprocal learning settings of 20 minutes were implemented to learn BLS according to guidelines set by the European Resuscitation Council (ERC) (15). Settings differed in the quality and quantity of structure that was implemented. Task cards combining a picture of the BLS skill with specific instruction about how to perform this skill were developed as learning tools for BLS. To foster constructivist learning, the development and design of the task cards were based on multimedia learning research (16). The target group consisted of university students in Kinesiology.

Reciprocal learning is a cooperative learning strategy in which students are paired and exchange roles of doer and helper (17). In this format students work together to maximise their own and each other's learning. While one learner (doer) performs the task, the other learner (helper) instructs, observes and gives feedback based on information provided by the teacher orally or in the form of task cards. A substantial body of literature has documented the effectiveness of pairing students to teach and assess each other in both regular (18, 19) and physical education settings (20-25). Moreover, it has been shown that academic gains occur for both doers and helpers (26, 27). The helper is intended to be 'learning' by teaching' (28), the doer by doing. Despite these positive research findings, peer learning effects are not incidental. Therefore, merely placing students in pairs is insufficient to ensure that learning will occur. It is only when structure is implemented so that students understand how they should work together, cooperation and learning get maximised (29). This raises the question which instructional variables could maximise learning outcomes in reciprocal learning within a specific target group. In this study two instructional variables, namely role switching and role definition, are implemented separately and combined in reciprocal learning settings with task cards. According to COHEN (1994) (30) role switching fosters a reciprocal exchange in which the output of the helper becomes input of the doer. Student partners can work in their roles for a specific amount of time (perhaps three to five minutes) or a set number of turns (perhaps 10 to 15 turns) depending on the skill to be learned (31). This role switching is considered to be an important factor in explaining learning gains in general education settings.

Clearly defining roles of being a helper or doer helps to prevent social loafing, engaging in small talk and increases student participation and respon-

sibility (32, 33). With clearly defined roles, the doer knows exactly what he/she should be working on while the helper knows exactly what components of a skill to look at and what kind of feedback that should be given (31). For these reasons, task cards can be useful as a source for giving feedback and as important tools to facilitate peer tutoring roles (20, 22, 25, 31).

In this article it was investigated whether the separate and combined implementation of two instructional variables, namely role switching and role definition, was beneficial for learning BLS in a reciprocal learning setting with task cards. In all settings, task cards combining a picture of the BLS skill with specific instruction about how to perform this skill were used as learning tools. BLS consists of nine actions to be performed in a specific order, aimed at saving a person's life. Based on Romiszowski's (1999) (34) skills scheme, BLS can be classified as a reproductive skill because of the application of a standard procedure (algorithm).

MATERIALS AND METHODS

Sample and student grouping

The sample was made up of a total of 72 freshmen Kinesiology students (aged 17-19 years), 21 men and 51 women from a Belgian university. The study was embedded in a curricular Life Saving course at university. Students chose partners they preferred to work with and marked their relationship individually with 1 (unknown person), 2 (acquaintance), 3 (friend) or 4 (bosom friend). Student pairs were randomly divided into four groups of 18 students : role switching group (5 men and 13 women), role definition group (5 men and 13 women), combined group (5 men and 13 women) and control (6 men and 12 women). Analysis indicated no significant differences in relationship between partners across the four groups. All participants had given their informed consent for participation in this study. Students reported no previous training in BLS skills.

Experimental design and conditions

Baseline BLS performance was measured individually. Therefore, students received standardised instructions and the following scenario on a laptop computer : 'You are asked to help a man who has just collapsed in this room. The manikin in this room represents that man. You have two minutes to

help the man to the best of your abilities. I will answer questions concerning the victim's condition, but I will not tell you what to do.' A mobile phone was present next to the victim. Student's actions were assessed as baseline BLS performance. After baseline assessment students were paired for intervention and were given 20 minutes to learn a BLS sequence by means of task cards. Task cards were continuously available during intervention. Also, task cards were the only source of information for learning BLS. Student pairs were randomly assigned to one of four peer learning settings and received standardised instruction on a laptop computer according to their experimental group. In the role switching group students were asked to work in a doer-helper relationship. The function of the doer and helper was not defined. Every five minutes students had to switch roles as prompted by the researcher. In the role definition group students were also asked to work in a doer-helper relationship. The function of the helper was defined as 'checking the doer's actions with the task cards in one's hands and giving continuous feedback concerning the correctness of his/her actions.' The function of the doer was defined as 'following the instructions and taking into account the feedback given by the helper.' No specific instruction concerning the switching of roles was given. In the combined group students worked in a defined doer-helper relationship and they switched roles every five minutes. In the control group students received no instructional guidance on how to structure the learning setting. During intervention all student pairs were videotaped in order to collect BLS data and allow adequate analysis afterwards. After 20 minutes intervention time BLS performance was individually re-assessed. Retention testing of BLS performance occurred two weeks following intervention. Participants were asked not to engage in BLS activities meanwhile.

BLS task cards

Eleven task cards were developed to learn BLS. Their content was developed according to the European Resuscitation Council 2005 guidelines and comprised the instruction of nine BLS items (15), namely safe approach, check responsiveness by shaking gently and shouting loudly, shout for help, open airway, check for breathing, call 112, perform thirty chest compressions, perform two ventilations and continue the 30 compressions-2 ventilations sequence until you become exhausted, professional rescuers take over or the victim starts

breathing normally. Instructions for performing chest compressions and ventilations were provided on two task cards due to the complexity of these skills. All task cards had an A4 format and combined a picture of the BLS skill with instruction on how to perform the skill. To foster constructivist learning, the development and design of the task cards were based on multimedia learning research (16).

Assessment of BLS performance

All BLS assessments were individually completed on a Laerdal AED ResusciAnne manikin connected to a laptop computer running the PC-Skill Reporting system version 2.0 (Laerdal Medical, Belgium). This software recorded the following cardiopulmonary resuscitation variables: total number of compressions, average compression depth, average compression frequency, hand position, total number of ventilations, average ventilation volume, rescue breath flow rate, duty cycle and ventilation-compression ratio. In addition, qualitative assessments were made by two researchers, naïve to the purpose of this study and certified BLS instructors. These qualified observers evaluated the following variables from BLS videotape recordings at baseline, intervention and retention: safe approach, check responsiveness by shaking gently and shouting loudly, shout for help, open airway, check for breathing, call for help or 112, continue 30-2 sequence, performed all BLS skills and performed all BLS skills in correct order. Some of these variables evaluated by observers were dichotomous (performed – not performed), others had multiple responses. Intra- and inter-observer reliability was measured using Cohen's Kappa. Intra-observer reliability was 0.98 for researcher A and 0.96 for researcher B. Inter-observer reliability was 0.91, based on 40% of all BLS video tapings. To calculate the overall BLS performance, data from the research manikin and assessments made by observers were entered in a scoring system based on the Cardiff Test (35) (see appendix). Total BLS scores could range between 16 and 69 points. Individual BLS variables were also analyzed. At baseline, participants were given 2 min to act as best as possible. At intervention and retention assessment was stopped after participants performed three compression-ventilation cycles.

The following agreements were made:

- safe approach was performed correctly when verbally indicated by the participants;
- correct compression-ventilation ratio was 30 ± 2:2;

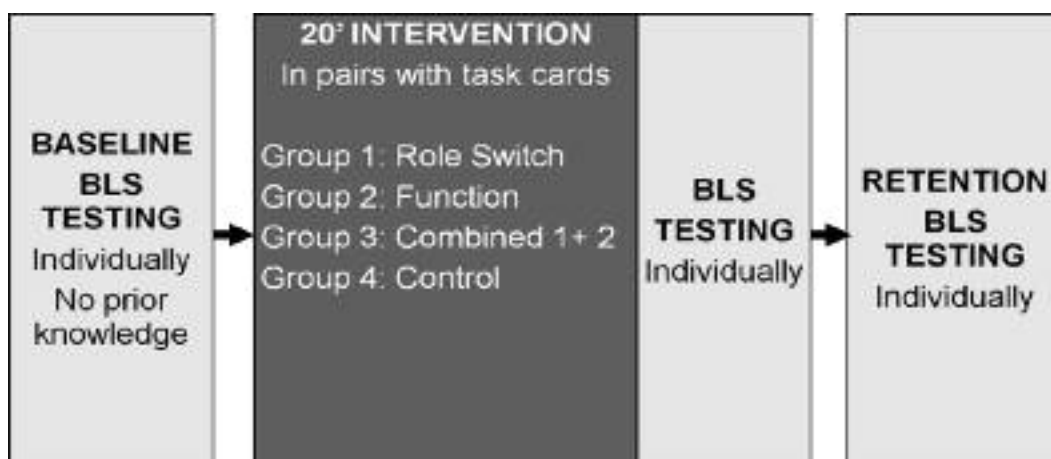


Fig. 1. — Study design

- participants unable to ventilate the manikin but who attempted a ratio of 30:2 were scored as such because they apparently had learned the skill for the ratio ;
- the item ‘continue 30:2 ratio’ was evaluated by asking participants how long to perform the ratio. On the task cards it was instructed to continue until (1) qualified help arrives and takes over, (2) the victim starts breathing normally or (3) you become exhausted. This was consistent with the ERC 2005 guidelines.

Statistical methods

For BLS, dichotomous variables (performed – not performed) were analysed using Pearson’s chi squared analysis. Variables with multiple responses, total BLS scores and continuous cardiopulmonary variables from the manikin were analysed using one way analysis of variance (ANOVA), in order to detect significant differences between groups. Scheffé’s test was conducted for post hoc analysis in order to discriminate significantly different groups. An alpha level of .05 was used for all statistical tests.

RESULTS

Total BLS scores and BLS items

Average total BLS scores at baseline, intervention and retention in the four groups are shown in figure 1. No significant differences between groups were found at baseline, intervention and retention. Also for individual BLS items, no significant differences between groups were found.

CPR variables

Data for mean CPR variables from intervention and retention testing are presented in Tables 1 and 2.

At intervention, a significant difference between groups was found for the percentage of correct chest compressions ($P = 0.039$). Post hoc Scheffé analysis however could not discriminate between groups.

The mean rescue breath volume in all groups was consistent with guidelines, except for the role definition group. Duty cycles in all groups were low compared to target guidelines. The percentage of correct rescue breaths was poor in all groups.

At retention, no significant differences were found between the four groups. In all groups mean chest compression rates and depths were consistent with guidelines. The mean rescue breath volume in all groups was consistent with guidelines, except for the role definition group. Duty cycles in all groups were low compared to target guidelines. The percentage of correct rescue breaths remains poor.

BLS sequence

At retention, significantly more students from the combined group remembered and consequently performed all nine BLS skills compared to their counterparts in the control group ($P = 0.03$) (see figure 2).

DISCUSSION

This study demonstrated that student pairs without instructor involvement can learn BLS in a

Table 1

Comparison of mean CPR variables and standard deviations at baseline and after three compression :ventilation cycles at intervention testing in the role switching (RS), role definition (RD), combined (COM) and control (CON) group (n = 4 × 18). The *F* and *P* values presented are calculated on between groups intervention scores

	Guideline targets	Baseline Means	Intervention testing means				<i>F</i> value	<i>P</i> value
			RS	RD	COM	CON		
Total compressions performed	90	5(9)	91(3)	88(14)	92(7)	92(5)	0.869	0.461
Chest compression rate (min ⁻¹)	100	16(25)	108(18)	108(18)	117(20)	101(23)	1.941	0.131
Chest compression depth (mm)	40-50	9(14)	45(3)	42(12)	44(9)	42(7)	0.601	0.616
Chest compressions with correct hand placement (%)	N/A	4(5)	87(21)	77(32)	89(29)	79(23)	0.922	0.435
Duty cycle (%)	50	13(18)	36(8)	37(7)	41(8)	36(5)	1.880	0.141
Correct chest compressions (%)	N/A	2(3)	74(24)	45(34)	61(38)	69(27)	2.940	0.039
Total RB performed	6	1(1)	5(1)	6(1)	5(2)	6(2)	1.126	0.344
RB volume (ml)	500-600	32(170)	572(147)	668(165)	536(265)	570(177)	1.533	0.214
RB flow rate (ml/s)	500-600	24(130)	598(322)	519(181)	385(362)	512(312)	1.530	0.215
Correct RB (%)	N/A	0(0)	17(24)	21(23)	16(22)	23(23)	0.413	0.744

Table 2

Comparison of mean CPR variables after three compression :ventilation cycles at retention testing in the role switching (RS), role definition (RD), combined (COM) and control (CON) group (n = 4 × 18)

	Guideline targets	Retention testing means (standard deviation)				<i>F</i> value	<i>P</i> value
		RS	RD	COM	CON		
Total compressions performed	90	90(0)	83(17)	90(2)	88(8)	1.690	0.177
Chest compression rate (min ⁻¹)	100	95(25)	101(32)	111(20)	99(20)	1.374	0.258
Chest compression depth (mm)	40-50	43(5)	42(14)	44(9)	44(8)	0.188	0.904
Chest compressions with correct hand placement (%)	N/A	81(33)	63(35)	90(17)	80(36)	2.457	0.070
Duty cycle (%)	50	36(8)	34(12)	40(9)	38(5)	1.621	0.192
Correct chest compression (%)	N/A	61(36)	33(28)	44(25)	43(36)	2.582	0.061
Total RB performed	6	4(3)	6(2)	5(1)	5(3)	0.814	0.490
RB volume (ml)	500-600	502(273)	693(318)	528(240)	525(246)	2.461	0.070
RB flow rate (ml/s)	500-600	535(367)	536(310)	528(465)	442(277)	0.283	0.837
Correct RB (%)	N/A	16(26)	12(18)	13(20)	11(15)	0.278	0.840

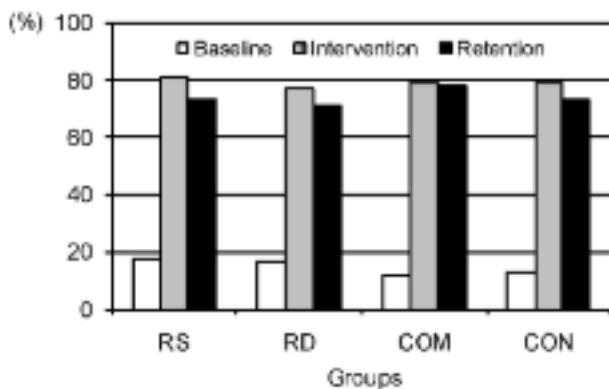


Fig. 2. — Average Basic Life Support performance at baseline, intervention and retention testing in the role switching (RS), role definition (RD), combined (COM) and control (CON) group.

20 min reciprocal learning setting with task cards. Task cards have demonstrated to be effective tools to learn BLS. Consequently, this format is less time consuming, less instructor intensive and allows

more active learning time to learn BLS compared to traditional classroom teaching. Additionally, it is easy to implement this format in regular, everyday BLS courses because it only enhances the established setting with student pairs sharing a manikin.

At intervention and retention all groups achieved high percentages of the total maximum BLS score. No significant differences were found between groups. Although not significant, the combined group achieved the highest total BLS score at retention. Compared to the total BLS score at intervention, the combined group only drops 1%. This is a small drop compared to the decline in total BLS score from intervention to retention in other groups. It seems that the performance of subjects where role switching and role definition are implemented is more persistent over time.

When looking at individual CPR variables, all groups achieved or approached the European Resuscitation guidelines 2005 guidelines, indicating effective BLS learning. However, performance

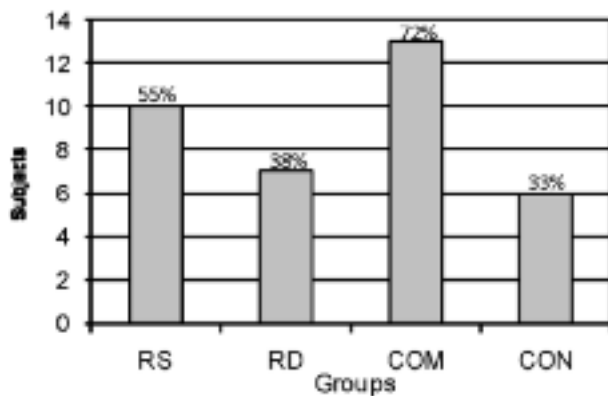


Fig. 3. — Number and percentage of subjects performing all Basic Life Support skills at retention in the role switching (RS), role definition (RD), combined (COM) and control (CON) group. The combined and control group differ significantly at $P < .05$.

of rescue breathings and the achieved duty cycles remains poor.

Retention of all nine BLS skills was the highest in the combined group. A significant difference was found between the combined group and the control. This means that significantly more subjects from the combined group remembered and consequently performed all BLS skills compared to their counterparts from the control group. In this study, it is striking that skill retention was only enhanced in the condition where role switching as well as role definition were implemented. The isolated implementation of those variables does not seem to affect skill retention. It is only when both are implemented, skill retention is enhanced.

Static media like task cards have two main advantages in fostering student learning: they allow controlling the learning pace and they can serve as an organisational and/or feedback tool. In the present setting students could decide themselves when to proceed to the following BLS skill on the next task card. This control over the pace of learning has demonstrated to improve learning outcomes (36). In dynamic multimedia (video, DVD and CD-ROM) or instructor demonstration, control over the learning pace is often limited. Consequently learners could face a high cognitive load because of the overwhelming amount of information they receive, which negatively affects learning (16).

From a sociocognitive perspective on learning, teaching and learning are highly social activities. Interactions with teachers, peers and learning materials like task cards could influence the cognitive and affective development of learners (37, 38). It is stated that when learners perform intellectual

activities, they dynamically interact with the learning environment which could support improved performance. In the present study, individual learners were able to interact with their peer and the task cards. Hence, improved interaction with this learning context should enhance performance. Therefore, implementing role definition could have affected interactions between learners and the task cards because it defined the roles of being a doer and a helper. Being a helper was defined as 'checking the doer's actions with the task cards in one's hands and giving continuous feedback concerning the correctness of his/her actions'. The role of the doer was defined as 'following the instructions given by the helper'. These role definitions contain guidance on how to use the learning tools and how to interact with the partner, which might be advantageous to enhance learning outcomes. The importance of instructing students how to use learning tools has previously been stressed for learning cardiopulmonary resuscitation performance in a classwide peer learning setting (22). However only when role definition as well as role switching is implemented, skill retention is enhanced. It seems that both variables are reinforced by each other.

This study has some limitations. Firstly, the performance of ventilations remains poor. This confirms previous research where ventilation technique has been documented to be poorly acquired (39, 40). Secondly, the nature of the BLS skill as a restriction to the generalisability of this study should be acknowledged. Different results could have been obtained when the task involved a more motor –, cognitive – or non algorithmic skill. Thirdly, the sample group in this study consisted of university students in Kinesiology. These students are perhaps more acquainted with learning psychomotor tasks such as BLS and consequently achieve higher learning outcomes compared to other learners. In other words, the question arises whether the impact of instructional variables on student performance in this target group is more restricted in comparison to other groups. Additionally, it could be stated that for the present target group task cards as learning tools in itself promote effective cooperation between peers, explaining high learning outcomes but no significant differences for total BLS scores at intervention and retention. Finally, practice time in this setting was set at 20 minutes. Maybe this intervention time is too long for discriminating the impact of organisational variables and allowing initially weaker groups to achieve similar performance. Further research is needed to investigate the generalisability of the findings of this study.

In conclusion, this study indicated that BLS skill retention is enhanced when role switching and role definition is implemented in a 20 min reciprocal learning setting with task cards. At retention significantly more students from the combined group remembered and consequently performed all items of the BLS sequence. Furthermore, learning BLS with task cards in a highly structured 20 min RL setting with task cards appears to be an effective and efficient method for laypersons to master BLS.

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Appendix
Assessment of Basic Life Support performance

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|--|--|
| 1. <i>Safe approach</i> | 6. 100 |
| 2. Performed | 5. 85-99 |
| 1. Not performed | 4. 70-85 |
| | 3. 55-70 |
| 2. <i>Check consciousness</i> | 2. < 55 |
| A. By shaking gently at shoulders | 1. Not attempted |
| 3. Performed | D. Average compression rate (rate/min) |
| 2. Not performed | 6. 90-110 |
| 1. Performed potentially dangerous | 5. 110-120 |
| B. By shouting aloud | 4. 80-90 |
| 2. Performed | 3. > 120 |
| 1. Not performed | 2. < 80 |
| | 1. Not performed |
| 3. <i>Shout for help</i> | 7. <i>Ventilation</i> |
| 2. Performed | A. Total amount of ventilations after three cycles |
| 1. Not performed | 7. 6 |
| 4. <i>Check breathing</i> | 6. 4-5 |
| A. Opening airway | 5. 7-8 |
| 4. As instructed on task cards | 4. 1-3 |
| 3. Other and effective | 3. > 8 |
| 2. Visibly attempted | 2. Attempted |
| 1. Not performed | 1. Not performed |
| B. Look, listen, feel | B. Average ventilation volume (ml) |
| B1. Actions | 7. 500-600 |
| 4. Correct | 6. 300-499 |
| 3. Not correct | 5. 600-800 |
| 2. Not effective | 4. 1-299 |
| 1. Not performed | 3. > 800 |
| B2. Time | 2. Attempted |
| 4. 8-12 seconds | 1. Not performed |
| 3. > 12 seconds | C. Ventilation : compression ratio |
| 2. 1-8 seconds | 5. 2 : 30 (2 : 28-32) |
| 1. Not performed | 4. Other |
| 5. <i>Call 112</i> | 3. Compression only |
| 3. Performed | 2. Ventilation only |
| 2. Called unspecified help | 1. No ventilation nor compression |
| 1. Not performed | 8. <i>Continue with resuscitation</i> |
| 6. <i>Chest compressions</i> | 4. 3 items correct |
| A. Total amount of compressions after three cycles | 3. 2 items correct |
| 4. 85-95 | 2. 1 item correct |
| 3. > 95 | 1. No items correct |
| 2. 1-84 | Extra analysis : |
| 1. Not performed | 9. <i>Performed all BLS items</i> |
| B. Average compression depth (mm) | 2. Yes |
| 6. 40-50 | 1. No |
| 5. 51-55 | 10. <i>Performed all items in the correct sequence</i> |
| 4. 24-39 | 2. Yes |
| 3. > 55 | 1. No |
| 2. 1-24 | |
| 1. Not performed | |
| C. Compressions with correct hand position (%) | |

Total Basic Life Support score (1-8) : range 16-69 points