CARDIOPULMONARY RESUSCITATION – A PROMISING SCHOOL TOPIC? A PRE-POST-EVALUATION OF EMOTIONS, PSYCHOLOGICAL ATTITUDES AND KNOWLEDGE

Claas WEGNER[a], Rico DUMCKE[a]*, Roland BENDER[b], Luisa KUCKNAT[a], Niels RAHE-MEYER[c]

[a] Bielefeld University, Universitätsstr. 25, 33615 Bielefeld, Germany

[b] Paderborn University, Warburger Str. 100, 33098 Paderborn, Germany

[c] Franziskus Hospital Bielefeld, Kiskerstraße 26, 33615 Bielefeld, Germany

Abstract

Cardiopulmonary resuscitation (CPR) education is suggested to be part of the official school curricula in Europe to increase bystander resuscitation and survival rates after cardiac arrest. Many postgraduate teachers are reluctant to teach CPR to their students. This study aims to evaluate if prospective biology teachers are able to plan and conduct CPR lessons successfully. 88 German students in 9th grade high school classes participated in a CPR workshop consisting of practice and conversational phases. A pre-post questionnaire was used to assess CPR related mental overload, self-efficacy, prosocial attitudes, and knowledge. The emotional state was tested separately after participating. Results indicate that positive emotional states were predominant afterwards and that competency perception and knowledge increased significantly, whereas mental overload decreased. A CPR lesson conducted by non-professional, CPR trained prospective biology teachers has a positive impact on high school students' attitudes and knowledge, indicating the concept's practicability.

Key words*: Cardiopulmonary resuscitation, implementation, psychological attitudes, schools*

1. Background and Aims

Although the incidence of cardiac arrests treated by Emergency Medical Services (EMS) in western industrial countries is around 184 343 and 275 000 persons per year in the US (Benjamin

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* Corresponding author. Rico Dumcke

E-mail address: rico.dumcke@uni-bielefeld.de

et al., 2018) and Europe (Atwood et al., 2005), the rate of bystander cardiopulmonary resuscitation (CPR) varies between less than 30% and over 70% (Gräsner & Bossaert, 2013). However, there is evidence that the odds of survival increase two- to fourfold when basic life support measures are provided immediately after cardiac arrest (Hasselqvist-Ax et al., 2015; Wissenberg et al., 2013). Thus, it has been suggested that CPR should be implemented as a repeated part of the regular school education to improve bystander CPR significantly (Bohn et al., 2015; Böttiger et al., 2017; Böttiger & van Aken, 2015; Cave et al., 2011) as there are multiple benefits for schoolchildren to be trained in CPR (Böttiger & van Aken, 2015).

Although it has been shown that high school students can successfully perform CPR (Abelairas-Gómez et al., 2014; Jones et al., 2007; Lukas et al., 2016), there are still cross-national barriers that impede a systematic implementation. Different models of CPR trainings in schools (by healthcare professionals, Red Cross instructors, peer learning or teachers) exist and have been successfully tested in several studies. However, for regular training in schools, teachers are in focus as they are cost-effective and available multiplier. In this respect, noTable factors include the teachers' competence perception (qualification for CPR instructions) and setting aside the necessary time (for CPR lessons adjacent to the curricula) (Bakke & Schwebs, 2017; Hoyme & Atkins, 2017; Lockey et al., 2016; Malta Hansen, Zinckernagel et al., 2017; Salciccioli et al., 2017; Zinckernagel et al., 2016).

Our aim is to evaluate if CPR trained prospective biology teachers (Master of Education university students) in Germany are able to successfully plan and conduct CPR lessons in school which could increase the school's teaching possibilities. The results were primarily defined by high school students' emotions and attitudes: (i) positive emotional associations with CPR education, (ii) increase in self-efficacy and prosocial attitudes, and (iii) a reduction of mental overload and anxieties. In addition, changes in theoretical knowledge were assessed (secondary outcome).

2. Methods

2.1. Intervention and Data Acquisition

The pre-post-study (see Figure 1) was conducted in late 2017 in four 9th grade classes of a public high school (Bielefeld, Germany) by two prospective biology teachers from Bielefeld University during a practical phase of their academic education.

The advanced CPR training (5 hours) for the prospective biology teachers was insured by the Franziskus Hospital Bielefeld (Clinic of Anesthesiology and Intensive Care Medicine) following the American Heart Association (AHA) and the European and German Resuscitation Council (ERC/GRC) resuscitation guidelines of 2015 (Kleinman et al., 2015; Perkins et al., 2015).

All 9th grade students of one German high school (n=112) were invited to participate in the workshop. Students were informed about research aims and participated voluntarily; their parents gave written informed consent. Since this questionnaire study was not on humans or animals, ethics approval was not necessary to obtain.

One week prior, a pre-test was conducted to assess baseline conditions (t1). During the workshop, the four classes were divided into two learning groups involving approx. 50 high school students each, and received 90 minutes of both theoretical and practical CPR instruction (see Appendix 1 for detailed teaching concept) with inflatable Mini Anne manikins (Laerdal Medical; Stavanger, Norway). After the workshop (t2), the students were asked to complete the post-test which measured their emotions in addition to the questions at baseline.
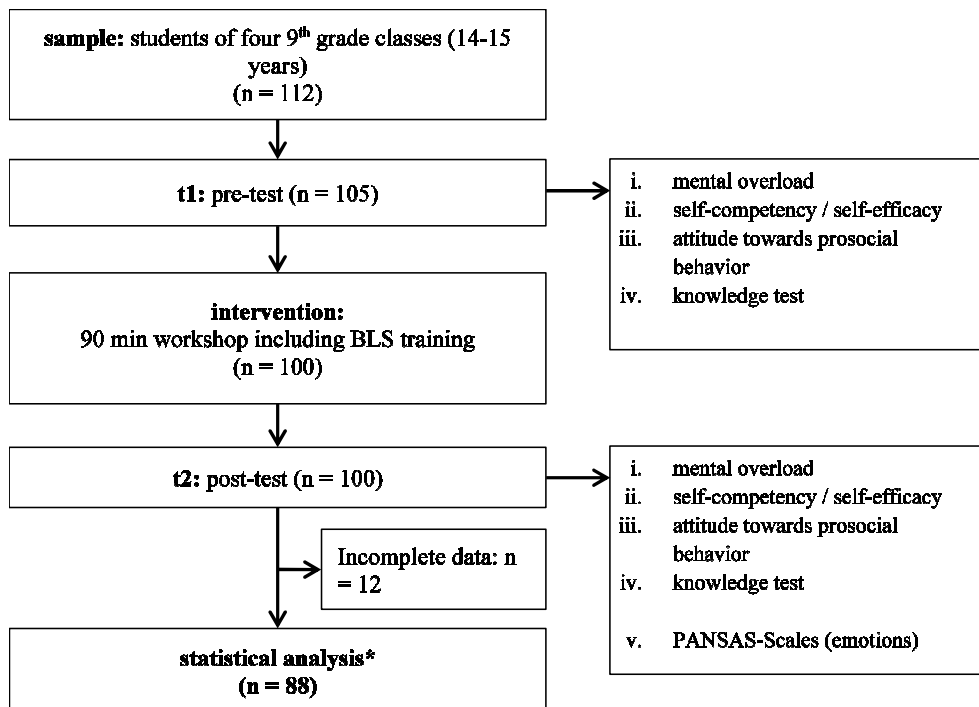
Figure 1. Flow-Chart for the used pre-post comparison. Additionally, used testing dimensions are listed. *indicates that high school students missing one of the testing points due to illness or staying abroad were excluded. t: testing point; BLS: basic life support

2.2. Test Instrument

The questionnaire was divided into three sections. The first contained statements about psychological attitudes and opinions about CPR (12 items). The items were developed specifically for this evaluation. The answer options ranged from (1) "very slightly or not at all" to (5) "extremely" on a five-point-scale ('Likert-Type' scale). Three psychological sections for behavior modification during an emergency situation (e.g. cardiac arrest) compromised of four items each: (i) assessment of mental overload, (ii) expectation on self-efficacy (realizing and conducting first aid) and (iii) general prosocial attitude towards CPR assistance (see Appendices 2, 4).

The second section additionally evaluated the current emotional state after the intervention at time-point t2 by the Positive and Negative Affect Schedule (PANAS) using a modified German version (Krohne et al., 1996; Watson et al., 1988) (see Appendix 7). The PANAS questionnaire contains 20 adjectives describing emotional states, which are sub-classified into (i) ten positive and (ii) ten negative affects (see Appendix 7). The answer scale equals the one in section one.

The third section was a knowledge test (secondary outcome) and consisted of six questions in multiple-choice format. Three questions each were given for (i) identification and examination of a circulatory arrest and (ii) the correct CPR-performance (Appendices 2; 5, 6). Answers were coded gradually (range 0-1) according to the right-false-ratio of checked items.

2.3. Statistics

The Statistical Package for the Social Sciences (SPSS) v. 25 (IBM, Armonk/NY, USA) was used for analysis. The emotional and psychological sub-tests were described by the mean values and standard deviation. Mean values and relative frequencies of the answers were calculated for the results of the knowledge items. The dimensions of the knowledge test and the PANAS were summarized to a total score. To evaluate differences of the psychological indicators and knowledge questions, paired t-tests between the two testing points were calculated, unless there was an inhomogeneity of variances (Levene's-Test: $p \leq 0.05$), in which case, the Welch-test was used. Differences below the significance level of 5% ($p \leq 0.05$) were considered to be significant. Effect sizes were calculated as Cohen's d (Cohen, 1992). All questionnaire sections took gender differences into account (unpaired t-test, Welch-test). Reliability was proofed by calculating explorative factor analysis and internal consistency.

3. Results

3.1. Demographics

Out of 112 cases (all 9th grade students of the participating high school), 88 datasets could be analyzed, as absent students were excluded (Figure 1). Each of the four classes consisted of 19 to 24 students. Of the surveyed students 53.4% were female and 45.5% were male; one stated neither male nor female (1.1%). Fourteen percent of the students had already participated in a first aid course that included CPR training before the workshop.

3.2. Emotions after the intervention

The high school students' current emotional states were gathered after the intervention. The reliability of the PANAS-Test was satisfying (see Limitations and Psychometrics). Mean values with standard deviation are shown in Figure 2.

High school students asked directly after the workshop (t_2), on average distinctly agreed to emotional descriptions of positive affects (M=3.38; SD=0.79). When dividing the scale into two sections of agreement (lower: 1.0 to 2.99; higher: 3.0 to 5.0), 78% of the students displayed high positive emotional characteristics on all 10 items. Negative affects were valued low on all 10 adjectives (M=1.48; SD=0.45) by 100% of the participants (range: 1.0 to 2.7). Single descriptions of positive affects such as "attention" and "interest" (M=3.83 and 3.85, respectively; item-label: "quite a bit") as well as "experience" and "activity" (M>3.5) were especially high. However, the perception of stamina was markedly weakened ("persistent", M=2.86; see Figure 2). When taking negative emotions into account, students were mostly "distressed" (M=1.84), followed by "nervousness" and "disgust", with other negative affects rarely pronounced (M<1.5).

3.3. Psychological attitudes: mental overload, self-efficacy, prosociality

Results based on psychological self-statements (assessment of mental overload, expectation of self-efficacy, prosocial attitude) are presented by single items at both test points (see psychometrics; Table 1). The average assessment of mental overload, e.g. the feeling that they might worsen the patient's condition, the fact that they were disgusted by rescue breathing, or felt uncomfortable if the torso has to be exposed, was significantly lower after intervention (t-test; p≤0.001 see Table 1). The anxiety of worsening the patient's condition decreased the strongest (M=2.32 vs. 1.57; p≤0.001) with high effect size (d=.85) (Cohen, 1992). Moderate concerns that the strength might not be able to be maintained remained consistent at both time points (M=2.00 vs. 2.06; p=0.681).
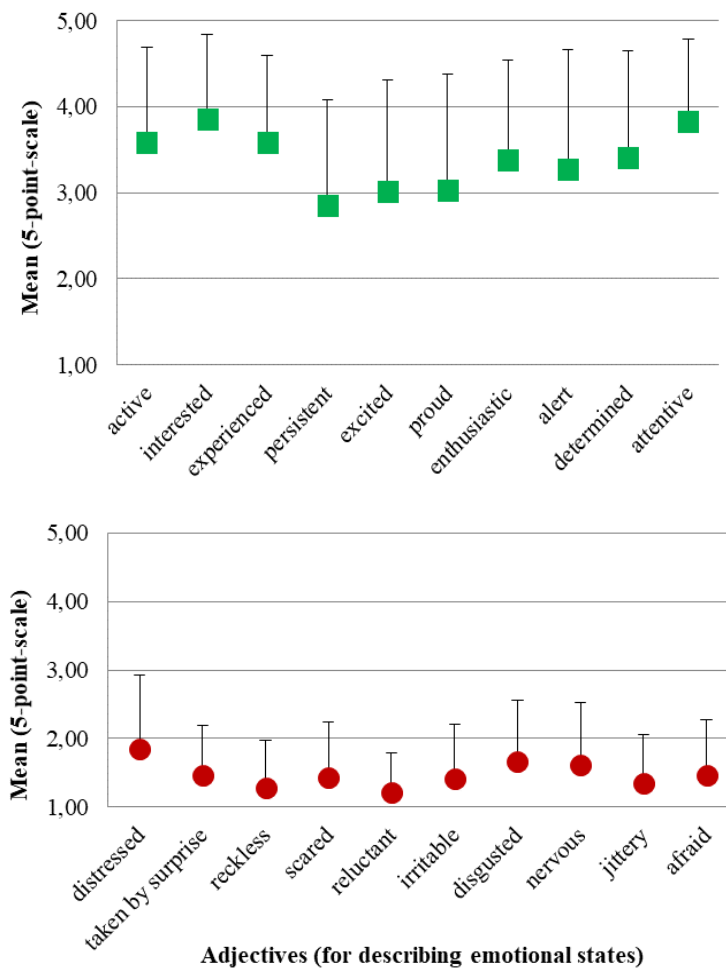
Figure 2. The result of the modified PANAS-tests at t2 (after intervention), with its own translation (modified items) or by (Watson et al., 1988). However, the German version (Krohne et al., 1996) was used. The Mean values of positive (PA, upper figure.) and negative affects (NA, lower figure) as well as the standard deviation (SD; positive bars) are shown. The scale ranges from (1) "very slightly or not at all" to (5) "extremely" (n=87-88, list wise missing values).

Items dealing with self-efficacy as a subjective perception of competency (e.g. knowing how to deal with an unconscious person, the recognition of cardiac arrest, the performance of chest compressions) is significantly higher at t2 ($p<0.001$; $d>1.00$). The students' tendency to see themselves as unsuitable aids decreases slightly but significantly on a low agreement level, (M=1.95 vs. 1.66; p=0.008; d=0.30). Attitudes towards prosocial behavior in three of four items increased significantly (item-label: "extremely") at t2 ($p\leq0.005$; d=0.72-0.85, Table 1), with the most evident being the increased satisfaction about acquired knowledge (Δt2-t1: +0.8).

Additionally, the opinion that an ambulance is fast enough and more qualified for aid is lower at t2 (M=3.12 vs 2.41; p<0.001; d=0.74).

Table 1. High school students' self-assessment of mental overload, self-efficacy (subjective perception of competency) and prosocial statements. n: sample size; M: mean values; SD: standard derivation; t: testing point (1 = before; 2 = after); Δ (Delta): difference in mean values; p-value: significance of t-test (paired) differences from t1 to t2; Cohens d: effect size.

Section	Item (shortened description)		M (±SD)		Δ	Sig.	Effect size
		n	Pre t1	Post t2	t2-t1	p	Cohens d
Mental overload	Anxiety to worsen the patient's condition	88	2.32 (±1.0)	1.57 (±0.7)	-0.75	<.001	0.845
	Disgust of mouth-to-mouth resuscitation of a stranger	85	2.52 (±1.1)	2.07 (±0.7)	-0.45	<.001	0.455
	Reluctance to expose the patient's torso	86	1.98 (±0.9)	1.63 (±0.8)	-0.35	.001	0.425
	Concern that they do not have enough strength	84	2.00 (±1.1)	2.06 (±1.1)	0.06	.681	0.052
Self-efficacy (Self-competency)	Procedural knowledge about dealing with an unconscious person	87	2.46(±1.3)	4.30 (±0.8)	1.84	<.001	1.649
	Certainty to recognize a cardiac arrest	87	2.57 (±1.2)	3.87 (±0.9)	1.30	<.001	1.231
	Certainty to conduct chest compressions sufficiently and correctly	85	2.35 (±1.4)	4.05 (±1.0)	1.70	<.001	1.384
	Reluctance and passive behaviour because of doubt to be the most sufficient aide	87	1.95 (±1.1)	1.66 (±0.9)	-0.29	.008	0.299
Attitude towards prosocial helping behaviour	Emphasis on the importance of an emergency call	88	4.48(±1.1)	4.85(±0.7)	0.37	.005	0.845
	Emphasis on better qualification and speed of the ambulance	85	3.12 (±1.3)	2.41(±1.3)	-0.71	<.001	0.545
	Satisfaction about knowing how to help people	84	3.65 (±1.4)	4.51 (±0.8)	0.86	<.001	0.737
	Emphasis on the importance of immediate bystander first aid before the ambulance arrives	86	3.88 (±1.1)	4.58 (±0.8)	0.70	<.001	0.721

3.4. Learning Growth of Theoretical Knowledge

On testing knowledge, the overall score was significantly higher after the intervention, as high school students correctly answered 73.3% of the items, when compared with 38.6% in the pre-test (M=4.9 vs. 3.1 at t1; p<0.001, see Figure 3). More specifically, five out of six items showed a positive significant increase between both time points (t-test: p<0.001; see Appendices 5; 6).

Most students remember the take-home message "check, call, compress" and the correct compression depth after t2 (95.5%; ΔM= +0.57 and 96.6%; ΔM = +0.64, respectively). More than 60% of the high school students knew the correct steps to check for cardiac arrest, when to stop CPR, and specific indicators for quality.

a)

b)
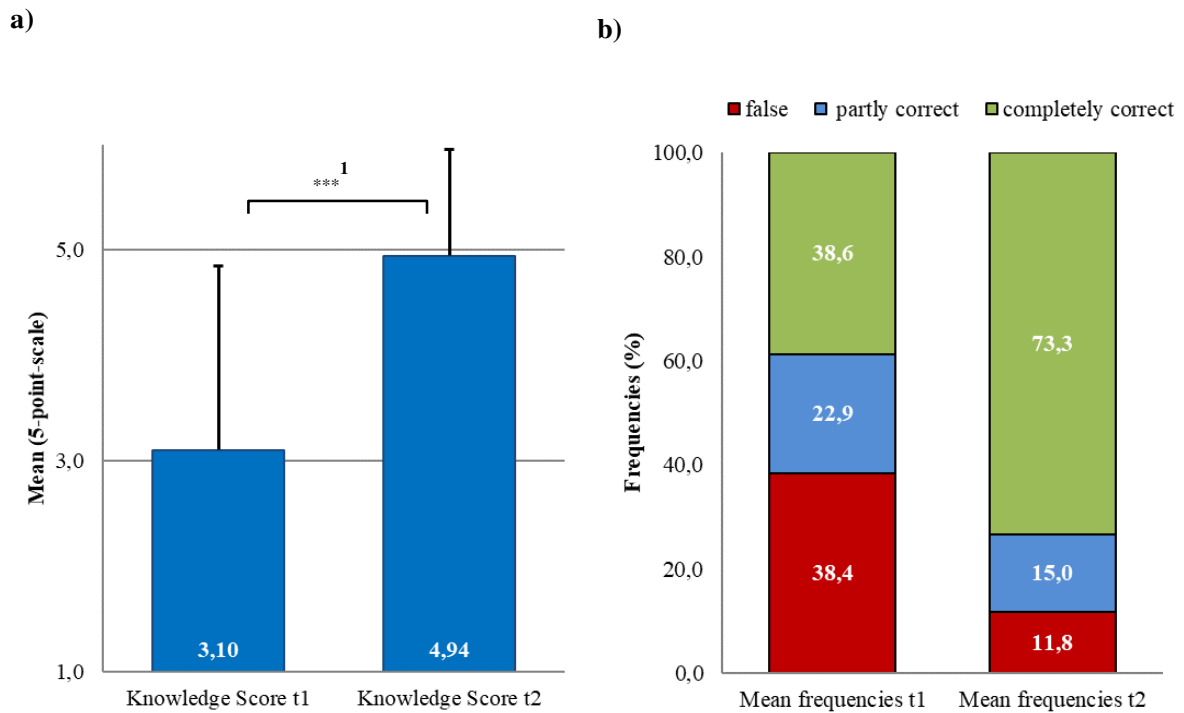
Figure 3. Change in theoretical knowledge. a) Mean values of the total score (max. score was 6 points) before (t1) and after (t2) the intervention. *** indicates p≤0.001. [1] indicates: paired t-test (two-sided). b) Distribution of relative frequencies (all six items) categorized by answer correctness (n = 88).

3.5. Gender Differences

Gender differences for two emotional descriptions were discovered; directly after the intervention, boys felt more determined (M=3.68 vs. 3.15; Welch-test: p=0.047), but also more reckless (M=1.48 vs. 1.11; p=0.021) than girls. Concerning psychological indicators between female and male participants no effects became statistically significant, except that girls were more afraid that they did not have enough strength for chest compression before and after the training (Welch-test$_{t1; t2}$: p=0.021; 0.001). No differences were found in the knowledge test at t1 (p=0.78), but at t2 female high school students scored higher (M=5.25 vs. 4.56; p=0.002).

4. Discussions

All psychological and emotional attitudes were affected positively in all dimensions within the study.

4.1. Emotional Affects

This study evaluated positive and negative affects connected with the practical CPR exercises. A new finding of this study is that high school students link positive perceptions with CPR, when confronted with it as teaching issue, while negative feelings remain low. A positive affect (PA) describes the intensity to which a person is enthusiastic, active and attentive, and was explained in our survey by the terms "interest", "attention", "experience", and "action" (Krohne et al., 1996; Watson et al., 1988). These adjectives are connected with social activity and the person's contentment, reflecting concentration and dedication for a subject (Watson et al., 1988).

Intrinsic motivation is based on the satisfaction of basic needs by a subject: activities that are intrinsically interesting, the feeling of experiencing new things, or feeling challenged are motivating conditions to start learning processes (Ryan & Deci, 2000). These are important catalysts and often lead to a persistent motivation, combined with positive feedback and autonomy (Ryan & Deci, 2000). In fact, learning CPR in school is a serious issue, but such high scores of positive affects found in our study indicate that high school students actually do have fun and interest to acquire these skills. For example, a Norwegian study demonstrated that 75% of the participating high school students support compulsory CPR education (Kanstad et al., 2011).

However, some outliers have to be mentioned: the perception of stamina, a positive affect, was low (M = 2.86). This result may be explained by the experience that chest compressions are an invasive and exhausting activity which challenges the physical condition and capability of 13-14-year-old high school students (Abelairas-Gómez et al., 2014; Jones et al., 2007).

In spite of the evident tendency in this evaluation that positive emotions are interconnected with our CPR workshop, didactic methods should be enhanced to increase those associations. Autonomy supporting learning arrangements instead of fully controlled settings (presentation and instructed exercises) could be a favorable alternative. Other studies could, for example, confirm peer-learning (Beck et al., 2015; Iserbyt et al., 2016), computer-based simulations (Yeung et al., 2017) or competitions (Vetter et al., 2016) as successful methods.

4.2. Psychological Attitudes

After participating, high school students expressed a more positive attitude, such as being a sufficient aide, an improved subjective perception of competency, and accordingly perceived less mental overload. This is supported by prior evidence, especially in regard to certainty and self-efficacy (Felzen et al., 2018; Kanstad et al., 2011; Lukas et al., 2016). In accordance with Bandura's social-cognitive theory, self-efficacy is considered to be an important predictor for changes in behavior and action (Bandura, 1997). Therefore, it is essential to emphasize the importance of active methods such as approaching the person, managing the airway, and performing chest compressions; yet it is also crucial to consequently address psychological restraints such as disgust, the risk of infection, undressing the patient, or dealing with the role of making the decisions as first rescuer (e.g. regarding other laypersons). Misconceptions or the bystander-effect could reinforce negative decisions against an intervention (Latané & Darley, 1970). Our results indicate that negative attitudes may have been dissolved by discussions, as this contributes to the students' future willingness to perform effective CPR (Iserbyt, 2016). Both tasks, procedural and mental issues should be fulfilled by schools.

Student's concerns in relation to their sufficient physical capabilities, which remained constant at t1 and t2, demonstrated that 9th graders recognize CPR as physically challenging. Moderate CPR quality in trainings with high school students was revealed by prior studies (Abelairas-Gómez et al., 2014; Jones et al., 2007). One recommendation following this evidence should be a reflection of problem-solving considerations such as teamwork or rapid changes of compression providers (Abelairas-Gómez et al., 2014). These mentioned worries regarding physical stamina were significantly higher in females. A new review by Finke et al. reported general gender-associated differences in CPR education and highlights this point: Male students physically performed better, whereas females were more motivated and could remember new knowledge more easily (Finke et al., 2018). Consequently, expanding constructive feedback and alternative solutions for both genders should be considered.

4.3. Learning Growth of Theoretical Knowledge

The acquired knowledge was significantly higher after the intervention; other studies have previously confirmed that CPR training improves declarative knowledge (Kua et al., 2018; Wingen et al., 2018). The higher overall score of girls in our study is in line with findings by Finke et al. (2018). However, it was surprising that fewer students correctly answered how to deal with an unconscious but breathing person after the intervention (see S6). One potential

explanation could be that the recovery position (correct answer) was not discussed in enough detail. A similar phenomenon is described by Kleikamp and Breckwoldt: when high school students have to decide whether to apply CPR or the recovery position in a knowledge test, 58% of the answers are wrong beforehand, afterwards 80% and 70% are wrong after retesting three months later (Kleikamp & Breckwoldt, 2010). The result of this knowledge test question contradicts the subjective certainty to be able to correctly help an unconscious person (see Table 1). Thus, recovery position issues and medical indication, if addressed and not skipped, need to be explicitly discussed.

5. Limitations and Psychometrics

This evaluation was designed as a feasibility-study and is a snapshot of individual opinions and knowledge status after an intervention with a confined sample size. Longitudinal investigations and bigger sample sizes are necessary for a generalization of the discovered scores and differences.

With exception of the self-efficacy assessment at baseline (t1), all three short scales dealing with psychological attitudes partially displayed low reliability parameters for internal consistency and discriminatory power (e.g. $\alpha < 0.7$; $r_{it} < 0.4$; see Appendix 3). Reasonable explanations could be a relatively small sample size or the potential imprecise phrasing of some items. Additionally, further limitations are given because only four items were used per scale (Cortina, 1993; Schmitt, 1996). Hence, a summary of individual indicators to a one-dimensional, one feature capturing scale was waived. Notwithstanding the above, our results present relevant information for CPR lesson evaluation. We therefore decided to present the data on the basis of single items.

The exploratory factor analysis of the PANAS-test predominantly resulted in the two-dimensional structure of the validation documentation (see Appendix 7) (Krohne et al., 1996; Watson et al., 1988). Some modified adjectives had a low discriminatory power ($r_{it} < 0.40$) compared to the original items, e.g. for "disgusted". Disgust (such as the fear of infection) is an emotion which dissuades non-professionals from performing CPR (Malta Hansen, Rosenkranz et al., 2017; Vaillancourt et al., 2008). Thus, all items were calculated, because an evaluation and discussion of such emotions are relevant for training. Internal consistency of the positive affect scale equaled that of the original PANAS scales ($\alpha = 0.86$), the one of the negative affects ($\alpha = 0.76$) was lower (Krohne et al., 1996; Watson et al., 1988), but sufficiently high (Schmitt, 1996).

6. Conclusion

Ninety-minute CPR lessons including practical exercises were conducted by trained (and dedicated) prospective biology teachers who have no medical qualification, and were successful in such a way that positive emotional associations were dominant afterwards. The high school students' association with CPR lessons was distinctly positive, but negative affects were hardly seen in our study; this displays important evidence that the topic can be easily provided, is interesting and motivating. Improvements in the perception of competency, fear of mental overload, and prosocial attitudes indicate an effective intervention, which consisted of practical CPR exercises and discussions of social-psychological aspects to deliberately reduce anxiety. Learning concepts regarding the maintenance of those positive emotions as potential motivation for CPR education need to be developed further.

Acknowledgements

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Supplementary Appendix

Appendix 1. Educational Concept

Educational concept description (duration approx. 90 minutes) of a BLS-workshop for 9th graders

Phase	Description/Content	Social form
Introduction	Introductory video-sequence: Missing CPR-knowledge in the case of "heart failure" Physiological explanation: Why is sudden cardiac arrest life threatening?	Teacher-led
Theory/lecture	Background: • statistical facts and relevance of CPR • Discussion about frequently expressed misconceptions, such as injury, disease transmission or psychological effects in emergency situations	Teacher-led with question period
Instruction 1	Step-by-step instruction for compression-only CPR using illustrations, following the concept of the campaign "Ein Leben Retten"[2]: Check - Call - Compress	Teacher-led with question period
Practical training 1	Training of cardiac compression on an inflaTable resuscitation doll for 4 min/student. To assist with rhythm and retention, a song (Stayin' alive) with 100 bpm was played in the background.	Working in pairs
Introduction 2	Step-by-step instruction for CPR including rescue breathing with two persons using illustrations	Teacher-led
Practical training 2	Training of cardiac compression (student 1) and rescue breathing (student 2) for 4 min with changing roles after 2 min.	Working in pairs
Closure / feedback & questionnaire	Option for student questions and feedback. Completion of the questionnaire.	Discussion/ self-assessment

Abbreviations: BLS: basic life support; CPR: cardiopulmonary resuscitation

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[2] https://www.einlebenretten.de/ (assessed 22.03.2018)

Appendix 2. Listing of the questionnaire items

Psychological Self-Assessment Items
Instruction: How much do the following statements about CPR with chest compression apply to you personally?

No. t1	No. t2	Labelling (for post-testing variables „_p" is added)	Item verbalisation (German original)*	Item verbalisation (translated)*	Dimension
5.1	5.1	over1_fear	Ich habe Angst, bei der Herzdruckmassage den Zustand des Patienten noch zu verschlimmern.	I am scared to worsen the patient's condition while conducting cardiac compressions.	Assessment of mental overload
5.2	5.2	pro1_emergencycall	Ich bin der Meinung, zu helfen und den Notruf 112 zu verständigen, ist eine wichtige Hilfe.	I believe helping by calling 112** is important first aid.	Attitude towards prosocial behaviour
5.3	5.3	self1_unconscious	Ich weiß, wie ich bei einer bewusstlosen Person Hilfe leisten kann.	I know how to help an unconscious person.	Self-efficacy (Self-competency)
5.4	5.4	self2_check	Ich bin sicher, dass ich einen Herzstillstand überprüfen und schnell erkennen kann.	I am sure that I am able to check for and recognize a cardiac arrest quickly.	Self-efficacy (Self-competency)
5.5	5.5	over2_disgust	Vor der Beatmung einer fremden, bewusstlosen Person schrecke ich wegen Ekelgefühl zurück.	I am reluctant to conduct rescue breaths on an unfamiliar, unconscious person because of feelings of disgust.	Assessment of mental overload
5.6	5.6	over3_undress	Es kostet mich Überwindung, den Oberkörper einer Person freizumachen.	I am reluctant to undress a person's torso.	Assessment of mental overload
5.7	5.7	self3_compression	Ich bin davon überzeugt, dass ich eine Herzdruckmassage im Notfall durchführen kann.	I am confident that I am able to conduct chest compressions in an emergency situation.	Self-efficacy (Self-competency)
5.8	5.8	over4_power	Ich habe Bedenken, dass ich für eine Reanimation nicht ausreichend Kraft habe.	I am afraid that I do not have enough strength to conduct CPR.	Assessment of mental overload
5.9	5.9	pro2_ems	Ich denke, der Rettungsdienst ist sehr schnell vor Ort und gut ausgebildet. Der kann viel besser das Leben des Patienten retten.	I think that the EMS arrive quickly and are qualified. They are better suited to save human lives.	Attitude towards prosocial behaviour
5.10	5.10	pro3_satisfaction	Es stellt mich zufrieden, dass ich durch meine Kenntnisse in der Reanimation einem Menschen helfen kann.	It is satisfying that I am able to help other people with my knowledge about CPR.	Attitude towards prosocial behaviour
5.11	5.11	pro4_importancelayperson	Ich bin der Meinung, dass der erste Helfer am Notfallort bei einem Herzstillstand die Überlebenswahrscheinlichkeit mehr erhöht als der Rettungsdienst.	I think that the immediate responder increases the chances of survival in case of a cardiac arrest higher than the ambulance.	Attitude towards prosocial behaviour

No. t1	No. t2	**Labelling** (for post-testing variables „_p" is added)	**Item verbalisation (German original)***	**Item verbalisation (translated)***	**Dimension**
5.12	5.12	Self4_wait	Wenn an einem öffentlichen Ort eine Person plötzlich das Bewusstsein verliert, würde ich vorerst abwarten und gucken ob jemand anderes vielleicht besser helfen kann.	If a person becomes unconscious in a public place, I would wait to see if someone else could help better.	Self-efficacy (Self-competency)

* Response options

(German original):	(1) ganz wenig oder gar nicht, (4) erheblich,	(2) ein bisschen, (5) äußerst.	(3) einigermaßen,
(translated)	(1) very slightly or not at all, (4) quite a bit,	(2) a little (5) extremely.	(3) moderately,

** European emergency call number.
Abbreviations: CPR: cardiopulmonary resuscitation; EMS: emergency medical services

Knowledge Items

No. t1	No. t2	**Labelling** (for post-testing variables „_p" is added)	**Item verbalisation (German original)***	**Item verbalisation (translated)***	**Dimension**
6	10	Knowledge_E1	Wie gehe ich in einer Reanimationssituation vor?	How would I act in a CPR situation?	Recognize CA
7	11	Knowledge_D1	Wenn ich mit einer Wiederbelebung begonnen habe, wann höre ich mit der Wiederbelebung wieder auf?	If I have started CPR, when is the right time to stop?	Perform CPR
8	12	Knowledge_E2	Wie stelle ich einen Atemstillstand fest?	How do I recognize respiratory arrest?	Recognize CA
9	13	Knowledge_E3	Was mache ich, wenn ein Patient auf dem Boden liegt, nicht ansprechbar ist, aber noch schwach atmet?	What should I do when a patient is lying unresponsive on the ground but is still breathing?	Recognize CA
10	14	Knowledge_D2	Wie tief muss ich bei einer Herzdruckmassage bei einem durchschnittlichen Erwachsenen in den Brustkorb drücken?	How deep do I have to compress an average adult's chest?	Perform CPR
11	15	Knowledge_D3	Was trifft zu, wenn ich eine Herzdruckmassage durchführe?	What is correct when conducting chest compressions?	Perform CPR

Response options: Several Multiple-Choice-options were given.
Abbreviations: CPR: cardiopulmonary resuscitation; CA: cardiac arrest

Emotional State

Instruction: Please state how you feel <u>at this moment</u> directly after the workshop.

No. t2	Labelling	Item verbalisation* German original (Krohne et al., 1996)	Item verbalization English original (Watson et al., 1988) or translated by authors	Content
9.1	Pan1_aktiv_p1	aktiv	active	Positive Affect (PA)
9.2	Pan2_bekümmert_n1	bekümmert	distressed	Negative Affect (NA)
9.3	Pan3_interessiert_p2	interessiert	interested	Positive Affect (PA)
9.4	Pan4_erfahren_p3	erfahren	experienced**	Positive Affect (PA)
9.5	Pan5_überrumpelt_n2	überrumpelt	taken by surprise*	Negative Affect (NA)
9.6	Pan6_ausdauernd_p4	ausdauernd	persistent**	Positive Affect (PA)
9.7	Pan7_rücksichtslos_n3	rücksichtslos	reckless*	Negative Affect (NA)
9.8	Pan8_erschrocken_n4	erschrocken	scared	Negative Affect (NA)
9.9	Pan9_abgeneigt_n5	abgeneigt	reluctant*	Negative Affect (NA)
9.10	Pan10_angeregt_p5	angeregt	inspired	Positive Affect (PA)
9.11	Pan11_stolz_p6	stolz	proud	Positive Affect (PA)
9.12	Pan12_gereizt_n6	gereizt	irritable	Negative Affect (NA)
9.13	Pan13_begeistert_p7	begeistert	enthusiastic	Positive Affect (PA)
9.14	Pan14_angeekelt_n7	angeekelt	disgusted*	Negative Affect (NA)
9.15	Pan15_wach_p8	wach	alert	Positive Affect (PA)
9.16	Pan16_nervös_n8	nervös	nervous	Negative Affect (NA)
9.17	Pan17_entschlossen_p9	entschlossen	determined	Positive Affect (PA)
9.18	Pan18_aufmerksam_p10	aufmerksam	attentive	Positive Affect (PA)
9.19	Pan19_durcheinander_n9	durcheinander	jittery	Negative Affect (NA)
9.20	Pan20_ängstlich_n10	ängstlich	afraid	Negative Affect (NA)

*Response options:

(German Original) (1) ganz wenig oder gar nicht, (2) ein bisschen, (3) einigermaßen (4) erheblich, (5) äußerst

(English version) (1) very slightly or not at all, (2) a little, (3) moderately, (4) quite a bit, (5) extremely

** modified adjective, see Appendix 7.

Appendix 3. Psychometric Parameters: Attitudes

Item parameters for attitude sections. Developed by the authors. Internal consistency (Cronbach α), mean inter-item-correlation (MIC) and corrected discriminatory power at both time points t1 and t2 are shown.

	No.	Item-verbalisation	Cronbach's alpha [α]	Mean Inter-Item-Correlation [MIC]	Corrected Item-Scale-Correlation [r_{itc}]
Mental Overload	5.1	I am scared to worsen the patient's condition while conducting the cardiac compression.			.174
	5.5	I am reluctant to conduct rescue breaths on an unfamiliar, unconscious person because of feelings of disgust	**0.373**	.126 (.226)	.245
	5.6	I am reluctant to undress a person's torso.			.144
	5.8	I am afraid that I do not have enough strength to conduct a CPR.			.236
Self-efficacy	5.3	I know how to help an unconscious person.			.666
	5.4	I am sure that I am able to check for and recognize a cardiac arrest quickly.			.543
	5.7	I am confident that I am able to conduct chest compression in an emergency situation.	**.738**	.401 (.666)	.638
	5.12	If a person becomes unconscious in a public place, I would wait to see if someone else could help better. (–)			.297
Attitude towards prosocial helping behavior	5.2	I believe helping by calling 112** is important first aid.			-.053
	5.9	I think that the EMS arrive quickly and are qualified. They are better suited to save human lives.			.072
	5.10	It is satisfying that I am able to help other people with my knowledge about CPR.	**.279**	.084 (.281)	.251
	5.11	I think that the immediate responder increases the chances of survival in case of a cardiac arrest higher than the ambulance.			.331

** European emergency call number.
(–) Item polarity reversed.
Abbreviations: CPR: cardiopulmonary resuscitation; EMS: emergency medical services

Appendix 4. Differences in Mean values: Attitudes

A) Descriptive statistics and B) central tendencies of psychological questions about attitudes in the questionnaire. Developed by the authors.

Content	No.	Item-Verbalisation	Descriptive Statistics [t1]			Descriptive Statistics [t2]		
			n	Mean	SD	n	Mean	SD
Mental Overload	5.1	I am scared to worsen the patient's condition while conducting the cardiac compression.	88	**2.32**	1.001	88	**1.57**	.740
	5.5	I am reluctant to conduct rescue breaths on an unfamiliar, unconscious person because of feelings of disgust	85	**2.52**	1.098	85	**2.07**	.828
	5.6	I am reluctant to undress a person's torso.	86	**1.98**	.881	86	**1.63**	.752
	5.8	I am afraid that I do not have enough strength to conduct a CPR.	84	**2.00**	.124	84	**2.06**	.125
Self-efficacy	5.3	I know how to help an unconscious person.	87	**2.46**	1.319	87	**4.30**	.764
	5.4	I am sure that I am able to check for and recognize a cardiac arrest quickly.	87	**2.57**	1.187	87	**3.87**	.887
	5.7	I am confident that I am able to conduct chest compression in an emergency situation.	85	**2.35**	1.412	85	**4.05**	.107
	5.12	If a person becomes unconscious in a public place, I would wait to see if someone else could help better. (–)	87	**1.95**	1.077	87	**1.66**	.900
Attitude towards prosocial helping behavior	5.2	I believe helping by calling 112** is important first aid.	88	**4.48**	1.061	88	**4.85**	.653
	5.9	I think that the EMS arrive quickly and are qualified. They are better suited to save human lives.	85	**3.12**	1.034	85	**2.41**	1.284
	5.10	It is satisfying that I am able to help other people with my knowledge about CPR.	84	**3.65**	1.410	84	**4.51**	.784
	5.11	I think that the immediate responder increases the chances of survival in case of a cardiac arrest higher than the ambulance.	86	**3.88**	1.100	86	**4.58**	.789

Values of the descriptive statistics.
Abbreviations: n: sample size; MW: mean values; SD: standard deviation; CPR: cardiopulmonary resuscitation; EMS: emergency medical services

*: significant < 0.01. (–) indicates that the polarity of the item has to be reversed.
**112 is the European emergency call number.

Table continued.

Content	No.	Item-Verbalisation	Differences in Central Tendencies: t-test					
			n	ΔMean	95% CI	t-value (df)	Sig. (2-tailed)	Effect size d
Mental Overload	5.1	I am scared to worsen the patient's condition while conducting the cardiac compression.	88	**.750**	.525 - .975	6.612 (87)	**<.001**	0.845
	5.5	I am reluctant to conduct rescue breaths on an unfamiliar, unconscious person because of feelings of disgust	85	**.447**	.211 - .684	3.759 (84)	**<.001**	0.455
	5.6	I am reluctant to undress a person's torso.	86	**.349**	.144 - .554	3.387 (85)	**.001**	0.425
	5.8	I am afraid that I do not have enough strength to conduct a CPR.	84	**-.060**	-.346 - .227	-.413 (83)	**.681**	-0.052
Self-efficacy	5.3	I know how to help an unconscious person.	87	**-1.839**	-2.111 - -1.567	-13.457 (86)	**<.001**	-1.649
	5.4	I am sure that I am able to check for and recognize a cardiac arrest quickly.	87	**-1.299**	-1.575 - -1.023	-9.355 (86)	**<.001**	-1.231
	5.7	I am confident that I am able to conduct chest compression in an emergency situation.	85	**-1.694**	-2.040 - -1.348	-9.739 (84)	**<.001**	-1.384
	5.12	If a person becomes unconscious in a public place, I would wait to see if someone else could help better. (–)	87	**.299**	.081 - .517	2.721 (86)	**.008**	0.299
Attitude towards prosocial helping behavior	5.2	I believe helping by calling 112** is important first aid.	88	**-.375**	-.637 - -113	-2.849 (87)	**.005**	0.845
	5.9	I think that the EMS arrive quickly and are qualified. They are better suited to save human lives.	85	**.706**	.380 – 1.032	4.309 (84)	**<.001**	0.545
	5.10	It is satisfying that I am able to help other people with my knowledge about CPR.	84	**-.875**	-1.175 - -.539	-5.360 (83)	**<.001**	-0.737
	5.11	I think that the immediate responder increases the chances of survival in case of a cardiac arrest higher than the ambulance.	86	**-.698**	-.946 - -.449	-5.583 (85)	**<.001**	-0.721

Values of the paired t-test (t1;t2).
Abbreviations: n: sample size; CI: confidence interval; df: degrees of freedom, Sig.: p-value, Cohens d: measure of effect size); (-) indicates that the polarity of the item has to be reversed; CPR: cardiopulmonary resuscitation; EMS: emergency medical services

*: significant < 0.01. (–) indicates that the polarity of the item has to be reversed.
**112 is the European emergency call number.

Appendix 5. Differences in Mean values: Knowledge Test

Descriptive statistics and parametrical student's t-test in paired samples to the time points t1 (pre-test) and t2 (post-test).

No. in FB	Descriptive Statistics					Correla-tion	Paired Difference: t-test			
	Complex: Recognise	**n**	**Mean**	**SD**	Δ_M t2-t1	**r**	**T**	**df**	**Sig.**	**d**
6	Phrase "check, call, compress" [t1]	88	.383	.478	0.572	.061	-10.510	87	**<.001**	-1.55
10	Phrase "check, call, compress " [t2]	88	.955	.209						
7	Recognition of respiratory arrest [t1]	88	.656	.409	0.205	.237*	-4.536	87	**<.001**	-.60
11	Recognition of respiratory arrest [t2]	88	.861	.242						
8	Action for unconsciousness and breathing [t1]	88	.652	.438	-0.174	.358*	-3.302	87	**.002**	-.40
12	Action for unconsciousness and breathing [t2]	88	.478	.463						
	Complex: Procedure									
9	CPR termination [t1]	88	.634	.408	0.185	.156	-3.629	87	**<.001**	-.50
13	CPR termination [t2]	88	.819	.323						
10	CPR compression depth [t1]	88	.337	.473	0.636	-.034	-11.892	87	**<.001**	-1.82
14	CPR compression depth [t2]	88	.974	.153						
11	CPR quality parameters [t1]	88	.442	.361	0.417	.183	-9.429	87	**<.001**	-1.29
15	CPR quality parameters [t2]	88	.860	.276						
	Total score [t1]	**88**	**3.104**	**1.741**	**1.841**	**.311**	**-10.050**	**87**	**<.001**	**-1.265**
	Total score [t2]	**88**	**4.945**	**1.007**						

Abbreviations: n: sample size; M: mean values; SD: standard derivation; T: t-value; df: degrees of freedom; Sig.: p-value; d: Cohens d (effect size); CPR: cardiopulmonary resuscitation; EMS: emergency medical services

*: significant < 0.01.

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Appendix 6. Relative frequencies of item scores and differences in Means between at t1 and t2: Knowledge-Test
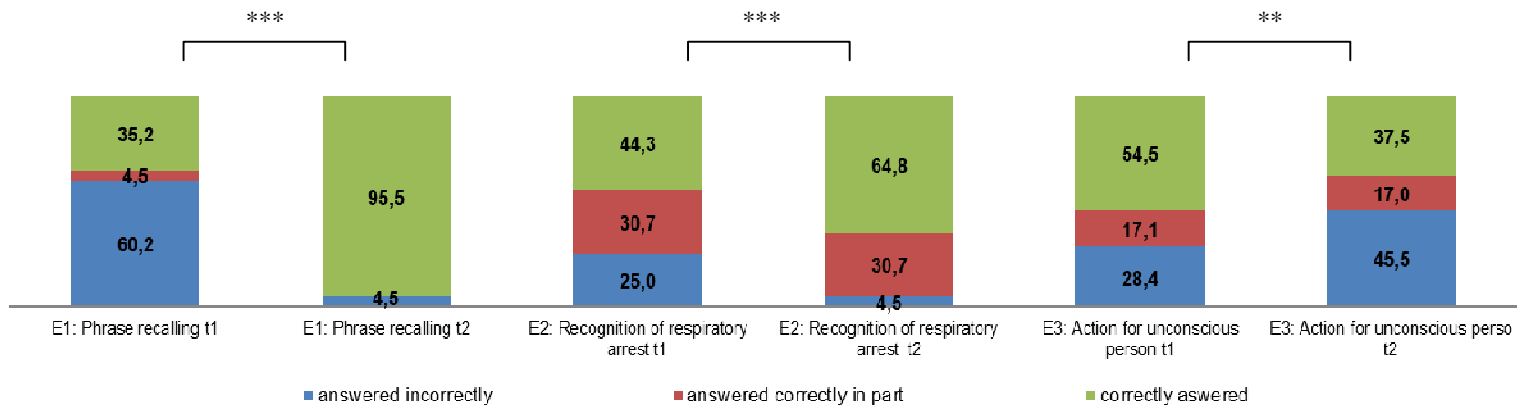
Knowledge-test: Approach and Recognition. Results at both testing points t1 and t2 (relative frequencies) for answer correctness (scores from 0 to 1). ***: p-value ≤.001; **: p-value ≤.01 (paired t-test)
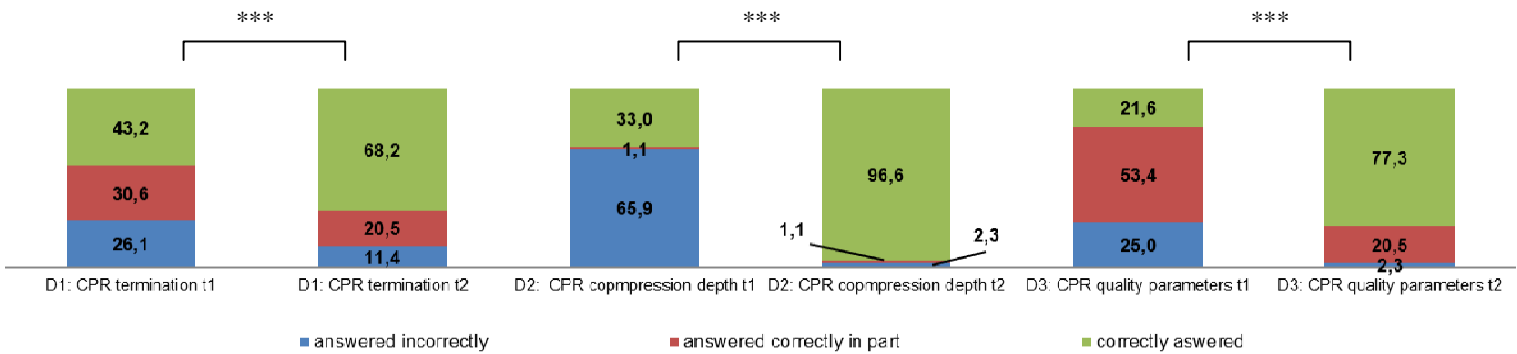
Knowledge-test: Conduction of basic life support techniques. Results at both testing points t1 and t2 (relative frequencies) for answer correctness (scores from 0 to 1). ***: p-value ≤.001; **: p-value ≤.01 (paired t-test)

Appendix 7. Psychometric Parameters: PANAS-Questionnaire

Item-parameters for the PANAS-section. Partly changed PANAS-adjectives (see third column) following Krohne et al., 1996; Watson et al., 1988. Components of two-factorial factor analysis (presented with factor loadings), communalities, corrected discriminatory power and internal consistency (Cronbach's α) are shown

No.	Items (adjectives) English Original (Watson et al., 1988)	German Version (Krohne et al., 1996)	Adopted Adjectives, (translation by the authors)	Factor analysis Component/Factor[a] 1 positive	2 negative	Communa-lities h²	Further psychometric properties Item-to-Total Correlation (subscale) r_{it}	Internal consistency (of subscale) α
9.1	active	aktiv		0.724		0.526	0.625	
9.3	interested	interessiert		0.718		0.515	0.615	
9.4	excited	freudig erregt	**erfahren (experienced)**	0.477	-0.316	0.327	0.383	
9.6	strong	stark	**ausdauernd (persistent)**	0.637		0.409	0.556	
9.10	Inspired	angeregt		0.718		0.571	0.613	
9.11	proud	stolz		0.622		0.389	0.538	.861
9.13	enthusiastic	begeistert		0.724		0.529	0.644	
9.15	alert	wach		0.556		0.309	0.449	
9.17	determined	entschlossen		0.706		0.499	0.637	
9.18	attentive	aufmerksam		0.824		0.681	0.746	
9.2	distressed	bekümmert			0.558	0.318	0.400	
9.5	upset	verärgert	**überrumpelt (taken by surprise)**		0.694	0.526	0.579	
9.7	guilty	schuldig	**rücksichtslos (reckless)**		0.544	0.296	0.352	
9.8	scared	erschrocken			0.562	0.321	0.416	
9.9	hostile	feindselig	**abgeneigt (reluctant)**	-0.344	0.388	0.269	0.315	.762
9.12	irritable	gereizt			0.444	0.203	0.339	
9.14	ashamed	beschämt	**angeekelt (disgusted)**		0.454	0.217	0.291	
9.16	nervous	nervös			0.675	0.505	0.531	
9.19	jittery	durcheinander			0.704	0.498	0.559	

Table continued	Items (adjectives)			Factor Analysis			Further Psychometric Properties	
				Component/Factor[a]		Communalities	Item-to-Total Correlation (subscale)	Internal consistency (of subscale)
				1	2			
No.	**English Original** (Watson et al., 1988)	**German Version** (Krohne et al., 1996)	**Adopted Adjectives (translation by the authors)**	**positive**	**negative**	**r_{it}**		**α**
9.20	afraid	ängstlich			0.607	0.368	0.468	
	Eigenvalue (before rotation)			4.88	3.43			
	Explained variation			24.15%	17.24%			

Extraction method: principal component analysis.
Rotation method: Varimax, Kaiser normalization
a. Rotation converged after 3 iterations.
b. Factor loadings ≤ .30 are not shown.

* Response options:

(German original):	(1) ganz wenig oder gar nicht;	(2) ein bisschen,	(3) einigermaßen
	(4) erheblich	(5) äußerst	
(English version)	(1) very slightly or not at all	(2) a little,	(3) moderately,
	(4) quite a bit,	(5) extremely	

References of the Supplementary Appendix

Krohne, H. W., E oft he Supplementary Appendixgloff, B., Kohlmann, C.-W., & Tausch, A. (1996). Untersuchungen mit einer deutschen Version der «Positive and Negative Affect Schedule» (PANAS). *Diagnostica*, *42*(2), 139–156.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*(6), 1063–1070. https://doi.org/10.1037/0022-3514.54.6.106.3