

# THE IMPACT OF STUDENT PARTICIPATION AND THE EFFECTIVENESS OF DEBRIEFINGS ON TEAMS PRACTICING CARDIOPULMONARY RESUSCITATION AND THEIR LEARNING IN SIMULATION-BASED TRAINING

A study into the effect of the amount of student participation during debriefings and the perceived effectiveness of the debriefing on team performance and learning in a simulated medical emergency training.

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## MASTER THESIS

Title THE IMPACT OF STUDENT PARTICIPATION AND EFFECTIVENESS OF DEBRIEFINGS  
ON TEAMS PRACTICING CARDIOPULMONARY RESUSCITATION AND THEIR LEARNING IN SIMULATION-BASED  
TRAINING

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# SUMMARY

Post scenario debriefings are recognized as a crucial component in practicing simulation scenarios- and can improve medical educational outcomes in cardiopulmonary resuscitation. This study considers student participation during debriefings and the perceived effectiveness of the debriefing in student medical teams performing a cardiopulmonary resuscitation simulation. Debriefing is a post action review where facilitators guide learners to reflect on their experience in hopes to learn deeper and future improvement during similar tasks. Post scenario debriefings have been identified as a key factor in influencing learning as well as future team performance. While there has been extant research about debriefing in regard to facilitator involvement and the influence on learning and performance this study considers the perceived effectiveness of the debriefing as well as the amount of participation from the learners, which is objectively measured through sociometric sensors, during the debriefing and how this influences future team performance and learning. It is hypothesized that more participation from learners and debriefings that are perceived as effective are positively related with higher future team performance and learning. The study utilized a mixed-method approach in a longitudinal design with both quantitative and qualitative data. The study gathered data from video observations, team performance scores, sociometric badges, and surveys from approximately seventy-one respondents spread through 17 teams who are master students in the “Advanced Life Support” course at the University of Twente. No statistically significant relationships were found between the concepts: effectiveness of debriefing, learning, student participation, and team performance. The information from this study may assist future research where debriefings are employed in student teams practicing CPR simulation scenarios.

**Keywords:** debriefing, cardiopulmonary resuscitation, simulation, team performance, students, learning, participation

# 1 INVESTIGATION AND RESEARCH RATIONALE

## 1.1 Introduction

Practicing medical emergency situations, such as cardiopulmonary resuscitation (CPR), in simulated settings is an integral component to prepare students for the actual event (Friederichs et. al., 2014). Learning from practice and being able to transfer the knowledge and skills gained during simulated emergency medical situations to future situations can be augmented by post scenario debriefings (Cantrell, 2008). It is important during the simulation sessions that students are able to apply the skills that they have learned. While it is widely accepted that debriefings are a critical component in simulation-based training, there are few studies that have empirically tested what constitutes an effective debriefing and if this influences learning (Fanning and Gaba, 2007). Medical training experts agree that post simulation debriefing is an effective educational activity in the learning process that has the potential to enhance future medical outcomes. Such debriefings are aimed at evaluating how students responded to stressful and life-threatening events; and can leading to future performance improvement (Edelson et. al., 2018). Despite the general agreement that debriefings are paramount to simulation-based training, also in a CPR context, few studies have investigated what is happening in those conversations and how this influences future learning and performance (Grande et. al., 2017).

Debriefing is an especially valuable and frequently utilized tool used in CPR simulation-based training (SBT). CPR simulation-based training provides the most optimal setting to practice performing CPR outside of the live setting. Accompanying this with debriefing allows for improvement in performance and deeper understanding and learning. To enhance the performance of medical teams and to prepare students and medical professionals for life-threatening medical scenarios, several universities and hospitals have put in place simulation units for simulation-based training (SBT). Debriefing is integral as a critical component in simulation-based training programs, particularly in CPR practice, as many experts have demonstrated (Edelson et. al., 2018, Grande et. al., 2017, Fanning and Gaba, 2007). However, the amount of student versus facilitator participation during a debriefing and the effect on learning and team performance is not extensively researched. This study aims to contribute to the literature in the following ways: (1) To give a better understanding on the role of student participation in debriefings, (2) whether or not an effective debriefing is adding to students

future learning, and (3) if more student participation during a debriefing can help increase future team performance. With the results medical education institutions can design more effective debriefings and advise on what is required from the facilitators. The results can also help graduate students; as it may help to keep them interested after the actual simulation, as the added value is empirically substantiated. This study follows a change over time in student medical teams practicing CPR simulations. This longitudinal data eliminates recall bias, by collecting data prospectively and prior to the post scenario debriefing. Both learning and team performance are measured at two points in time (T1 & T2) the first simulation and the second simulation. The goal of the present research is to examine whether and how perceived debriefing effectiveness and student participation during debriefings effected future team performance and learning.

The following research question was developed to direct the research:

*How is student participation and perceived debriefing effectiveness is related with future team performance and future learning in student medical teams performing a cardiopulmonary resuscitation simulation?*

In the research model (figure 1) an overview is given of the included concepts and possible relations.

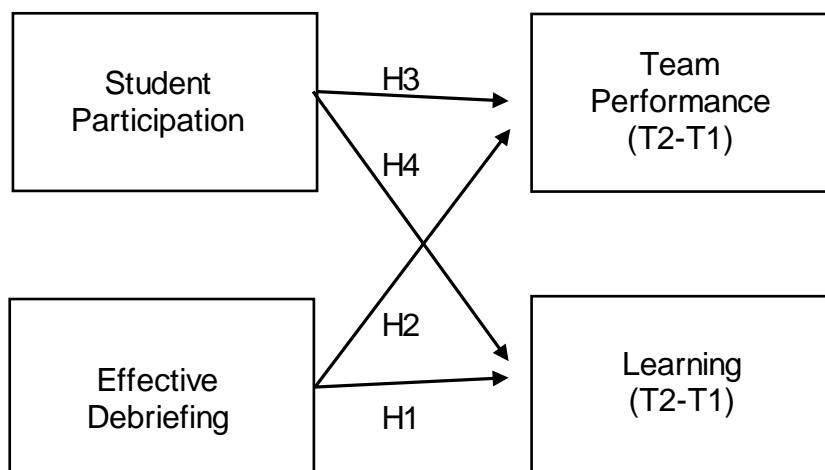


Figure 1. Research model

## 1.2 Theoretical framework

**Cardiopulmonary resuscitation simulation-based training.** The number of educational programs that train students to perform an in-hospital CPR such as the Advance Life Support (ALS) course is rising. According to the American Heart Association, CPR is an emergency lifesaving procedure performed when the heart of a patient stops beating (American Heart Association, 2018). When CPR is immediately and effectively administered to a cardiac arrest patient the chances of survival can double or triple (American Heart Association, 2018). Many studies have shown that survival of the patient is often correlated with the quality of the CPR performed (Abella et. al., 2008). To increase survival rate of this frequently occurring medical emergency CPR training is commonly taught in medical education settings as CPR training helps improve skills leading to a higher quality CPR given to patients. CPR training facilitates medical students and hospital staffs to improve their skills and subsequently the quality of CPR which enhances patient survival rate (cite). To enhance effective training of CPR many medical educations and hospital training sessions are increasingly using high-fidelity human patient simulators to imitate actual CPR situations (Andersen et al., 2010). Therefore, quality training programs are directly linked to competent profession skill development and patient survival rates.

Gaba (2004) defined simulation as "... a technique, not a technology, to replace or amplify real experiences with guided experiences, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion" (Gaba, 2004). The simulation sessions, such as those offered in ALS courses, utilize a life-sized automated mannequin which can be manipulated to imitate the physiological conditions of various medical problems and respond to any medicine or rescue actions carried out by the medical team (Fritz et al. 2008). An advantage of using CPR simulations is that active participation and engagement of learners is assured in the simulation process. Therefore, it aids retainment of the set of skills that students learn and is regarded as more effective form of education as opposed to traditional formal education (Fanning and Gaba, 2007). A simulation environment also offers a non-risk setting where students can encounter the same issues and concerns comparable to a hospital setting, but without major consequences. Using debriefing as an educational tool in CPR simulation training can enhance the learning and development of required skills in a medical education (Grande et. Al., 2017).



**Learning.** A widely accepted definition of learning in higher education is not yet available; many different definitions which tap into distinct aspects are available (Dandy and Bendersky, 2014). However, Lachman (1997) defined learning in traditional behaviorist terms: A relatively permanent change in behavior due to prior experience. This definition captures the essential element of learning from experience which is a crucial component in CPR simulation-based training. Driefuerst (2009) states that; “Learning occurs in simulation through contextual task training and repetition, but significant learning occurs when deep insight is made explicit through reflection during debriefing”. Learning is the primary overall goal in a simulation-based training, including the CPR training in the ALS course. In CPR simulation based-training, learning occurs throughout the process (i.e., training prior to the simulation, the simulation itself, the debriefing, reflection of the simulation after the debriefing, and subsequent training), however there have been a number of empirical studies that have shown that learning does not occur in simulation-based education without debriefing (Mahmood & Darzi, 2004; Savoldelli et al., 2006; Shinnick & Woo, 2010). These studies looked at the data in a longitudinal configuration as to examine the effect over time. Without the debriefing learning may not take place as not all students are not able to effectively process the simulation on their own and can unintentionally perceive components of the simulation as executed well performed.

Learning in a simulation debriefing can best be labelled as experiential learning (Fanning and Gaba, 2007). Experiential learning falls under the constructivist concept, which suggests that learners learn from personal understandings of meaning through reflection on their actions (Fenwick, 2001). Kolb describes that experiential learning cycles through four parts, including: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). Reflective observation, abstract conceptualization, and active experimentation aspects are closely linked to debriefing because of the time needed to reflect on the simulation experience, understand and examine their own meaning through their mental models and then come up with new mental models that can be utilized in future situations or real scenarios (Daniels et. Al.,2014). Reflection on an event or activity is the main foundation of experiential learning; in simulation-based training facilitators can guide this process through debriefing (Fanning and Gaba, 2007).

Not all learners can analyse, make sense of, and assimilate learning experiences on their own and might need some guidance in their learning process. This is where debriefing plays a critical role in the simulation-based training and learning experience (Lederman, 1983). Multiple reviews of

simulation literature established that receiving feedback during a debriefing appears to be vital to learning (Issenberg et al., 2005; McGaghie et al., 2010). While valuable and well facilitated debriefings have a positive effect on learning, debriefings that are lacking in quality have the potential to result in erroneous learning or continuous inadequate clinical judgment and skills (Dreifuerst, 2009). It can be concluded from the literature that students who report that higher levels of learning received a more effective debriefing than those who reported low levels of learning (Issenberg et al., 2005; McGaghie et al., 2010, Mahmood & Darzi, 2004; Savoldelli et al., 2006; Shinnick & Woo, 2010).

**Effective Debriefing.** Mullan et al., (2013) defined debriefing as “a facilitated discussion of participant actions and thought processes to encourage reflection and assimilation of learning into practice.”. Debriefings originated in the military setting as a way to detail each individual soldier’s report of their mission and help strategize for subsequent missions (Pearson & Smith, 1986) but also has the potential to improve CPR quality in medical education settings. (Abella et. al., 2008). Debriefing, a post action review, allows for individuals to reflect on their clinical or professional experience and greatly aids in the ability of the students to go through the experiential learning cycles (Eppich et. al., 2008). This is because students can understand, analyse, and synthesize what they thought, felt, and did during simulations and improve for future similar situations (Eppich et. al., 2008). In a systematic review of the simulation literature, it was found that feedback, including feedback given in debriefings, was the most valuable component of simulation-based medical education (Issenberg SB et. al., 2005). However, how educators facilitate debriefings is highly variable and often strays away from the most optimal or effective debriefing (Cheng & Eppich, 2015). Effective debriefings are neither harshly judgemental nor falsely non-judgmental, but rather they provide clear, constructive critiques that include the student’s involvement (Eppich et. al., 2008). The studies that have been conducted so far in relation to debriefing provide insight about the components that lead to an effective debriefing. These components include sufficient amount of time for the debriefing, a climate where students are supported and feel comfortable to speak out, tailored to the learning objectives and participants, and a qualified facilitator to guide the process (Fanning and Gaba, 2007). Lederman identified seven common structural elements that are key to debriefing effectiveness including: the facilitator, participants, the experience, the impact of the experience, recollection, report, and time (Lederman, 1992). In a similar vein, Moughrabi and Wallace (2015) present five

components of effective debriefing in a medical education setting for medical students, including: allowing reflection on student's clinical judgement and approach to patient care, supportive and constructive feedback, feedback that aids in learning, adequate time for reflection and discussion of clinical performance, and the feedback helped to understand the rationale for the actions and responses to performances. Debriefing Assessment for Simulation in Healthcare or DASH was developed as some best practices for debriefing in healthcare. Six key debriefing elements are included in DASH: establishes an engaging learning environment, maintains an engaging learning environment, structures debriefing in an organized way, provokes engaging discussions, identifies and explores performance gaps, and helps trainees achieve or sustain good future performance (Simon et al., 2010). When an effective debriefing is administered many agree that more and deeper learning will take place (Grande et. Al., 2017). Without an effective debriefing the opportunity for deep reflective learning may be missed. In a review of debriefing in medical education, it was found students reported higher learning when structured seemingly effective debriefings were administered (Driefurst, 2015).

Based on theoretical findings, the assumption can be made that reported effective debriefings can have a positive effect on learning. Therefore, the following hypothesis was developed:

*Hypothesis 1: Perceived debriefing effectiveness is positively related with learning.*

**Team Performance.** The goals of debriefing are to allow learners to explain, analyse, process information and emotions to improve individual and team performance in future similar situations (Dufresne et. al., 2007). Debriefings can be a manageable and cost-effective method to raise performance outcomes in medical simulation trainings (Edelson et. al., 2013). In a study of 95 undergraduate nursing student teams on performance during human patient simulations, student teams who were given facilitated debriefings over the course of a semester had the greatest improvement scores as opposed to those who received only feedback, self-debriefed, or all three (Gantt et. Al., 2017). In different studies, including internal medicine residents at a university hospital, CPR performance transcripts were reviewed after a debriefing program was instituted. The results showed that the debriefing program helped to improve objective CPR performance measurements and initial patient survival (Arora et. Al., 2008). Cheng and Eppich (2015) state "Effective debriefings can provide a forum for feedback that is essential for performance improvement". In an extensive

meta-analysis conducted by Tannenbaum and Cerasoli that reviewed findings from 46 samples they concluded that individual and team performance can improve by approximately 20% to 25% by using properly conducted debriefings (Tannenbaum & Cerasoli, 2013). To facilitate transfer of knowledge, the formal training period should be followed by additional learning opportunities (e.g. after-action reviews, feedback, debriefing). This transfer of knowledge can help expedite the time of transfer into actual performance outcomes (Grossman & Salas, 2011).

In the literature it can be seen that team debriefings play an integral function on team performance. When student teams are perceiving the debriefing as effective, according to constructs that make up an effective debriefing, the student teams are more likely to perform better in subsequent future scenarios. Therefore, we propose the following:

*Hypothesis 2: Perceived debriefing effectiveness is positively related with future team performance.*

**Participation.** As previously mentioned, there are several critical components that should be present in effective debriefing. One of the most crucial elements is the participation of the learner during the debriefing. In relation to debriefings the amount of student participation plays an integral function. This is because a successful debriefing is one in which the participants, or in the case this case the student teams, do most of the talking (Fanning and Gaba, 2007). The facilitator's role however is not directed around high amounts of participation but in creating a safe environment for the students to learn and to structure a seemingly unstructured learning event (Moughrabi and Wallace, 2015). How a debriefing is facilitated can greatly influence student participation during a debriefing which in turn can affect future learning and team performance. Dismukes and Smith delineate three levels of facilitation which impacts students participation in debriefings: high, intermediate, and low. In "high" level debriefings the learners primarily debrief themselves and the role of the facilitator is to outline the process and guiding the learners only when necessary. Therefore, in high level debriefings there is a very low level of facilitator involvement. In an intermediate level debriefing the facilitator plays a larger role. Often the learners struggle to analyze the experience on a deeper level and this is where the facilitator steps in. Lastly in a low level debriefing the facilitator has an intensive role. The facilitator is responsible for guiding the discussion through the entire debriefing and at this level it is often seen that the learners do not take their own initiative (Dismukes and Smith,

2000). Facilitating at the highest level when possible is the most beneficial to the student teams as they are able to generate deep conversation leading to more extensive learning and better prepare for future similar situations (Fanning and Gaba, 2007). Participation of the teams during the debriefing is elemental to an effective debriefing as participation allows for other critical components of an effective debriefing to take place (Grande et. Al., 2017). While the facilitator plays a role, the participation of the student teams strengthens the efficacy of the debriefing and brings out more components necessary for an effective debriefing (Mayville, 2011). It should be noted that the skill of the facilitator giving the debriefing is critical to the success of reflective conversations (Daniels et al.,2014). It is interesting that most studies focused on the role of the facilitator while objective information about the amount of participation remains unknown. There is a one-sided approach to debriefing literature and research that focuses primarily on participation from the facilitator.

In a study that looked at student medical teams who received two different types of debriefings, student teams who received debriefings where participation was higher due to facilitator encouragement had higher reporting of learning than teams who received feedback in a traditional teacher centred approach (Cant et. al., 2011). Participation during a debriefing allows for more reflective and critical thinking of the student teams which allows for deeper more meaningful learning to be occurring (Mayville, 2011). In summary higher amounts of student participation during post simulation debriefing is proposed here to lead to more effective debriefings, which allows for the students to learn and improve for their next simulation performance. This improvement can lead to higher performance scores for future simulations that are performed. Higher amounts of student participation can suggest that more learning is taking place during the debriefing as students are able to reason for themselves on deeper level than highly facilitated debriefings. Based on these findings in literature we hypothesize:

*Hypothesis 3:* Higher amounts of student participation during debriefing are positively related with future team performance.

*Hypothesis 4:* Higher amounts of student participation during debriefing are positively related with future learning.

## 2 RESEARCH METHODS

### 2.1 Research design

The research conducted examined the relationship between the following constructs: effectiveness of debriefing, learning, student participation, and team performance. A mixed-method approach was utilized in a longitudinal design. This longitudinal study utilized two measurement points for team performance and learning (T1 and T2). Three data sources were employed including: 1.) Survey which assess effectiveness of the debriefing and student learning 2.) sociometric badges which capture the amount of student participation 3.) expert rating of technical and non-technical team performance.

**2.2 Research context.** This research was an undertaking by the faculty of Behavioural, Management and Social Sciences (BMS) in partnership with the Experimental Centre for Technical Medicine (ECTM) at the University of Twente in Enschede, the Netherlands. The data collected at the ECTM, where modernized simulation technologies and medical equipment provide a natural and safe learning space for Technical Medicine students. The ECTM has two simulation rooms, a simulated Intensive Care Unit (ICU) and a simulated operation room (OR). Both rooms were used simultaneously during the ALS-course. The data was collected during the “Advanced Life Support” course. This course is offered to master students in their third quartile of their first year. The course took place from February to April of 2018. The culmination of the course is a 20-minute formal assessment where students are graded on their performance and roles are set beforehand. A further detailed description of the course curriculum can be found in the appendix. The ECTM has one Human Patient Simulator (CAE iStan/CAE HPS) and other manikins which are METI men as well as a patient monitor (Infinity, Dreager) and defibrillator (Philips) (ECTM, 2016). Video data was documented with the METIvision system. The system recorded data via three ceiling mounted camera’s, the patient monitor, microphones in the operating room and the simulator itself. In both simulation rooms video equipment was present; however, this research did not utilize the video recordings as the debriefing moments were not captured by the recordings.

**2.3 Respondents and sampling.** 77 students willingly agreed to participate in the study. These students were spread throughout 20 teams which were formed by the students prior to the start of the

simulations. Three out of the 20 teams were not used in the data as one team member from the groups did not give informed consent another three teams were not used as the sociometric data was corrupted. This left the study examining 14 teams in total. The total respondents consisted of 28 males (36.4%) and 49 females (63.6%). Their age ranged from 20 to 26 years old ( $M = 21.88$ ,  $SD = 1.05$ ). The students have concentrations in either “Medical Imaging & Interventions” or “Medical Sensing & Stimulation” with in the master.

**2.4 Ethical considerations.** Before the study, the research team, consisting of four master students in collaboration with two thesis supervisors, the contact person of Technical Medicine department, and the two teachers of the ASL course developed a research protocol. Within the research protocol ethical considerations and operational proceedings were outlined (see Appendix). The research protocol was read and approved by the BMS Ethics Committee of the University of Twente. All participants were informed about the details of the research protocol during an informative presentation and given a week to decide if they would participate or not. A week after the informative presentation students who decided to participate signed written consent forms. Participation was not mandatory, and it was stated that nonparticipation did not affect their assessment in the ALS course as teachers were not aware who did or did not participate in the study. The data was analysed anonymously.

## **2.5 Measures**

**Learning.** The learning scale was a blended scale that included questions from Van de Walle (1997) – these questions regarded an individual's disposition toward developing or validating one's ability in achievement settings. The other questions were from Sorbal (2005) –used as an index of the students' frame of mind in regard to reflective learning. The questioned were translated into the Dutch language from English and used on a 5-point Likert scale. 1 being totally disagree and a 5 being totally agree. A reliability analysis was conducted in SPSS to measure the reliability for the learning scale. A Cronbach's Alpha of .828 was found for learning which indicates a high level of internal consistency for our scale.

**Effective Debriefing.** Debriefing quality was measured by a three-question scale directly after the simulation. The three questions were taken from Wallace and Moughrabi (2015) who identified constructs essential to an effective debriefing. These included: the feedback received was supportive

and constructive, the feedback was helpful to my learning, and adequate time was given to reflect and discuss clinical performance. The two questions were excluded as they were not found to be relevant to an effective debriefing (Lederman, 1992, Fanning & Gaba, 2007) These three questions included where based off the content of the questions and factor loading. The constructs were translated into Dutch from English and used on a 7-point Likert scale. 1 being totally disagree and a 7 being totally agree. A reliability analysis was conducted in SPSS to measure the reliability for the effectiveness of the debriefing scale. A Cronbach's Alpha of .783 was found for debriefing effectiveness which indicates a high level of internal consistency for our scale.

**Team performance.** Team performance was measured by two scales. These scales were separated into technical and non-technical skills. The non-technical skills were measured by four statements from the team performance scale of Gibson, Cooper, and Conger (2009). This scale used a 7-point Likert scale from *very inaccurate (1)*, to *very accurate (7)*. The technical skills were measured using the ALS effectiveness scale, which is based on the ALS-course competencies. This is a scoring list for assessing technical and non-technical skills. To measure the ALS effectiveness a 5-point scale was used, ranging from *insufficient (1)* to *excellent (5)* The constructs that were being assessed are: execution of ALS-protocol, execution of treatment, diagnostic and clinical reasoning, therapeutic plan, and method. A reliability analysis was conducted in SPSS in order to measure the reliability for both the scales ALS performance and team performance. A Cronbach's Alpha: .969 for team performance and .883 for ALS performance which indicates a high level of internal consistency for our scales. The team performance scale and the ALS-effectiveness scale can be found in Appendix. Spearman's rho testing resulted in a significant positive correlation between the scales for team effectiveness and ALS performance ( $r_s = .89, p < .001$  (two-tailed)). This means that when the team effectiveness score increased, the ALS performance score increased, and vice versa. For this reason, and because the ALS performance scoring list is a better representation of how effective a team is in this specific context, it was decided to only use ALS performance in further analysis. This research focused on two measurement points, one prior to the debriefing and one following the debriefing. The final team score was determined as the difference between T1 and T2. A n analysis with Spearman's rho was run and indicated that ALS performance and team effectiveness are significantly related ( $R_s = .89, p < .001$ ). When the team effectiveness score increased, the ALS performance score increased and showing a very strong association between the two variables. For continuing with further analysis ALS



performance was solely used to represent team performance as ALS performance provides an effectiveness measure which takes the simulation environment into explicit consideration.

**Participation.** Sociometric badges were used to measure student participation amounts. These badges allow for a more objective depiction of participation than observation or surveys. The respondents wore the badges around their neck, positioned with tape high on their chest for best results. The sociometric badge measures (1) speech features, such as volume, tone of voice, speaking time, (2) body movement features such as energy and consistency, and (3) the proximity to others that are wearing a Sociometric Badge (Kim, Chang, Holland, & Pentland, 2008). However, in this research only the amount of speaking time was utilized from the data to measure participation. The following formula was utilized to gather the percentage of student participation:  $\frac{\text{Total debriefing time} - \text{Total Silent time}}{\text{Total debriefing time}} = \text{student participation time}$ ,  $\frac{\text{student participation time}}{\text{total debriefing time}} = \% \text{ of participation of the debriefing.}$

**2.6 Procedure.** Before the start of the ALS course the student research team, course instructors, and advisors from the ECTM and BMS met and established aspirations and objectives for the research project. Scales for team performance were developed and modified to fit the study and explained to the instructors. A survey for the students after participation in a simulation was developed and approved by the instructors and advisors of the project. Prior to data collection, approval was received from the Ethical Committee of Twente University. At the first meeting for the course a presentation was given by the student research team and all students were informed about the study. A week following the presentation in the next class willing participants signed informed consent forms and filled out preliminary test. This test included demographic questions, a personality questionnaire, as well as questions regarding the cohesion of their groups. Once the theoretical portion of the course concluded the student groups began with practical simulations in CPR. Each group practiced five total simulations including a pre-assessment and final assessment. After each simulation excluding the assessment the teams were debriefed by instructors and another peer student team. Simulations were administered in two rooms which were both equipped to carry out high fidelity CPR simulations utilizing a mannequin. The instructors filled in the scales for team performance during the simulations and following the simulations students filled out a questionnaire that covered their perceptions of their team's performance, learning, and debriefing. Students wore

sociometric badges during simulations and debriefings to gather data on speech, interactions, and body movement. In each room there was one ALS course instructor as well as a qualified person from the field. The student research team was present during each data collection moment to correct any problems that may have arisen. This research only utilized data from practice assessment two. In practice assessment two each team performed two simulations with a debriefing in between.

**2.7 Data analysis.** The data analyses of the research were conducted by using the statistics program IBM SPSS version 23. All data was aggregated to the team level and all tests were conducted with the team level data. The Shapiro-Wilk test indicated that both factors ALS performance ( $p = .00$ ), team effectiveness ( $p = .00$ ), were normally distributed. The distribution of all continuous variables were checked by looking at skewness and kurtosis values, z-scores and by using the Shapiro-Wilk normality test. This test is suitable for small sample sizes (Field, 2013). The participation data was calculated as a percentage. This was done by subtracting the total silent time from the total time of the debriefing to get the amount of participation then further dividing this number by the total time of the debriefing. This was done to enable comparison of the different teams. The team performance measure was calculated as the difference between T2 and T1. This allows to see whether the team improved or declined from the first simulation to the second simulation after the debriefing. There have been studies which examined future performance and learning in a longitudinal design to observe changes in team performance and learning in future scenarios (Cant et al., 2011, Gantt et al., 2017, Arora et al., 2008). Lastly, all hypotheses were confirmed or rejected using multiple linear regression. This is because multiple regression allows for a relationship to be modelled between multiple independent variables and a single dependent variable where the independent variables are used to predict the dependent variable (Laerd, 2018). Structural equation modeling (SEM) was considered, but ultimately rejected in favor of the multiple linear regression analysis. There are better alternative methods such as SEM, which is the combination of factor analysis and multiple regression analysis, however factor analysis was not needed for this study thus forgoing the SEM alternative.

# 3 RESULTS

## 3.1 Descriptive statistics

In table 1 below, the sample size, minimum and maximum scores, mean and standard deviations for all four continuous variables are listed. The mean score of amount of student participation is 44% (SD = 9.10). The range is between a minimum of 29% and a maximum 58%. The mean score for learning and effective debriefing did not vary drastically. The team performance score shows a mean of .24, showing on average a mild not statistically significant positive performance improvement from T1 to T2. The sample size for all variables is 14.

*Table 1. Descriptive statistics of all continuous variables.*

	<i>n</i>	Minimum	Maximum	<i>Mean</i>	<i>SD</i>
Team performance (T2-T1)	14	-1.00	2.20	0.24	0.83
Learning (T2-T1)	14	3.67	4.41	4.10	0.20
Effective Debriefing <sup>b</sup>	14	5.00	6.67	5.77	0.47
Student Participation <sup>a</sup>	14	29	58	44	9

*Note.* <sup>a</sup> based on a percentage score. <sup>b</sup> 7 point likerd scale.

A pearson's partial correlation was run to assess the relationships between participation, effective debriefing, team performance, and learning after adjusting for facilitator. The correlation table (table 2) can be seen below.

Table 2. Correlation table

	1	2	3	4	5		
<i>Participation</i>							
1. Participation	--						
<i>Team Performance</i>							
2. Team Performance	-.02 [-.47, .33]	--					
<i>Debriefing</i>							
3. Debriefing Effectiveness	-.15 [-.71, .57]	-.02 [-.47, .48]	--				
<i>Learning</i>							
4. Learning	-.14 [-.50, .33]	-.50 [-.90, .35]	.34 [-.15, .70]	--			
<i>Control variables</i>							
5. Facilitator	.186 [-.49, .31]	.377 [-.47, .57]	-.689 [-.45, .52]	-.415 [-.65, .54]	--		

note. N = 14. \*\* Correlation is significant at the 0.01 level (2-tailed). \* Correlation is significant at the 0.05 level (2-tailed). Values in square brackets indicate 95 % confidence intervals for each correlation.

There were linear relationships between effective debriefing, participation, team performance, and learning, as assessed by scatterplots and partial regression plots. There was univariate normality, as assessed by Shapiro-Wilk's test ( $p > .05$ ), and there were no univariate or multivariate outliers, as assessed by boxplots and Mahalanobis Distance respectively. A Pearson's correlation established that there was non-statistically significant linear relationships between effective debriefing, participation, team performance, and learning.

### 3.2 Hypothesis 1&2: Perceived debriefing effectiveness on future team performance and learning.

A multiple linear regression analysis was used to test if perceived debriefing effectiveness significantly predicted learning and team performance. Regression coefficients and standard errors can be found in Table 3 (below).

Table 3. Summary of multiple regression analysis on team performance and learning.

Variable	<i>B</i>	<i>SE<sub>b</sub></i>	$\beta$
Team Performance	-.046	.536	-.026
Future Learning	.140	.124	.324

Note. \*  $p > .05$ ; *B* = unstandardized regression coefficient; *SE<sub>b</sub>* = Standard error of the coefficient;  $\beta$  = standardized coefficient

The results of the regression indicated the two predictors explained 12% of the variance ( $R^2 = .12$ ,  $F(2,11) = .765$ ,  $p > .05$ ). It was found that perceived debriefing effectiveness did not significantly predict future team performance ( $\beta = -.026$ ,  $p = .93$ ), perceived debriefing effectiveness also did not significantly predict future learning ( $\beta = .324$ ,  $p = .28$ ).

### 3.3 Hypothesis 3&4: Student participation on future team performance and future learning.

A multiple regression analysis was used to test if student participation significantly predicted future team performance and future learning. Regression coefficients and standard errors can be found in Table 4 (below).

Table 4. Summary of multiple regression analysis on Future Team Performance and Learning.

Variable	<i>B</i>	<i>SE<sub>b</sub></i>	$\beta$
Team Performance	-.002	.028	-.025
Learning	-.002	.006	-.091

Note. \*  $p > .05$ ; *B* = unstandardized regression coefficient; *SE<sub>b</sub>* = Standard error of the coefficient;  $\beta$  = standardized coefficient

The results of the regression indicated the two predictors explained .18% of the variance ( $R^2 = .180$ ,  $F(2,11) = .006$ ,  $p > .05$ ). It was found that student participation did not significantly predicted future

team performance ( $\beta = -.025$ ,  $p=.94$ ), student participation also did not significantly predict future learning ( $\beta = -.091$ ,  $p=.76$ ).

## 4 DISCUSSION AND CONCLUSION

### 4.1 Discussion of results

This study aimed to investigate the effect of perceived debriefing effectiveness and student participation during debriefings on future team performance and learning. Based on several theoretical assumptions and empirical insights in the field it was hypothesised that more reporting from the students that the debriefing was effective and higher amounts of student participation during the debriefing positively influenced team performance. No relation was found between debriefing effectiveness, student participation, and team performance. The average team performance did mildly improve from the first measurement moment (T1) to the second (T2) following the facilitated debriefing, but not significantly as a result from higher debriefing effectiveness or more participation. This could have been because of other factors not considered in this research such as the length of time between T1 and T2 was not long enough for the knowledge to transfer into practice

Furthermore, it was hypothesised more reporting from the students that the debriefing was effective and higher amounts of student participation during the debriefing positively influenced learning. Active learning educational methods such as simulation may be stressful and cause feelings of anxiety to learners. Therefore, post simulation debriefing should be utilized to help learners moderate these feelings and allow for reflection and further learning moments (Boese et. Al, 2013). However, the regression analysis didn't show a correlation between more reporting from the students that the debriefing was effective and higher amounts of student participation and learning. In a meta-analysis conducted by Kluger and Denisi (1996) they reviewed 131 studies with 607 reported outcomes. The review found roughly a third of the time, debriefing seemed to negatively affect performance. Albeit overall the intervention indicated a moderate positive effect on performance. This shows that the results of debriefing are varied and debriefing itself does not guarantee improvement in performance.

The results gathered from this study are varied from the literature reviewed. This study was unique in that the concepts had not been researched within the context of CPR simulation-based training. The measure of participation was uncommon in that the sociometric badges were utilized to objectively calculate the amount of time the student teams participated. From reviewing literature no other studies were found where student teams participation was measured by use of sociometric

badges in this specific context. Utilizing the sociometric badges may lead to further understanding of the facilitator and participator role in debriefings. In this study all scores were aggregate to the team level. There may have been more visible effects on team performance and learning if one looked at the individual level. Some students may have reflected on their individual performance during the debriefing while others focusing on the team as a whole. Approaching the debriefing as a team as opposed to on the individual level may affect team's performance as individual performance does not necessarily lend itself to team performance. Video debriefing may be an advanced option that can be reviewed. Chronister and Brown (2012) state that "for many students, viewing their own video replay piques their interest, engages them and can contribute to higher learning". Allowing the students to see their own performance while debriefing may contribute to more learning and improved future performance than just debriefing alone (Reed et al., 2013).

Since the sample size is small, and this seems to be the first exploration of this topic in this context, more research is needed. With this research yielding no significant results one can gather that further research into this topic with a larger sample size, over a longer period is needed, and investigating different concepts is needed. However, this study brings about many intriguing points for further research and exploration.

#### **4.2 Practical implications**

Even though this study utilized a small sample this type of research seems promising for practice if more data is collected. Understanding the relations between perceived debriefing effectiveness and student participation during debriefings on future team performance and learning could provide critical insights for medical education and simulation research. There are parties who can benefit from this work including future students, faculty, researchers, and medical education programs. The results yielded no statistically significant connection between perceived debriefing effectiveness and the amount of student participation during debriefings on future team performance and learning, however this research can provide a base for future studies. This research could practically aid in CPR debriefings as the results indicate the amount of student participation during debriefings and the students perceived notion of the debriefings effectiveness do not influence their learning or team performance at the team level. There may be other influencers during a debriefing that have more of an effect on team performance and learning.



The facilitators of the debriefings in the ALS course at the University of Twente can use this information in future debriefings. Encouraging the regulation and unity of debriefings can help mainstream for both the students and facilitators the structure and content of the debriefing. Also educating the students on debriefings and their benefits may help to incline the students to do more reflection and understand the process of the debriefings. This research was conducted in simulation-based trainings for CPR within in the context of a course. For this reason, the results found in this particular study are not generalizable to legitimate emergency lifesaving situations.

#### **4.3 Limitations, strengths, and future research**

There are several limitations to this research that need to be addressed for future research to scrutinize. One of the limitations is having a small sample size at  $n=14$ . Optimum sample size is an essential component to a research project and it is possible to not detect effects due to inadequate sample size (Pourhoseingholi et. a., 2013). The sample size in this research was hindered by technical malfunction of the sociometric badges and data corruption. Data corruption in this study being; computer data that has become unreadable or unusable due to user mistake or an internal (hardware-software) problem. This research only looked at two measurement points in time for team performance. The effectiveness of debriefing scale was based off students perceived notions of the debriefing. High reporting from students that the debriefing is effective does not mean the debriefing was effective in actuality, as the students are not trained to evaluate the debriefings. Each debriefing was different in that the total time varied and the facilitators did not follow a certain debriefing protocol. There could also be another variable that influenced the results that was not considered by this research.

Another limitation of this study was the variance in debriefings given by two sets of different facilitators. There was no set guideline or protocol for the facilitators to follow while debriefing the student teams. In the ideal scenario all teams would be debriefed by the same pair of facilitators adhering to a debriefing protocol to remain consistent. The debriefing itself was also varied in length, content, and intensity. These measures could have been taken into consideration prior to the study by instructing the facilitators to adhere to a debriefing protocol. The protocol could set guidelines for best practices including length of time, which content to cover, and the intensity level.

Furthermore, the debriefing effectiveness scale contained only three out of the five questions from the original scale due to restraints to the number of questions allowed on the surveys after

simulations. However, the three questions included were based off the content of the questions and factor loading. The Chronbach's Alpha showed a good reliability of this scale. How the students perceived the debriefing is not in actuality a judge of whether the debriefing is effective or not as they are not trained in the components essential to an effective debriefing, but the scale used. Lastly, this research looked only at two measurement points in time for team performance. A longer study may better show patterns of the variables over time as opposed to two points in time separated by two weeks.

There are some strengths to this research. One namely being that there is little research conducted in this setting on this specific topic and constructs, so it will add to a limited research base. The research can aid future research by avoiding mistakes made and building off already gathered data. Future research can control for the limitations in this study to strengthen results gathered in the future. In this study the sociometric badge data was aggregated to the team level. A future study may look at the individual level as some students in the team may be doing a majority of the participating. Along this vein a future study may look at the composition of the team. What team composition is best for stimulating effective debriefings. The debriefings in this study were not recorded by video observation. A future study may look into verbal and non-verbal behaviors displayed in debriefings in high performing teams.

Despite the significance of debriefing in medical education, the critical factors of effective debriefing are not universally adhered too by facilitators of debriefings. A lack of clear guidelines can lead to numerous variations in debriefing practice (Alhaj and Musallam, 2017). A future research may look into how to facilitate effective debriefings; what type of critical behaviors are best to display to enhance debriefings, and what enables effective team dynamics during debriefings (e.g., how should the facilitator behave to stimulate high participative interaction patterns). Lastly a future research may investigate other similar ALS courses within the Netherlands and abroad to observe how debriefings are administered and the level of facilitation and participation in high performing teams. There are many intriguing future research possibilities to explore in this specific topic and context which have the potential to further develop debriefing in the context of CPR simulation-based training with student medical teams.

#### 4.4 Conclusion

This study aimed to examine the team performance and learning of student teams practicing CPR in a simulation-based training and if perceived debriefing effectiveness and student participation during debriefings influenced them. This led to the following research question:

*How is student participation and effective debriefings related with team performance and student learning in student medical teams performing a cardiopulmonary resuscitation simulation?*

No statistical evidence was found that there was an effect of perceived debriefing effectiveness and student participation during debriefings on future team performance or learning. Based on these findings more future research with a larger sample size avoiding the oversights in this research is needed. The potential of studies, such as this one, have the ability to further develop and enhance post scenario debriefing which may lead to higher quality CPR training and medical education.

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## 6 APPENDIX INDEX:

Survey after simulation including learning and effectiveness of debriefing scale.....	32-33
Team Performance scale.....	34



# Vragenlijst

Datum: \_\_\_/\_\_\_

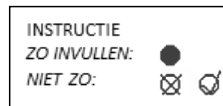
Groep: \_\_\_\_\_

Studentnr: \_\_\_\_\_

Hieronder volgen enkele uitspraken. Geef aan in hoeverre je het eens of oneens bent met de uitspraak of item. Kleur daarvoor de desbetreffende cirkel in. Noteer ook de datum en je studentnummer in de rechterbovenhoek van deze bladzijde.

Geef bij elke uitspraak een antwoord, zelfs als je niet helemaal zeker van je antwoord bent. Belangrijk om te weten: er is geen goed of fout antwoord. Alle gegevens worden enkel ten behoeve van dit onderzoek gebruikt.

## Gedurende de ALS-trainingssessie(s) van vandaag...



	Volledig mee oneens				Volledig mee eens		
	1	2	3	4	5	6	7
1. De feedback uit de nabespreking draagt bij aan mijn leerproces	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Tijdens de debriefing was er voldoende tijd om de simulatie te bespreken en te reflecteren.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. De feedback tijdens de debriefing was ondersteunend en constructief	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Gedurende de ALS training van vandaag...

	Volledig mee oneens				Volledig mee eens
	1	2	3	4	5
4. was ik bereid om een uitdagend scenario te doen waar ik veel van kan leren	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. ben ik op zoek geweest naar kansen om nieuwe vaardigheden en kennis op te doen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. deed ik graag uitdagende en moeilijke taken waar ik nieuwe vaardigheden door heb geleerd	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. was het ontwikkelen van ALS-vaardigheden zo belangrijk dat ik het niet erg vond om fouten te maken	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. werkte ik het liefst in scenario's die een hoog niveau van vaardigheden en talent vereisten	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. heb ik nagedacht over welke kennis ik al had en wat ik nog moest leren over ALS vaardigheden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10. ben ik bewust geweest van wat ik heb geleerd en waarom	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Gedurende de ALS-trainingssessie(s) van vandaag...**Volledig mee  
oneensVolledig mee  
eens

	1	2	3	4	5	6	7
1. Was er een gevoel van eenheid en samenhang in mijn team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Was er een sterk gevoel van samenhang tussen mijn teamleden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Voelden mijn teamleden zich verbonden met elkaar	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Hadden mijn teamleden een gedeelde focus op onze taak	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5. Concentreerde mijn team zich op het voor elkaar krijgen van onze taak	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Werkte mijn team nauw samen om onze taak te voldoen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

# Teameffectiviteit en prestatieschalen

voor docenten

Groep: \_\_\_\_\_  
 Datum: \_\_\_\_/\_\_\_\_/\_\_\_\_  
 Tijd blok: \_\_\_\_\_  
 scenario nummer: \_\_\_\_\_  
 Shock/non-shock: \_\_\_\_\_  
 beoordelaar: \_\_\_\_\_

INSTRUCTIE  
 ZO INVULLEN:  
 NIET ZO:

## Team effectiviteit

Erg inaccuraat

Erg accuraat

	1	2	3	4	5	6	7
1. Dit team is steeds een goed presterend team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2. Dit team is effectief.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3. Dit team maakt weinig fouten.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4. Dit team verzet kwalitatief hoog werk.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## ALS effectiviteit

1 = onvoldoende, 5 = uitstekend

--      -      +/-      +      ++

	1	2	3	4	5
5. ALS-protocol	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6. Uitvoering handelingen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Diagnostiek en klinisch redeneren	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Therapeutisch plan	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9. Werkwijze	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Leiderschapseffectiviteit

1 = volledig mee oneens, 5 = Volledig mee eens

Volledig mee oneens

Volledig mee eens

	1	2	3	4	5
10. Vergeleken met andere leidinggevendenden is deze leidinggevende <b>niet</b> erg efficiënt.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11. De manier waarop deze leidinggevende functioneert is een goed voorbeeld voor andere leidinggevendenden.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12. Deze leidinggevende slaagt er vaak <b>niet</b> in doelen te behalen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13. Deze leidinggevende heeft succes binnen het team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

