Debriefing in facilitator-led and student-led healthcare simulation – a comparative analysis

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Student Carl Robert Christiansen

Supervisor Peter Dieckmann

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Author(s)/Thesis candidate(s):

Carl Robert Christiansen

Supervisor:

Peter Dieckmann

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Preface

The master´s degree program has opened my eyes to scientific rigour and evidence-based practice. Being a lecturer at Oslo Metropolitan University and having worked with developing the simulation and skills lab for the Paramedic Bachelor's Degree Program since 2014, has now motivated me to investigate the simulation practices we employ. As luck would have it, one of the nestor's in simulation and debriefing is Professor Peter Dieckmann at the University of Stavanger, and I have had the privilege of having him as my supervisor. He has given invaluable advice throughout the process.

Thank you to all paramedic students who participated. I am sure you already know how highly I value every single one of you. Also thank you to all facilitators who took part. You are important role models and have greatly contributed to what the students have developed into. Without the students and facilitators, there would never have been a study.

Jeanette; my colleague, fellow student, and friend. Thank you for good discussions, sharing of burden, motivation, and lots of good old fun along the way. I could not have done it without you.

A very special thank you to all my colleagues. I know my study leave has left an additional burden to your workload. Thank you Head of Studies Trine Møgster Jørgensen for giving me encouragement and flexibility to pursue this degree. Astrid Karina Harring, your advice on academic structure and writing has been invaluable, and for this I am grateful. Thank you to Ola Græsli for your priceless IT-skills. When I and Jeanette could not be present for data collection we were as nervous as could be, but one person who can always be trusted is facilitator and paramedic Trude Øygård who assisted us in data collection. Finally, Mia Ledang who has been captain of the simulation ship in my absence. She has not had an easy job but delivered above and beyond what was expected of her. Trude and Mia, you are true stars of the simulation centre, for which I am incredibly grateful.

To my friend Eystein Grusd, for the advice I rarely followed and all the procrastination you offered. I thank you for helping keep my mental health through this process.

A special thank you to the support team who taught me statistics: Astrid Karina Harring, Kristin Häikiö, and Eystein Grusd. You made me and the thesis significantly better.

Thank you to all my dear friends and family who have endured, helped, and encouraged me through these years of study.

Oslo, October 30th, 2022

Abstract

Background. Healthcare simulation is method of training healthcare professionals to gain knowledge and skill in an experiential way through mock-patient encounters. Costs associated with simulations are amongst others related to staff due to high teacher-to-student ratio. This study aims to investigate whether simulation-experienced paramedic students can plan, deliver, and debrief simulations. This will be compared to ordinary simulations as part of a university bachelor's degree program in Paramedic Science delivered by regular facilitators. The first research question is if level of reflection in debriefing is equivalent between facilitator-led and student-led simulation. The second research question is whether there is equivalent level of participation between the two modes of simulation.

Theoretical foundation. The study builds on research in healthcare simulation, and peer-assisted learning. It also draws on ideas of reflection, and its implication for professional competence.

Methods. This is an observational non-inferiority study. Debriefings from facilitator-led (n=10) and student-led (n=12) simulation where filmed and transcribed. Each turn in a debriefing conversation was considered a unit of analysis and was counted and rated for its reflective level. Rating was done using an adapted version of Fleck´s framework of reflection levels, giving ratings from R0 to R4 as the highest level. Statistical analysis was done comparing reflective levels between facilitator-led and student-led debriefing using Chi-Square Test of Independence. The study did not affect student's workload, learning opportunities, or assessments. Participation was based on informed consent.

Results. Reflective levels seen in facilitator-led vs student-led debriefings where at R0-level 32.7% vs 33.8%, R1-level 44.0% vs 44.3%, R2-level 14.7% vs 17.1%, R3-level 0.1% vs 1.3%, R4-level and 0.1% vs 0.1% respectively. Differences in reflective levels between facilitator-led and student-led simulations were not statistically significant. Students participating in the simulation activity contributed to 62.7% of the conversation in facilitator-led debriefings compared to 60.6% in student-led debriefings, and the difference was not significant.

Conclusion. This study shows that it is feasible for students to plan, deliver and debrief their own simulations, with comparable participation and reflection, when comparing to ordinary simulation. Student-led could be a cost-effective supplement to ordinary simulation.

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1. Introduction

Medical simulation is used in pre-hospital critical care services as well as in educational institutions as one of several tools for learning. Characteristic for simulation is the training in artificially constructed situations, and the post-simulation debriefing where the experience is reflected upon and put into context with the underpinning knowledge of the topic (1). Simulation as a tool for learning is particularly useful for prehospital critical care as it allows for, in a safe manner, to experience and learn from simulated situations that are demanding, rare and where consequences to staff or patient could be high (2-4). Because simulation is resource-intensive, the extent of its use may be limited. Costs are related to simulation equipment, and staffing (5, 6). Especially since teacher-to-student ratio his higher than in other forms of instruction (7).

1.1 Purpose and aim of study

The purpose is to investigate whether simulation-experienced students can plan, execute, and debrief simulations themselves, with similar learning outcomes as simulations led by a professional facilitator.

The background and context of this investigation is the bachelor's degree program in Paramedic Science at Oslo Metropolitan University (OsloMet). At the program students regularly engage in simulation. There has been a desire to increase the proportion of simulation, but financial constraints have limited this. This has led to the development of an approach where simulation-experienced students design, perform, and debrief their own simulation events. This has been coined student-led simulation and is supplementary to ordinary simulation organised and led by faculty (facilitator-led simulation). The intention is to shed light on this method of learning within the paramedic program as its efficacy has not been established. With the purpose in mind, the aim of the study is to investigate whether student-led simulation and debriefing provides a similar degree of reflection on the event, and a similar degree of participation in the debriefing, compared to facilitator-led simulation.

1.1.1 Research question

This thesis seeks to illuminate the degree of reflection in the debriefing, and to what extent the level of reflection differs when the debriefing conversation is led by a student

compared to a professional facilitator. In addition, an attempt is made to map whether the amount of students' contributions in the debriefing are the same, when there is no professional facilitator present. To help formulate the research question the PECO-framework (8) can provide an overview (table 1).

Table 1: PECO-framework

Population	Exposure	Comparison	Outcome
Third-year paramedic students	Student organised and led medical simulation	Formally organised facilitator-led medical simulation	1. Equal level of reflection in debriefing 2. Equal extent of student contributions in debriefing

This translates into two research questions.

1. Is the level of reflection in debriefing equivalent for facilitator-led and student-led simulation?

2. Do students have equivalent level of participation in facilitator-led and student-led debriefing?

The assumption for the first research question is that simulation-experienced students have through repeated simulation exposure gained sufficient knowledge to plan, deliver, and debrief their own simulations. This is a observational non-inferiority study (9), and to investigate the research question the hypothesis (H_1) and corresponding null hypothesis (H_0) is defined as (10, 11):

> H_1: Student-led simulation achieves equivalent levels of reflection in a debriefing, when compared to facilitator-led simulation.

H_0: Student-led simulation achieves non-equivalent levels of reflection in debriefing, when compared to facilitator-led simulation.

For the second research question, the assumption is the presence of an asymmetrical relationship between professional facilitators and students (12, 13). An asymmetry which could lead the facilitator to dominate the talking time in the debriefing, thus reducing the left-over time for students to voice their thoughts. The power-imbalance could potentially also affect students' willingness to contribute to the conversation. It could for example be that a greater proportion of what is said lies with the facilitator and with outspoken students, while less outspoken students are more hesitant to speak and therefore contribute less to the debriefing. By removing the dominant presence of a professional facilitator, students might feel less restricted and contribute more to the debriefing. This should be measurable by counting the student contribution in the debriefing. If simulation participants speak more often, it may be a sign that they get the floor to speak more easily. The hypothesis and null hypothesis for this research question is defined as:

H_1: Student-led debriefing results in equal partaking in the debriefing dialogue by students participating in the simulation, when compared to facilitator-led debriefing.

H_0: Student-led debriefing results in non-equal partaking in the debriefing dialogue by students participating in the simulation, when compared to facilitator-led debriefing.

1.1.2 Why is this important?

It is resource-intensive to run medical simulation, especially in pre-hospital services where staff might need to travel to training facilities away from ordinary workplaces like ambulance stations. By letting staff or students organise simulation themselves, the cost on ambulance services or educational institutions might be reduced. This could open for increased simulation activity. It is conceivable that employees of an ambulance service participate in formally organised simulations a few times each year. The simulation knowledge gained through these events could open for frequent local self-driven simulations in the interim periods.

The emphasis on reflection has been chosen in debriefing because reflective practice is thought to be a vital component for bridging the gap between theory and practice (14, 15). This study adds to the knowledge area of reflection in debriefing, an area that is scarce of research (16).

1.2 Thesis format

The thesis format is an article combined with a thesis overview which expands upon the theoretical background, methods, results, and discussion. In agreement with supervisor, the peer-reviewed scientific journal Advances in Simulation has been chosen. This publication aims to enhance the use of simulation in health and social care by sharing scholarly practice (17). Manuscript requirements are amongst others not to exceed 4,000 words, an abstract not beyond 350 words and Vancouver style reference format. Full details of requirements are accessible on the journal´s web page (18).

The reader should be aware the original transcription is a verbatim of debriefings done in Norwegian. For readability purposes examples in this text have been translated to English by the author. For brevity and clarity, statements have been paraphrased. Utmost care has been taken to maintain the original speakers meaning in each statement.

2. Background

This study rests on the theoretical foundation of medical simulation, peer-assisted learning, and reflection. In this section the what and why of these concepts will be briefly presented.

2.1 Medical simulation and debriefing

Key concepts to understand simulation in health care is simulation itself, the facilitator and debriefing.

Simulation can be defined as "the imitation or representation of one act or system by another". This could be done through role play, technological tools of varying fidelity, mock- or real life environment or a combination of these (4). Simulation is not the tools, but the technique used, to mimic the real-life experience in an interactive way. The purpose is to give learning opportunities that can be applied directly to patient care, and by this building a bridge between traditional classroom activities and clinical practice (4, 19). In a risk-free setting, simulation offers the chance to practice both task- and team-related skills (2). Simulation is additionally used for research when clinical research is deemed too difficult or risky, and for assessment in a safe and reproducible environment (4).

A facilitator is the person who facilitates, or enables, the simulation by guiding participants through the stages of briefing, the simulated experience, and the post-event debriefing. The facilitator should have both content knowledge, and be trained in the act of facilitating simulation (20).

Experiential learning is an active learning process, where the learner links new experiences and new information with previous knowledge and understanding (21). This is where debriefing has a pivotal role, as it is a post-event reflection process enabled by a facilitator. Without this, learning would mostly be left to chance, and lessen its potential for learning from the simulation experience (2). This is because learning is not the result of experience alone. Feedback and reflection are essential for effective learning. Thus, it is the facilitators role to help shape experience to growth, and transference of learning points to clinical practice, through debriefing (2, 19). In the debriefing, the facilitator and the participants will review what happened during the simulation and stimulate the development of clinical reasoning and decision-making skills through a shared reflective

process. This happens through a shared reflective process which provides the chance to give and receive criticism, to deal with emotions, and to learn from both successes and disappointments (13).

2.2 Peer-Assisted Learning

Peer-Assisted Learning (PAL), a type of collaborative learning, is defined as the active assistance and support of equals or matched partners in the development of knowledge and skills. It is considered an umbrella-term for the wide variations within the field of students learning from other students. Variations of PAL can be classified according to their features and Olaussen et al. suggests a typology, presented in table 2 (12, 22, 23).

Table 2: Typology of Peer-Assisted Learning (22)

Relationship between students	Peer-to-peer vs peer-to-near peer
Ratio of students	Mentoring (1-2 students) vs tutoring (3-10 students) vs didactic (>10 students)

Near-Peer students are defined as being at least one academic level apart. There are uncertainties how near-peer is defined when there is an inter-disciplinary mix of students. Peer-students are defined as true peers, however there are disagreements in the PAL field whether this means students on the same academic level or students with equivalent abilities. The second separator is groups sizes, as it is postulated that groups sizes affect social climate and learning approach. Mentoring is suggested possible with one or two students, and provides an intimate setting, where open dialogue and student involvement is highly likely. Whilst tutoring, which would consist of three to ten students and is characterised by allocation of roles (tutor and tutee), a clear structure, and focused on program content. Lastly, larger groups are characterised by one-directional teaching like lecturing (22). A variation is Reciprocal Peer Tutoring (RPT), where there is a structured switching between tutor and tutee roles (12). The ambiguity of PAL nomenclature can make it challenging to use in research (12, 22-24). For the purpose of this study, peers are considered to be randomly grouped students of 3-4 within the same cohort. The assisted learning is provided as a group-to-group endeavour by scripting, delivering, and debriefing simulation events. These groups would carry the intimate and open dialogue characteristics of mentoring, but also the clear structure of tutoring.

Among advantages identified in a systematic review on higher education are better knowledge and skill retention; increased course grades; improved communication and non-technical skills; better independent learning and self-direction; improved collaborative work and learning processes; and better understanding and retention of content (12, 23, 25). Studies included in the review were of variable quality, and some conclusions are supported by only single or few studies. Application of conclusions should be with caution.

Challenges with PAL has been reported to be too little time to prepare; variability in covered curriculum content; need for monitoring and quality control; lack of previous teaching experience; challenging group dynamics; different learning paces amongst students; and student anxiety (12, 25).

Reasons for using PAL have been reported to be promoting professionalism, identifying links between teaching and actual learning, replacement for skill assessment, enhancing students practice and non-technical skills, and to meet increasing student numbers when diminishing educational resources (12). Furthermore, it may be that student-led simulation adds something that ordinary simulation does not, as PAL is qualitatively different from ordinary teaching approaches (23, 25). For example, learning by teaching; and the acquisition of management, teaching, and social skills (12, 23).

2.3 Peer-assisted learning in healthcare simulation

PAL in healthcare simulation has been reported be multiple others. A comprehensive search and presentation have been beyond the scope of this thesis. No systematic reviews have been identified but some notable studies should be mentioned.

Four studies reporting on student-led simulation has been identified. In the first peer-led simulation was done with 79 final-year medical students, taking turns in facilitating and participating in simulations. Student-written scenarios received expert review prior to simulation. This study asked students if developing, delivering, and debriefing improved their knowledge. Students agreed to the statement 94%, 91% and 96% respectively, and gave a favourable rating overall on a 5-point Likert scale (mean 4.6, SD not reported) (26). The second trialled five faculty-scripted emergency medicine scenarios with 135 fourth-year medical students. Simulations used a monitor-simulator app tablets (SimMon™),

simple mannequins or actors, and necessary equipment. Student groups of 4-5 rotated between scenarios every 20 minutes, and groups also alternated between facilitation and participation. This study reported on a 5-point Likert scale and found simulation was a positive experience (mean=4.6, SD=0.7), and that this method helped retain knowledge better than ordinary simulation (mean=4.5, SD=0.8). Participants reported high-levels of learning, low levels of preparation effort, and a more interactive experience than faculty-led simulations (27). In a third study, second- and third year nursing students (n=509) in groups of 4-5 students rotated between 4 clinical scenarios. Scenarios were pre-scripted by faculty, medium-level fidelity with Sim Anne mannequins (Laerdal Medical), and lasted 20 minutes including a short feedback session. With a 16-item 6-point Likert scale questionnaire self-confidence (mean=4.14, SD=0.92) and learning satisfaction (mean=4.42, SD=0.93) was assessed. Students responded they either agreed or strongly agreed for all items (28). A fourth study, fourth-year medical students up to junior doctors, wrote scenarios in the morning, and alternated in delivering and participating in simulation in the afternoon. In a 5-point Likert scale questionnaire (n=58), all respondents either agreed or strongly agreed the approach was helpful, found writing scenarios was educationally valuable, and would recommend this method to others (mean and SD not reported) (29). All studies reported on the reaction-level in the Kirkpatrick evaluation model, with participants giving favourable self-report on learning experience and effect. A relationship between positive reporting on the reaction level has not been demonstrated to be associated with actual learning, behavioural changes in individuals or changes in organisational performances (30). Although positive student evaluations, these studies show that further research is needed to assess the efficacy of student-led simulation.

In a study of final-year students in Bachelor of Nursing, student groups of 4-5 alternated between designing and facilitating peer-simulations, and participating in such simulations. A qualitative analysis based on a focus-group interview (n=4) explored the experiences of the student-facilitator role. This uncovered that students perceived knowledge and experience from earlier in the nursing program was a precondition for preparing scenarios and being able to facilitate. Students also felt they had a responsibility for the learning outcome of fellow students. A particular challenge was finding the right difficulty level of the scenario to achieve learning. Students highlighted that facilitating trained them in communication and leadership skills, which they found relevant for their nursing profession (24).

Evidence of PAL in healthcare simulation is scarce (28), reporting seems to be case-based or of low evidence level, and no systematic overview has been identified. Studies that have been found provide encouraging evidence to pursue further exploration of this approach to simulation.

2.4 Reflection

Reflective practice is credited to Donald Schön and his extensive work on professions, and how professionals learn from experience (31). It is in Schön's opinion that professional competence not only is derived from scientific knowledge, but also has an experiential component to it. Knowledge must be applied to the indeterminate or swampy zones of practice, and for this the technical rationality of scientific knowledge alone is insufficient. To achieve application of bookly knowledge, reflecting on owns practice and experience is a key component to develop this artistry needed in professional competence (32). This reflection can be at the time of practice, reflection-in-action, when the practitioner is considering the what and how in real-time. Reflection can also be afterwards thinking about the event, reflecting-on-action (32-34). Debriefing and peer-feedback are tools that can facilitate reflection-on-action (31). Since reflection about own practice is a key part of developing professional competence, reflection might be a useful outcome measure when assessing debriefing after simulation.

3. Methods

This project has collaborated with Jeanette Viggen Andersen´s thesis project, and has comprised participant recruitment, data collection and secondary review in data analysis. Data reporting is in accordance with guidelines for health care simulation (35). Documentation in its entirety can be found in appendix E.

3.1 Study population and selection

The study was conducted at OsloMet´s simulation lab in the autumn of 2021. Students selected to the study were third- and final year students at the bachelor program in Paramedic Science. The whole cohort of third-year students (n=45) were recruited. Median age was 23 years (range 21-34), 23 were female, and 22 men. Final-year students were selected, which were in their second-to-last semester, and had by then extensive exposure to simulation throughout their program. It was considered they had the best prerequisites to perform their own simulations.

The study program has a pool of clinically active paramedics (n=25) who are part-time employed as facilitators at the simulation lab. They have a three-day course on how to conduct simulation and debriefing, and have experience from this through working at the simulation lab. Facilitators who happened to work on days with data collection were asked to participate.

None declined participation.

3.2 Data collection

During the semester the students had 16 days with simulation, whereof the last two were planned for student-led simulation and the 14 prior to this were ordinary facilitator-led simulations. Four conveniently chosen days with facilitator-led simulation were selected for data collection, in addition to the two days with student-led simulation.

On the facilitator-led simulation days five different scenarios were run in parallel, and every scenario was run five times. Each day two conveniently selected scenarios were selected, and the debriefing from all runs were recorded. In total, 37 facilitator-led

debriefings with eight different facilitators were recorded. On the student-led days, six scenarios were run in parallel, and they were run six times. Three scenarios were conveniently selected, and all runs recorded. This gave a total of 28 recorded student-led debriefings. Due to full memory cards on the video cameras, three facilitator-led and eight student-led debriefings failed.

Actual recording was done with video cameras placed on tripods with good view of the debriefing area. It was the facilitators and students themselves who initiated and stopped each recording.

3.3 Data analysis

For assessing the level of reflection by students in the debriefing sessions, an adapted version of Flecks framework for rating reflection on experience was chosen. See table 3. The framework was initially constructed to rate teacher students reflection when they commented on images from their teaching sessions (36). With adaptions, the framework has later been used to rate levels of reflection in post-simulation debriefing conversations (37).

Table 3: Flecks framework with Kihlgren´s adaptions (36, 37)

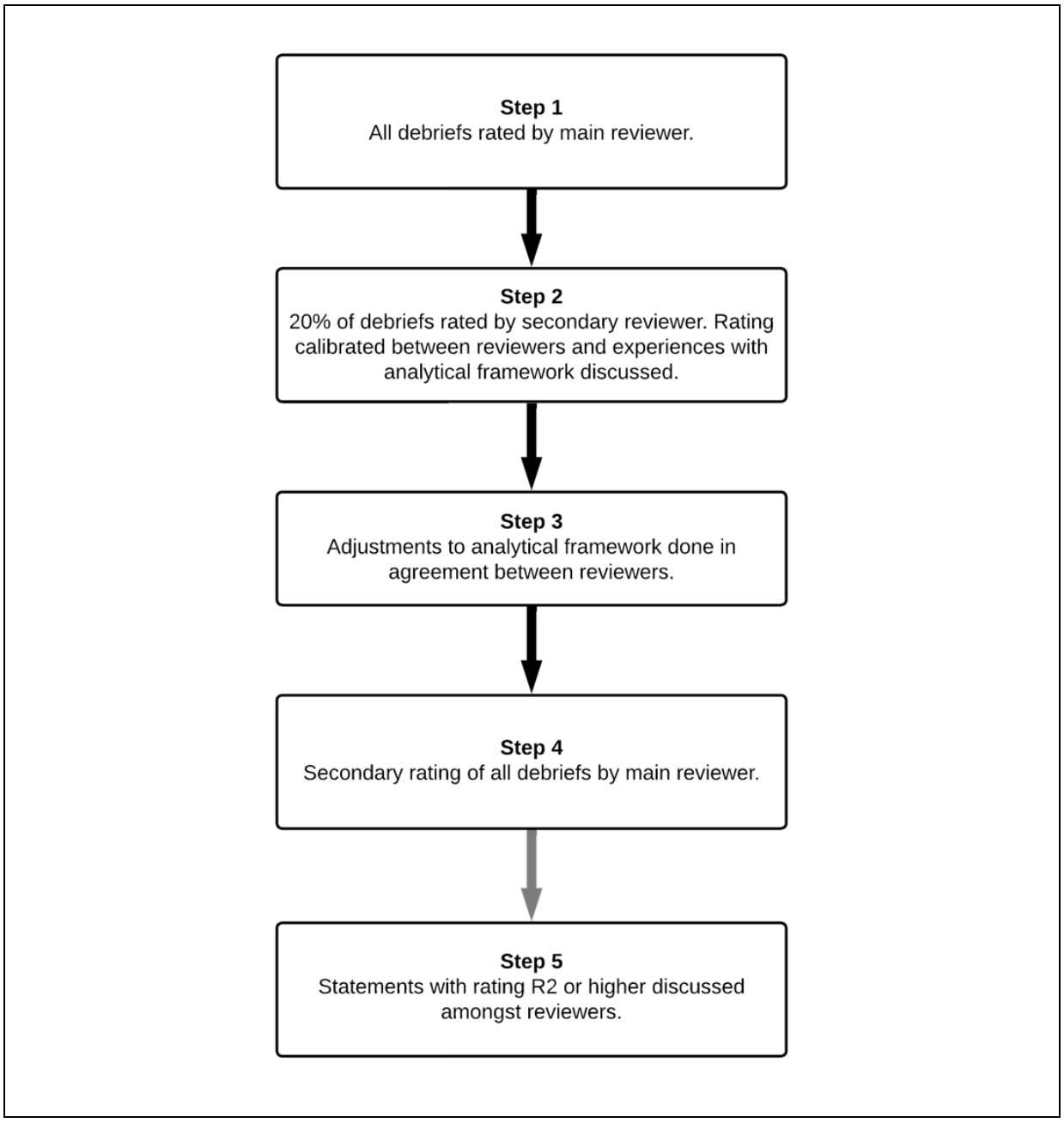
Definition	Features
R0 – description "A description or statement about events without further elaboration or explanation."	- Non-reflective - Descriptive - Clarifying - No reasons or justifications given - Short utterances such as ''Yes, it was''*
R1 – descriptive reflection "Description including justification or reasons for action, but in a reportive or descriptive way. No alternate explanations explored, limited analysis and no change of perspective."	- Descriptive with explanation - Evaluative - Reasons and justifications for actions - Explanations or ideas that are already possessed - Explaining or referencing guidelines and practices known beforehand by the participant* - Suggestion for change
R2 – dialogic reflection "A different level of thinking about. Looking for relationships between pieces of experience, evidence of cycles of interpreting and questioning, consideration of different explanations, hypothesis and other points of view."	- Questioning assumptions - Referencing to experiences - Relating experience to theoretical concepts - Interpreting and hypothesizing - Considering different explanations - Considering implications of observations, interpretations, and suggestions - Generalizing from experience
R3 – transformative reflection " Revisiting an event with intent to re-organise and do something differently. Asking of fundamental questions and challenging personal assumptions leading to a change in practice."	- Fundamental questioning of assumptions and motivations - Fundamental change of perspective
R4 – critical reflection "Where social and ethical issues are taken into consideration. Generally considering the (much wider) picture."	- Ethical - Political - Relating to society, culture and the world as a whole

*Additions suggested by Kihlgren et al. (37)

3.3.1 Analysis process

The analysis process was done in five steps, as illustrated in figure 1.

Figure 1: Stepwise approach to data analysis



In the first step all transcripts were assessed by the primary reviewer (Carl Robert Christiansen) using the adapted framework (37). The second step, 20% of the transcripts were assessed by a secondary reviewer (Jeanette Viggen Andersen). The purpose was to calibrate the primary reviewers rating practice. For this the differences in assessment were discussed and final agreement made. Experiences with the framework were also discussed. In the third step adaptions were made to the framework. See next section for details. Step

two and three can be seen as a calibration process which led to step four, where all debriefs received another assessment by the primary reviewer. As a fifth and last step, all statements receiving a rating of R3 and R4 where individually discussed between primary and secondary reviewer, as a measure to mitigate potential false high rating in the study. A coding manual with definitions was developed as a tool to guide the rating process (appendix C). This manual has been inspired by similar unpublished manual (38), shared by supervisor Professor Peter Dieckmann.

A debriefing is a dialogue between multiple participants, where speakers take turns in talking. What is said within each turn gave a chunk which was considered a unit of analysis. Multiple turns would produce multiple units of analysis´. A unit of analysis could contain multiple sentences and statements which could have different levels of reflection. Each unit of analysis (turn in a conversation) received one rating, and only the highest rating would be chosen. Only students' contribution in the conversation where assessed. For student-led simulation and debriefing, some of the students played in the simulation, and others had functions as actors or facilitators. Only contributions from students playing the simulation were assessed, and students filling roles as facilitators or actors were not assessed.

Microsoft Office 365 Word and Excel for Mac (version 16.63.1, Microsoft Corporation, Redmond, Washington, United States) was used in the rating process.

3.4 Adjustments to the analytical framework

The framework consists of five well-defined levels of reflection. Each level of reflection has a set of features which characterise statements at that reflective level. These features have been useful in the rating process. Rating is done by reading a statement, assigning the relevant feature which characterises the statement, and the identifying the reflective level associated with this feature. This is illustrated in example 1. The original framework was made for a different purpose. For rating student teachers reflecting on their own practice. In this setting it has been used in a debriefing, which is a group conversation between students reflecting on their joint efforts. This might have elicited additional features of reflection which might not have been observed in previous work. To be able to capture the observed variations of reflective statements some new features were added, and others were modified.

Example 1: Rating process and associated features

Unit #	Speaker	Statement	Features	Rating
62	Student 2	Of the good things, we are assessing the resources in relation to if it is necessary to bring him to A&E. Will the patient have any benefits of being taken to A&E. There must be an opportunity for the GP to come for a visit instead, he also has home care here. And a bit of consideration whether he had taken a toxic dose. Discovering he had taken a toxic dose meant we had good cause to bring him to A&E.	Evaluation with explanation Considering implications of observations, interpretations, and suggestions	R2 dialogic reflection
63	Student 3	I think it prolongs QT-time.	Reasons and justifications for actions, choices, or interpretations	R1 descriptive reflection
64	Student 2	QTC.	Clarifying	R0 descriptive
65	Student 3	Yes.	Short utterances such as ‘‘Yes, it was’’	R0 descriptive
Debriefing 22				

3.4.1 Evaluative statements

Evaluative statements are a feature of the R1 reflective description level in the framework (36, 37). During the rating process two different variations of evaluative statements were found, as demonstrated in example 2.

Example 2: Different forms of evaluation

Unit #	Speaker	Statement
1	Facilitator	What do you think of your teamwork?
2	Student 1	I thought it was great.
3	Student 2	10 out of 10.
4	Student 1	It worked really well. It felt natural. I did the primary assessment, but he injected questions or assessment points that I forgot.

Debriefing 5

The evaluative statements in unit four are different from unit two and three because the former provides an explanation, whilst the latter do not. The existing framework does not distinguish between these variations of evaluation, although unit four does seem to represent a higher level of reflection by providing a justification for the evaluation. To capture these nuances, two variations of evaluative statements are suggested: *Evaluation with explanation* and *evaluation without explanation*. Presence of justification has been considered to be a distinguishing factor between reflective level *R0 description* and *R1 reflective description*. For this reason, the adapted features were assigned to the reflective levels accordingly.

3.4.2 Asking questions

Questions is a phenomenon which is not described in Flecks framework, but a feature that appears frequently in the debriefings. Two variations of questions have been identified. True questions and concealed opinions or explanations, as seen in examples 3 and 4.

Example 3: A true question

Unit #	Speaker	Statement

86	Student 1	You remember the child I mentioned from practice placement? Turned out he had ketoacidosis.
87	Student 2	That's interesting, but did he have diabetes?

Debriefing 5

Example 3 shows what could be described as a true question. A true question is when the questioner does not know the answer. This could be questions of facts, procedures, emotions or how events progressed. For the continued analysis true questions have not been rated, as it was not possible to identify an appropriate reflective level for these. Future work on the framework could explore this further.

Example 4: A concealed explanation

Unit #	Speaker	Statement
100	Student 1	But couldn´t that be because they have exhausted all their reserves, and hence have insufficient to release?

Debriefing 1

Examples 4, 5 and 6 are more rhetorical in nature, as they seem to make a point in the way the questions are framed. These have not been considered real questions, as it seems the students are probing an explanation. It seems the students are truly unsure whether their explanation is correct. The students are possibly trying out an explanation they are unsure of, and to reduce the risk of embarrassment of being wrong, they pose it as a question. Regardless of the student's motivation for asking probing questions, they do carry the characteristics of being *descriptive with explanation* which are features of the *R1 reflective description*-level. However, this level also contains the feature *explanations of ideas already possessed*. Since it is posed as a question, it alludes to the student not knowing the answer, and could therefore be considered closer to *interpreting and hypothesising* which are features of *R2 dialogical reflection*. It could also be questions with varying degrees of certainty. In some questions the students are fairly certain of the answer, whilst other cases they are really quite uncertain. Examples 4 and 5 are interesting in this respect, because from a medical standpoint example 4 is a correct explanation. On the other hand, the postulation made in example 5 is factually wrong, it should be high blood sugar.

Example 5: A concealed explanation

Unit #	Speaker	Statement
6	Facilitator	Can those with diabetes get hypoglycaemia?
7	Student 3	Isn´t it with undiagnosed diabetes, they will present with low blood sugar because they do not produce insulin?
Debriefing 2		

Example 6: A concealed explanation

Unit #	Speaker	Statement
57	Student 3	Couldn´t too much intravenous fluid result in pulmonary oedema?
Debriefing 5		

There are reasonable arguments for placing probing arguments both within the R1- and R2-levels of reflection. Here the students have been given the benefit of doubt, and it is assumed they are testing explanations of which they are truly unsure about i.e., hypothesising. For this reason, a new feature *probing question with explanation* in the R2-reflective level has been added.

There is another variation which could be called the challenge-response situation, which is illustrated in example 7.

Example 7: The challenge-response situation

Unit #	Speaker	Statement
48	Facilitator	What could a critical care team contribute in this setting?
49	Student 1	CRP measurement?
50	Student 2	Intravenous paracetamol?
51	Student 3	Antibiotics?

52	Student 2	How about vasopressors?
53	Student 1	IV, if we are not able to gain access?
54	Student 1	Also, if the child arrests…
55	Facilitator	In this case I was really thinking of vasopressors, although antibiotics, IV assistance and possible deterioration are also good points. I´m quite certain they do not have access to CRP, but actually quite unsure of intravenous paracetamol.

Debriefing 3

It is evident by the facilitators response that the students are uncertain what a good answer to the question might contain. It seems like a situation with brainstorming, where the students collaboratively add ideas. There is some differences amongst the answers. While statement 53 and 54 contain an element of explanation, statement 49 to 52 do not. To solve this the feature *probing answers* in the R1-level of reflection has been added, to catch short answers to simple questions, as seen in statement 49-52. Whilst 53-54, have more resemblance to the feature of hypothesising or being probing questions with explanations in the *R2-level of reflection*. Although presented as questions, they are also answers to a direct question. To avoid uncertainty, this has been added as a feature under the R2-level as a *probing answer with explanation*.

3.4.3 Other adjustments

A few other adaptions have been made. Occasionally facilitators or participants ask what if-questions, and thus presenting a hypothetical case, as seen in example 8.

Example 8: A hypothetical question with a hypothetical answer

Unit #	Speaker	Statement
16	Facilitator	Let´s assume it was a cardiac arrest, and the nurse said there was a do-not-resuscitate order on this patient?
17	Student 1	I don´t think I would have trusted him; we would need to see it in writing.

Debriefing 6

In example 8 the student also offers a hypothetical answer. The answer resembles the *reasons and justification of actions*-feature in the R1-level. However, there was never an action. Though the decision-making process behind the choice, which would have led to an action is presented. For clarification an adaption to this feature has been done by adding *…or* choices so that this feature reads *Reasons and justifications for actions or choices*.

On some occasions participants explain the reasoning behind their interpretation, as seen in example 9.

Example 9: Reasoning behind an interpretation

Unit #	Speaker	Statement
17	Student 1	If it had been an adult, I would have thought a bit differently because the level of consciousness was not too altered at that point, but I think sick children become irritable and things like that a lot faster.
Debriefing 4		

Based on this, the previously presented feature has been further refined by adding *interpretations* to it. In this study the following definition of the feature was used: *Reasons and justifications for actions, choices, or interpretations.*

Another amendment is done to *considering different explanations* feature at the R2-level. It is my understanding that a distinction between R1 and R2 level is the presence of more than one approach. This can be more than an explanation, it could be providing a different solution. As seen in example 10.

Example 10: Suggestion an alternative

Unit #	Speaker	Statement
65	Student 1	I´m thinking the patient could continue sleeping, and the nursing home doctor could see to him during rounds the following day.

66	Student 2	We could potentially request an urgent care GP to come for a home-visit.
Debriefing 6		

To encompass both suggestions for other explanations or providing alternatives, this feature is adapted to c*onsidering or suggesting different explanations or alternatives*.

3.4.4 Adjusted analytical framework

Flecks framework of reflective levels (36) has clearly defined seemingly appropriate levels of reflection. During rating, the describing features have been essential to guide the rating process. As discussed, this has revealed a need for adaptions in addition to those previously suggested by Kihlgren et al. (37). The final framework used for this study is presented in table 4.

Table 4: Reflective framework with adaptions as used (36, 37)

Definition	Features
R0 – description "A description or statement about events without further elaboration or explanation."	- Non-reflective - Descriptive - Clarifying - No reasons or justifications given - Short utterances such as ''Yes, it was''* - Evaluation without explanation**
R1 – descriptive reflection "Description including justification or reasons for action, but in a reportative or descriptive way. No alternate explanations explored, limited analysis and no change of perspective."	- Descriptive with explanation - Evaluation with explanation** - Reasons and justifications for actions, choices, or interpretations ** - Explanations or ideas that are already possessed - Explaining or referencing guidelines and practices known beforehand by the participant* - Suggestion for change - Probing answer **

R2 – dialogic reflection "A different level of thinking about. Looking for relationships between pieces of experience, evidence of cycles of interpreting and questioning, consideration of different explanations, hypothesis and other points of view."	- Questioning assumptions - Referencing to experiences - Relating experience to theoretical concepts - Interpreting and hypothesizing - Considering or suggesting different explanations or alternatives ** - Considering implications of observations, interpretations, and suggestions - Generalizing from experience - Probing question with explanation ** - Probing answer with explanation **
R3 – transformative reflection " Revisiting an event with intent to re-organise and do something differently. Asking of fundamental questions and challenging personal assumptions leading to a change in practice."	- Fundamental questioning of assumptions and motivations - Fundamental change of perspective
R4 – critical reflection "Where social and ethical issues are taken into consideration. Generally considering the (much wider) picture."	- Ethical - Political - Relating to society, culture and the world as a whole

*Additions suggested by Kihlgren et al.

** Addition or adjustment used in this study

3.5 Statistics

Descriptive statistics were calculated in Microsoft Office 365 Excel for Mac (version 16.63.1, Microsoft Corporation, Redmond, Washington, United States). Statistical analysis for comparing facilitator-led with student-led debriefing was done using Chi-square Test of Independence using Social Science Statistics calculator (39). For significance testing the data was adapted to a 2x2-table. The data meets the five assumptions for a Chi-square Test of Independence (40). First, data is non-parametric. Second, variables are categorical. Third, observations are considered independent as it is only two groups to compare, and each group is understood as a single entity. Fourth, cells are mutually exclusive. Fifth, when combining data to a 2x2-table, no cell is less than 5. A *p*-value of equal or less than 0.05 was considered significant. The non-inferior margin (9), specifying what would be a meaningful difference, was by discretion set for 5%. Meaning that if the difference in reflective levels or amount of student's dialogue contribution was significant and 5% or more, the difference would be considered a meaningful difference in practical educational terms.

3.6 Ethical considerations

Participation was voluntary and based on written consent. Students and facilitators received verbal and written information. Guidelines from the Norwegian Centre for Research Data (NSD) were followed. See appendix A.

Since the researchers are teachers at OsloMet´s paramedic program there is a relationship of trust and power towards students and facilitators. Students and facilitators may hesitate to decline participation. For this reason, extra care has been taken to underline the voluntariness of participation. Recruitment was done in the early days of the semester, but data collection was done at later stages in the same semester. On days of data collection, students were reminded of the study, that participation was voluntary, and that withdrawal could be done even after data collection but prior to anonymisation. Information was given formally, but in a positive tone, to reduce the threshold for participants to ask questions or withdraw. Reminders of voluntariness and the option to withdraw was given repeatedly throughout the semester. Withdrawal could be done verbally, by proxy or on any of the digital communication platforms available to the participants.

As data was collected from regularly scheduled simulation activities, no extra time was required from the participants. The study did not interfere with or affect students' university learning or assessment activities.

Data management complied with General Data Protection Regulation (GDPR) and was approved by NSD (notification number 425765). Recording was done on non-network connected cameras and data transferred to university computers. An external professional transcription agency was used, and data transferred was done using encrypted pathways. Recordings were deleted and anonymisation in documents ensured immediately after data analysis.

According to Norwegian legislation the study is not eligible for consideration or approval from the Regional Ethical Committees, as neither patient nor biomedical data is collected (41, 42).

4. Results

In a single simulation day, different scenarios would be played out in five to six different simulation rooms. Every scenario would be played five or six times respectively, with students rotating between the rooms. Depending on availability of recording equipment, two or three of these rooms would be conveniently selected, and all post-simulation debriefings filmed. This resulted in 37 facilitator-led and 28 student-led debriefings recorded. Since there were five to six recordings of every scenario, the recording in the middle of the day was selected for analysis. The assumption was that the debriefers had not quite found their form for the initial debriefings, and might be fatigued towards the last debriefings. Hence the belief was the middle recording would represent the optimal performance. This resulted in the selection of 10 facilitator-led and 12 student-led debriefings for analysis.

4.1 Distribution of reflective statements in debriefings

The results regarding reflective statements are presented in the article accompanying this thesis. For ease of reading, an overview of the results is briefly summarised in table 5. For further details, see the article presented in section 8.

Table 5: Distribution of reflective statements in debriefings

	Facilitator-led		Student-led	
R0 description	32.7%	223 (n)	33.8%	237 (n)
R1 reflective description	44.0%	300 (n)	44.3%	311 (n)
R2 dialogical reflection	14.7%	100 (n)	17.1%	120 (n)
R3 transformative reflection	0.1%	1 (n)	1.3%	9 (n)
R4 critical reflection	0.1%	1 (n)	0.1%	1 (n)
Questions	8.4%	57 (n)	3.4%	24 (n)

4.2 Comparing reflections in paediatric and complex scenarios

In the research process a question arose whether specific scenario themes affected the reflective levels. The scenarios were therefore grouped into paediatric and complex scenarios. The former containing scenarios about critically sick children, and the latter situations with medical, social, legal and/or ethical issues in vulnerable or geriatric patients. These results are also presented and discussed in the article (section 8). For overview purposes, the results are briefly summarised in table 6 below.

Table 6: Comparison of reflective statements between paediatric and complex scenarios

	Paediatric scenarios (n=11)		Complex scenarios (n=11)	
R0 description	35.4%	209 (n)	31.7%	251 (n)
R1 reflective description	45.3%	268 (n)	43.3%	343 (n)
R2 dialogical reflection	13.4%	79 (n)	17.8%	141 (n)
R3 transformative reflection	0.5%	3 (n)	0.9%	7 (n)
R4 critical reflection	0.0%	0 (n)	0.3%	2 (n)
Questions	5.4%	32 (n)	6.2%	49 (n)

4.3 Proportion of turns between facilitators and simulation participants

As a debriefing is a conversation between the facilitator and the simulation participants (the students), their turns in the conversation were counted. During facilitator-led debriefings, the students had on average 62.7% (range 50%–77.6%) of the turns to speak. For debriefings led by students, the participating students had 60.6% (range 53.0%–76.6%) of the turns to speak. No significant differences were found between the amount of turns to speak when comparing facilitator-led with student-led debriefing using a Chi-square Test of Independence on this sample with a $p>.05$ (X^2 ($df = 1$, $N = 2246$) = 1.12, $p = 0.290$). Hence, H_0 is rejected. Since there were no significant differences, and differences are less than the pre-specified non-inferiority margin of 5% between the groups, student-led debriefing is not considered inferior to facilitator-led debriefing according to the pre-specified criteria. Results presented in table 7.

Table 7: Overview of debriefings

	Facilitator-led		Student-led	
Facilitator turns	37.3%	405 (n)	39.4%	457 (n)
Student turns	62.7%	682 (n)	60.6%	702 (n)
Total		1087 (n)		1159 (n)
Debriefings subject for analysis		10 (n)		12 (n)
Average length of debriefing	17.3 min		15.3 min	
Median length of debriefing	18.0 min		14.9 min	
Range length of debriefing	10.5 to 22.3 min		8.1 to 26.0 min	

Median length of debriefings for facilitators was 18.0 minutes (range 10.5 to 22.3 minutes) and for debriefings led by students 14.9 minutes (ranging 8.1 to 26 minutes). Time set of for simulation including debriefing was for the most part 45 minutes, however about half of the facilitator-led simulations had 60 minutes. This means that time available to conduct a debrief for facilitators in half the instances was longer than what student-led simulations had available. With different prerequisites', comparison regarding debrief length could not be made.

5. Analysis and discussion

The discussion must be seen in context with the accompanying article. The article focuses on the first research question on distribution of reflective levels. The following discussion comprises the second research question on the proportion of student´s contribution in the debriefings, and on additional issues arisen throughout the study concerning what might generate reflection.

5.1 Comparison of student's contribution in facilitator-led vs. student-led debriefing

The second research question asks whether the proportion of student's contribution is equivalent in student- and facilitator-led debriefings. One could imagine students spoke more freely when a facilitator is absent. Several possible explanations for such an assumption exist. On the one hand teachers are accustomed to dominating talk-time in a classroom, and this habit could possibly be transferred to the debriefing room. On the other hand, also students might restrain their contributions in fear of saying something incorrect in front of a teacher who is an authority figure and more knowledgeable on the subject area. This investigation did not find significant differences in the amount of turns to speak by students who participated in the simulation, regardless if the debriefing being led by a student or a facilitator. This might be because there are no true differences, or that amount of turns to speak is the wrong measure for the question. It could be that comparing total talk-time or sum of spoken words by students and facilitators are better measures for this area of research. It was however outside the remits of this thesis to explore this further. Another area of exploration could be whether teacher presence affects various students differently. Maybe outspoken students are vocal regardless of facilitator presence, and less outspoken students speak more freely in the absence of an authority figure (22). Mapping speakers in a conversation could possibly be an approach to investigate this (43, 44), however this was also outside the remits of this thesis.

5.2 What generates reflection?

This study has not been designed to answer the question of what generates reflection. Despite this, a few events in the debriefings have given cause to look further into this.

5.2.1 Effect of scenario design on reflective level

The research of Husebø et. al. looks into the questions facilitators ask, to understand what features result in reflection amongst simulation participants (16). Kihlgren et al. suggest that it might not only be the questions but also features of the scenario itself, which impacts reflective levels amongst the simulation participants (37). Whether scenario complexity impacts reflective level is analysed and discussed further in article presented in section 8. The continued discussion should be seen in the light of the article´s discussion.

5.2.2 Seminal events

Out of 22 simulations, one simulation stands out with more higher-level reflections than the others. This is shown in table 8. Of the 22 debriefings only 10 statements were rated as R3 transformative reflection. Half of these occurred in debriefing 22. This debriefing had a seminal event, a conflict between two students, which resulted in emotions flying high and an intense discussion followed. This event supports the idea that it might not only be the facilitators questions, but also characteristics of the scenario itself which promotes higher level reflection. Several authors describe this as reflection being stimulated by a problematic situation (16, 45).

Table 8: Comparison of ratings between debriefing 22 and all debriefings

	Debriefing 22	Debriefing in total
R0 description	18.6% (n=11)	33.2% (n=460)
R1 reflective description	42.4% (n=25)	44.1% (n=611)
R2 dialogical reflection	28.8% (n=17)	15.9% (n=220)
R3 transformative reflection	8.5% (n=5)	0.7% (n=10)
R4 critical reflection	0.0% (n=0)	0.1% (n=2)
Questions	1.7% (n=1)	5.9% (n=81)

5.2.3 Questions and situations that generate reflections

Continuing about what generates reflection in debriefings, Husebø et al. (2013) was specifically interested in characteristics of facilitators questions that elicited reflection. In this study, some questions seemed to frequently give reflections at the R1 descriptive

reflection level. These were when the facilitator or students leading the debrief came to the third and last step in the Steinwachs model of debriefing (46). Questions of the application phase would typically give responses containing evaluative statements with explanations or considerations for future change, which are features of the R1 descriptive reflection level. Examples of these questions are *Is there anything you would do differently next time?* or *Could you highlight something good or bad?* Further research comparing questions and reflection in responses in the analytical phase and the application phase might shed additional light on this issue.

Another type of questions that potentially could evoke higher level reflections could be questions closely linked to legal issues. Some of the scenarios had dilemmas related to mental health or assessment of mental capacity, which means considerations on the possible use of coercion. This topic is closely related to legal obligations and leads to referencing legal rules. Referencing to rules could be the feature of explaining ideas already possessed which is a feature of R1 descriptive reflection, but maybe even more likely relating experience to a theoretical concept (e.g., legislation) which is a feature of R2 dialogical reflection. Example 11 shows how a student does the latter.

Example 11: Legal issues producing R2 dialogical reflection

Unit #	Speaker	Statement	Reflective level
17	Student 2	I believe we have grounds to use section 7 in such cases, so we intervened physically and stopped her from being able to jump. At the same time, it must be assumed the patient has health care needs of vital importance which obligates us to provide it. Regardless of consent. According to the second paragraph of the The Health Personnel Act, if we are in doubt we must admit the patient for further assessment.	R2 – dialogic reflection
Debriefing 20			

Although no instances were identified in this study, it is reasonable to question whether legal dilemmas can lead to ethical discussions which are features of the R4 critical reflection level. Further research into scenarios with legal dilemmas could be a possible avenue for further exploration to understand this phenomenon.

5.2.4 Missed opportunities for identifying reflection

According to the coding manual statements were chunked as turns of speaking in the conversation. This resulted in one unit of analysis being one student's isolated turn in the conversation. Occasionally a series of statements after one another, seen as a whole, could be argued to produce a higher level of reflection at group level. In example 12 there is a series of statements which individually carry the R1 feature of explanations or ideas already possessed. On the other hand seen as a whole, the students collaboratively are considering different alternatives, which is a feature of the R2 dialogical reflective level. This effect could be called cumulative reflection, and it seems this effect is not caught when using turn-taking for chunking units for analysis.

Example 12: Cumulative reflection

Unit #	Speaker	Statement	Reflective level
7	Facilitator	What option where you considering when she threatened to jump from the balcony?	R1 – descriptive reflection
8	Student 1	We could have asked the fire brigade to put out rescue jump cushions.	R1 – descriptive reflection
9	Student 2	The police could have cleared the scene below the balcony.	R1 – descriptive reflection
10	Student 1	Yes, there is probably many people there	R1 – descriptive reflection
11	Student 3	I think maybe the police has a specialist group that can abseil down from the outside, and push those who threaten to jump inwards.	R1 – descriptive reflection

12	Student 1	Don´t they have negotiators too?	R1 – descriptive reflection
13	Student 2	We would have needed another ambulance and an on-scene commander too.	R1 – descriptive reflection
14	Student 3	And a critical care team	R1 – descriptive reflection

Debriefing 19

5.3 Limitations

There are several concerns regarding bias, validity, and reliability the reader should be aware of.

Bias. It is fair to question whether the researchers are independent of biases. As a lecturer on the paramedic program, it is reasonable to assume a wish, consciously or unconsciously, to portray the program and it´s students in the best possible light which could lead to higher ratings. Transparency and rigour in methodology has been attempted to limit this effect. For this reason, all R3- and R4-reflections have been provided for the readers own review in appendix D.

It has not been possible to blind the reviewers in the rating process to whether the debrief was led by professional facilitators or students. Since student-led simulation was a group exercise of about three students, their debriefings had multiple students facilitating the discussion. Multiple facilitators made it evident in the transcripts that the debriefing was student-led. In addition, scenario scripts used by the professional facilitators are well known known to the reviewers. A non-blinded rating-process has made rating additionally prone to bias from the reviewers.

Validity. There are several issues regarding validity. Firstly, to what extent the reflective framework measures true reflection. Fleck discusses that any instrument used to measure reflection merely gathers indirect evidence of it. Fleck makes clear that the framework might overlook or incorrectly attribute reflection. Further, Fleck points out the novelty of the framework, and it´s need for further development and validation (36). This research demonstrates the need for development and refinement since several features have

undergone additions or alterations. Secondly, it is only the reflection that students verbalise which are captured. Presumably there are also reflective thoughts that are never said out loud, and hence not captured. Thirdly, reflection can develop hours or days after the debrief, and are thus never captured. To the extent the framework measures reflection, it would in any case be the lowest level of reflection.

Occasionally students will draw wrongful conclusions as seen in example 13.

Example 13: Wrongful conclusions

Unit #	Speaker	Statement
6	Facilitator	Can those with diabetes get hypoglycaemia?
7	Student 3	Isn´t it with undiagnosed diabetes, they will present with low blood sugar because they do not produce insulin?
Debriefing 2		

In statement 7 (example 13) the student hypothesises how a patient would present if the patient had an unknown diabetic condition. Hypothesising is a feature of the R2 dialogical reflection level in the framework, and was thus rated as such. Ironically, the student's conclusion is factually wrong. Insulin contributes in moving glucose from the blood stream into the bodies´ cells. Insufficient insulin would therefore reduce the amount of glucose moved into cells. The net result is lack of sugar in the bodies´ cells, and accumulation of sugar in the blood stream known as high blood sugar. Hence, the reflective framework does not take into consideration if the reflection reaches a correct or incorrect conclusion.

Is has not been possible to compare this study to the other studies employing PAL in simulation, which have been presented in section 2.3. This is due to the studies having different practical approaches to PAL in simulation, and using different outcome measures.

Facilitators utterances have not been subject for rating and analysis. However, in all probability also facilitators will experience events that evoke reflection and learning. For student-led simulation this is particularly relevant, as reflection through facilitating debrief could have a learning value in its own right. Further research is needed to capture the learning experience for students facilitating a debrief.

Reliability. Although the framework provides guidance, there is an inherent subjective component in rating. Statements can be assessed purely verbatim, or given the nature of video, non-verbal cues can be added in the interpretation. Example 5 demonstrates how a response to a question has received question marks behind it. One would assume a response to a question is a statement followed by a full stop or an exclamation mark. In this case, the transcriber and later also the rater, has perceived these as uncertain suggestions. This is an example where there is subjectivity in assessing dialogue statements. To reduce this, a second reviewer rated 20% of the debriefs. The main intention was to calibrate the primary reviewers' practices. Inter-rater reliability was calculated based on 20% of the material. This comprised of 345 utterances, and the reviewers agreed on 231 of these. The calculation was based on agreed utterances divided by total utterances, and gave an inter-rater reliability score of 0.67. Generally, scores between 0.40 and 0.75 are considered fair to good agreement, and beyond chance. Less than 0.40 are considered poor agreement and above 0.75 excellent agreement (47). All ratings of R3 and R4 where subject of joint additional assessment by both reviewers, to avoid inflation in high ratings.

6. Final thoughts

This study has done further adaptions to Flecks framework (36) than those initially suggested by Kihlgren et al. (37), and has demonstrated how it can be used to assess reflection in simulation debriefing. It has been demonstrated how this can be used as a measure to compare facilitator- and student-led simulation, and how to compare groups of scenarios presumed to be of different complexity (paediatric vs. complex scenarios). Considering the framework needed further amendments shows the need for a continued effort to develop it for the purpose of assessing reflection in simulation debriefings. This study has struggled to use the framework to compare reflective levels across studies. This could be due to inter-rater reliability issues, or with comparability of the data itself. Further studies are needed to assess whether cross-study comparison is at all feasible. If possible, a common reporting template would be useful. For example containing distribution of reflective levels including amount of questions; proportion of contributions; time allotted for scenario in total and length of debriefing; and a complete account adhering to simulation research reporting template (35).

This research has shown that simulation-experienced students can successfully debrief simulations which they have prepared and delivered themselves, with equivalent levels of reflection as simulations delivered by facilitators in a university degree program. A series of simulations integrated in a university degree program are part of an overall plan which leads towards defined learning outcomes of the module, and subsequently the study program. Although students are given strategically selected topics, faculty have not had full oversight over content covered and its relevance to curriculum. To what extent student-organised simulations manage to cover relevant curriculum content is unclear. On the other hand, these simulations might fill knowledge-gaps which faculty are unable to grasp, but which is evident for students. Additionally it is recognised by others that PAL in general increases self-direction, and contributes to management, and teaching skills (12). It may be that student-led simulation adds something that ordinary simulation does not, so that the learning methods are not competitive, but complementary. As for the second research question, it seems students partaking in simulation debriefing speak an equal amount regardless of the debriefing being led by a facilitator or a peer-student.

The success of debriefing in student-led simulation has been demonstrated in a setting within an educational institution. This, combined with other published evidence of PAL in

simulation, should be sufficient evidence to trial this in other institutions, different study programs, and possibly to critical care services. Potentially, experienced critical care clinicians could organise own simulations in the interim periods between workplace organised training days. This could for example be done during regular shift-hours, and thus increase training frequency without necessarily increasing training costs. This approach would be aligned with the low-dose high frequency paradigm in simulation, with increased repetition and simulation within workplace context, which has shown increase in retention of knowledge and skill (48).

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8. Article

Comparing levels of reflection between facilitator-led and student-led debriefing after simulation training for paramedic students

Authors

Carl Robert Christiansen, Jeanette Viggen Andersen, and Peter Dieckmann

Keywords

Debriefing, Education, Healthcare Simulation, Paramedic Student, Peer-Assisted Learning (PAL), Reflection

Abstract

Background: Simulation in healthcare is a learning strategy that attempts to create a realistic representation of a patient encounter. The purpose is to provide experiential learning that can easily translate into patient care, bridging typical classroom activities and clinical practice. Increasing simulation activities is linked to increased staffing costs due to high teacher-to-student ratio. This study aims to investigate whether the principle of Peer-Assisted Learning can be used in simulation by letting simulation-experienced paramedic students prepare, deliver, and debrief their own simulations, with minimal faculty assistance.

Methods: Third-year students at the Bachelor in Paramedic Science program at Oslo Metropolitan University were recruited. Debriefings from facilitator-led and student-led simulations were filmed and transcribed. The degree of reflection in students' statements were rated according to a modified version of Flecks analytical framework of reflective levels, assigning them a score from lowest (R0 description) to highest (R4 critical reflection). Facilitator-led and student-led debriefing were compared using descriptive statistics and Chi-Square Test if Independence.

Results: Ten facilitator-led and twelve student-led debriefings where analysed. Paramedic students gave 682 contributions in the facilitator-led debriefings, and 702 contributions in student-led debriefings. Comparison of reflective levels between facilitator-led and student-led debriefings was R0-level 32.7% vs 33.8%, R1-level 44.0% vs 44.3%, R2-level 14.7% vs 17.1%, R3-level 0.1% vs 1.3%, and R4-level 0.1% vs 0.1%. There were no statistically significant differences in the reflective levels between facilitator-led and student-led debriefings. However, there was a significantly higher level of reflection between the two different scenario themes; paediatric scenarios and complex scenarios.

Conclusions: For the purpose of simulation in healthcare education, facilitator-led and student-led simulation and debriefing resulted in equivalent levels of reflection amongst participating students. Student-led simulation is potentially a cost-effective supplement to formally organised simulation within a healthcare degree program.

Introduction

Simulation in healthcare is a learning strategy that attempts to create a realistic representation of a patient encounter, which allows the learners to train a re-enacted clinical situation and reflect thereupon. Role-playing, simulation tools (e.g. mannequins, special monitors, etc.), medical equipment and a mock-environment may be used to achieve this (1). Simulation allows educators to control the clinical situation and learning environment, according to participants learning needs and curricular requirements. Objectives can be to train practical procedures, decision making, or teamwork in a safe and reproduceable environment (2). The intent is to provide opportunities for learning that can be directly applied to patient care, creating a link between typical classroom activities and clinical practice (1, 3). A key actor in this is the facilitator. This is a simulation-trained professional who enables the simulation itself, and guides the participants through the post-simulation reflective process known as debriefing (4). The debriefing is an essential element of experiential learning, and can be defined as a "discussion between 2 or more individuals in which aspects of a performance are explored and analysed with the aim of gaining insights that impact the quality of future clinical practice" (5). It is a structured conversation where the experiences are put into perspective and linked to prior knowledge. Experiential learning would be random if it was not for a debriefing (6, 7). Simulation is a costly endeavour because facilitator-student ratio is high, in addition to expenses of equipment, wear and tear, medical consumables and facilities (8, 9).

The Bachelor program in Paramedic Science at Oslo Metropolitan University (OsloMet) utilises simulation extensively. At the program groups of 5-7 students simulate a scenario, and every group requires one facilitator. There was a wish to increase simulation activity, but resource constraints required experimentation with alternative approaches. As facility and equipment largely is a fixed cost, and staff a variable cost, options of reducing staff presence were looked into. This led to the novel concept of student-led simulation where students wrote their own scenario scripts, and then facilitate the simulation and debriefing. Thus, removing the need for staff. The idea was founded on the principle of Peer Assisted Learning (PAL) where students learn from other students (10). Today student-led simulation is routinely arranged towards the end of the 3rd, 4th, and 5th semester. Students are given strategically selected topics from the curriculum to expose them to key concepts throughout the simulation day when rotating between scenarios.

PAL involve members of comparable social groups who are not trained teachers helping one another learn by teaching each other. This could be colleagues, students within the same program of study, or students within the same cohort. There are many variations of PAL, which can be classified according to group sizes (one-to-one, one-to-few or one-to-many), and relationship between the learners (peer-to-peer or peer-to-near peer) (10-12). PAL is believed to be qualitatively different from teacher-led learning, with different benefits and drawbacks. Benefits include increased comprehension and retention; improved non-technical skills and communication abilities; and improved self-direction and learning processes. Potential drawbacks can be insufficient time to prepare; uncertainties regarding extent of curriculum content covered; issues with group dynamics; varying learning paces amongst students; student anxiety; and the pooling of ignorance when students of insufficient understanding tutor each other (11-13).

Several studies have investigated the PAL in simulation within healthcare education. This article refers to the concept as “student-led simulation”. Studies report different practical approaches. Some let participants script their own scenarios(14, 15), some have faculty involvement and quality assurance in the scripting process (16), whilst others provide students with faculty-scripted scenarios (17, 18). Another variation is students alternating between delivering and debriefing each other (14, 16, 17), and student groups doing simulation alone and then self-debrief (18). There are also differences in same-cohort (16, 17) or mixed-cohort student groups (14, 18). Common for all identified studies is that participating students were towards the end of their education, and the use of a medium-fidelity approach to simulation (14-18). Outcome measures were mostly student self-reporting with Likert scale questionnaires. In all these studies students either agreed or strongly agreed PAL in simulation improved learning, was a positive learning experience, and increased self-confidence (14, 16-18). One study reported that writing scenarios was educationally valuable (14). A limitation is that no study reported to what extent this translated to actual learning, behavioural changes, or improved clinical outcome. In so far, no one has demonstrated association between students positive self-reporting on the reaction-level with higher-level outcome measures like learning, behavioural change or improved clinical outcome (19). These studies do however show positive indication of using PAL in simulation, and this warrants further investigation into this approach.

Donald Schön links the ability to reflect on experiences to professional competence. In his view, scientific knowledge´s technical rationality is alone insufficient to meet the indeterminate reality of professional practice. Professionals also need the artistry to apply knowledge to the practical real world, and this artistry is developed through reflecting on experience (20). Hence, ability to reflect on practice might be a useful indicator of professional competence.

This study aimed to investigate whether students could prepare and deliver medical simulation, with learning outcomes equivalent to those ordinarily arranged by a university degree program. This was investigated by evaluating student's level of reflection as demonstrated by their contributions in the post-simulation debriefing conversation. A secondary aim was to investigate whether type of scenario affected student´s levels of reflection in the debriefing.

The research questions were:

1. Is the level of reflection in debriefing equivalent for facilitator-led and student-led simulation?
2. Does the type of scenario affect student´s level of reflection in the post-simulation debriefing?

Methods

This is a observational non-inferiority study (21) comparing reflective levels between facilitator-led and student-led simulation and debriefing, and between scenario types.

Study context and population

The study was performed at OsloMet in conjunction with regular simulation activities at the bachelor program in Paramedic Science. The study population was 45 third- and final year paramedic students (23 female, and 22 men; median age 23 years, range 21 to 34 years), and the team of 25 clinically active paramedic facilitators who have part-time employment at the program. Facilitators have a three-day course on how to facilitate simulations, and between one- and four-year's experience. For debriefing, facilitators are taught to use the Steinwachs model which consists of a descriptive phase, an analysis phase, and an application phase (22). A group of faculty members standardises and curates the scenarios that facilitators provide, and these even include a debriefing guide to aid the process. Of the 170 scenarios delivered by facilitators in the study period, ten were conveniently sampled and their debriefings filmed. This comprised eight different facilitators and four different scenario scripts. For student-led simulation the cohort got divided into twelve groups of four students. Six groups delivered simulation on the first day, whilst the other half participated in their fellow students' scenarios. On the second day the roles were reversed. Student groups would rotate every hour between simulation rooms and got to experience all six scenarios. In preparation, the groups wrote the scenario scripts themselves, and for this they were assigned a unique topic from the syllabus three weeks prior. Script format, learning objectives and content within assigned topic was at the students' discretion. The students' scenarios were not reviewed by faculty. Six student groups with their scenarios were conveniently sampled, and twelve debriefings filmed. Overview of scenarios are presented in table 1.

Table 1: Scenario overview

	Facilitator-led
1	*Child with septic shock* Assessment, decision making and management of child with septic shock.
2	*Child with hypoglycaemia* Assessment, decision making and management of child with hypoglycaemia.

3	*Nursing home resident with complex needs* Scenario with frail, multi-morbid nursing home patient with uncertain end-of-life situation, and concomitant hypoglycaemia.
4	*Frail geriatric patient refusing help after fall* Scenario with a frail and alcoholic patient with frequent falls. Uncertainty surrounding coping of activities of daily life and mental capacity.
Student-led	
5	*Geriatric patient with complex needs* Focus could include frailty, polypharmacy, ethical dilemmas, cooperation with other health care professionals and/or triage to health- and social care service.
6	*Vulnerable patient group* Scenario related to a vulnerable patient group. Focus could include practical, communicative, medical and/or ethical dilemmas.
7	*Difficulty of breathing in children* Scenario related to a child with difficulty of breathing. Focus should include assessment, management, and communication with parents.
8	*Reduced level of consciousness in children* Scenario related to a child with reduced level of consciousness. Focus should include assessment, management, and communication with parents.

Data collection and preparation

Video recorders were placed with good view of the debriefing area. This was chosen over sound-only recording, as it was believed video would aid in distinguishing speakers during transcription. Those facilitating the scenario, either paramedic facilitator or student facilitator, were responsible for starting and stopping the recordings. Transcription was done by an external agency, but material was also reviewed by the authors.

Analysis

For the analysis an adapted version of Flecks framework (23) for assessing level of reflection in statements was used (table 2). This framework was originally developed for teacher students to reflect upon pictures from their classroom performance and has later been modified for simulation debriefing purposes (24). In the transcription, each participant's turn in a dialogue was considered a unit of analysis (unit). Each unit received one rating, and when multiple levels of reflection where evident within a unit, only the highest was selected. See table 3 for examples.

Table 2: Reflective framework with adaptions as used here (23, 24)

Definition		Features
R0	Description "A description or statement about events without further elaboration or explanation."	- Non-reflective - Descriptive - Clarifying - No reasons or justifications given - Short utterances such as ''Yes, it was''* - Evaluation without explanation**
R1	Descriptive reflection "Description including justification or reasons for action, but in a reportive or descriptive way. No alternate explanations explored, limited analysis and no change of perspective."	- Descriptive with explanation - Evaluation with explanation** - Reasons and justifications for actions, choices, or interpretations ** - Explanations or ideas that are already possessed - Explaining or referencing guidelines and practices known beforehand by the participant* - Suggestion for change - Probing answer **
R2	Dialogic reflection "A different level of thinking about. Looking for relationships between pieces of experience, evidence of cycles of interpreting and questioning,	- Questioning assumptions - Referencing to experiences - Relating experience to theoretical concepts - Interpreting and hypothesizing

	consideration of different explanations, hypothesis and other points of view.”	- Considering or suggesting different explanations or alternatives ** - Considering implications of observations, interpretations, and suggestions - Generalizing from experience - Probing question with explanation ** - Probing answer with explanation **
R3	Transformative reflection “Revisiting an event with intent to re-organise and do something differently. Asking of fundamental questions and challenging personal assumptions leading to a change in practice.”	- Fundamental questioning of assumptions and motivations - Fundamental change of perspective
R4	Critical reflection “Where social and ethical issues are taken into consideration. Generally considering the (much wider) picture.”	- Ethical - Political - Relating to society, culture and the world as a whole

*Additions suggested by Kihlgren et al.

** Addition or adjustment used in this study

Analysis was done in a five-step process, as illustrated in figure 1. In step 1 all transcripts were rated by the primary reviewer (C.R.C.). Rating was done by assigning the reflective features to each unit. These features are associated with a reflective level. An example of the coding process is presented in table 3. In step 2, 20% of transcripts were rated by a second reviewer (J.V.A.), and discrepancy in assessment discussed and agreed upon. This acted as a calibration of the primary reviewer. Additional features were discovered in the process, and other features needed modification to precisely capture the variations of reflection. Step 3 consisted of additional modifications to the framework, as indicated by ** in table 2. In step 4, all transcripts were re-rated by the primary reviewer. Lastly in step 5, all units receiving rating R3 and R4 were individually discussed between both reviewers to prevent false high ratings.

Occasionally participants would ask questions of which they truly did not know the answer. For example, a question of factual nature like the correct treatment for a specific condition.

These were designated true questions, to not confuse with statements which had the characteristics of probing question with explanation (a feature of the R2-level of reflection). Probing questions are concealed statements or claims. It is unclear how true questions would fit into the reflective framework and were therefore omitted from analysis.

Figure 1: Stepwise approach to data analysis

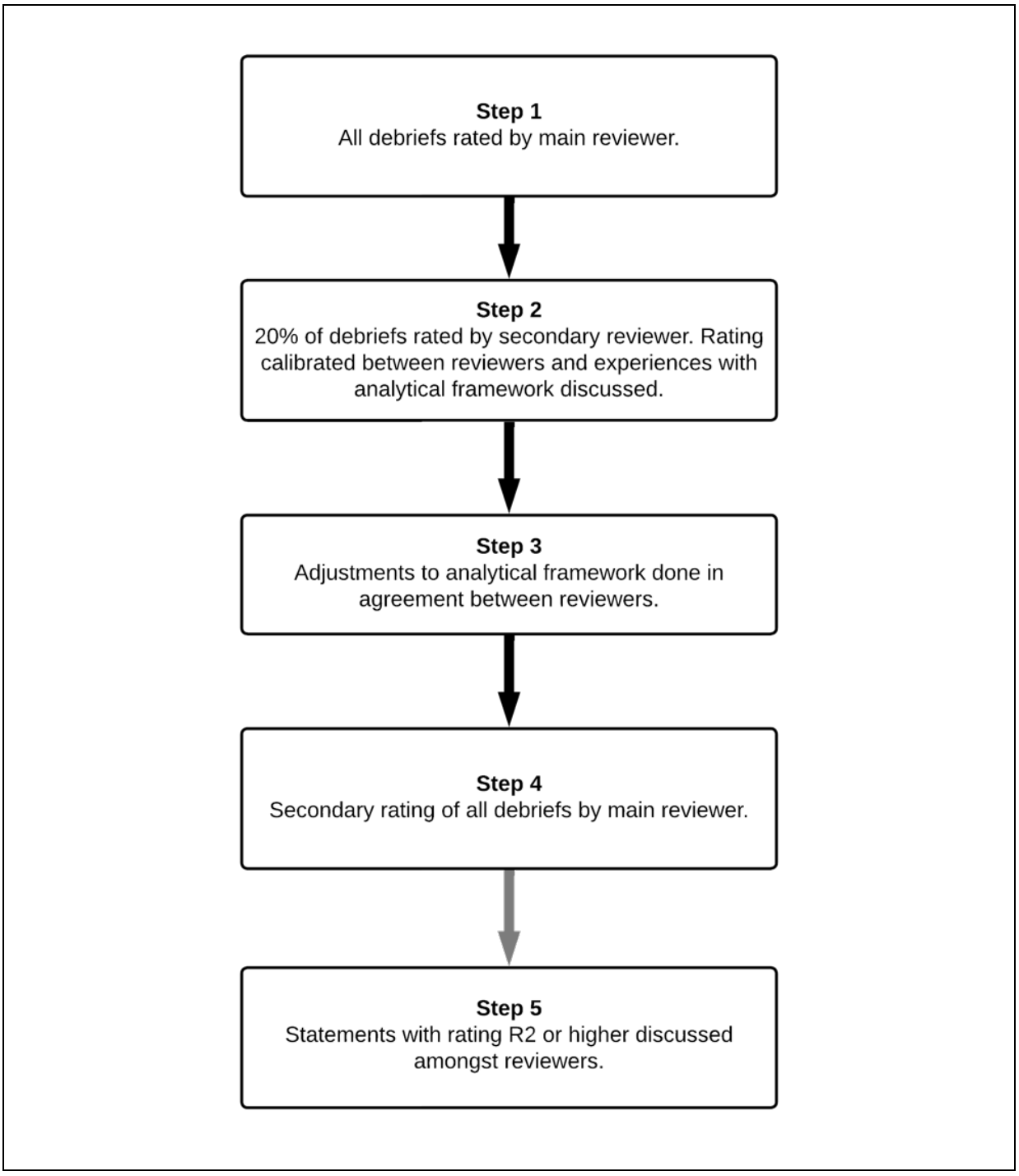

Table 3: Example of coding

Turn	Speaker	Unit of analysis	Features	Rating
36	Student 2	We should have auscultated when he became dyspnoeic	Suggestion for change	R1: Reflective description
37	Student 1	Yes! We should have jumped straight to assessment, and revealed that…	Suggestion for change	R1: Reflective description
38	Student 2	But we attached the pulse oximeter and saturations did not fall.	Descriptive Clarifying	R0: Description
39	Student 3	Saturations didn´t change.	Descriptive Clarifying	R0: Description
40	Facilitator	There is nothing wrong in stopping and re-assessing	-	Not rated
41	Student 2	But we didn´t have any significant findings either. That is why we stepped back and checked saturations, noted he was breathing heavier, and we adjust oxygen flow.	Explains or justifies actions	R1: Reflective description

Debriefing 21. Translation to English provided by authors.

Significance testing was done using Chi-Square Test of Independence with the Social Science Statistics calculator (25). This is an appropriate test for non-parametric data in a 2x2-table, when variables are categorical, groups are seen as independent single entities, cells are mutually exclusive, and expected frequency is not less than five (26). The data meets these assumptions. To allow for significance testing of reflective levels between groups in a 2x2-table, the reflective levels were categorised as low and high levels of reflection. R0-R1 were classified as low level, and R2-R4 as high level of reflection. This was based on findings in Kihlgren et al. who found only 10% of their debriefing contributions to be at R2-level, and none at R3 or R4 (24).

Laurtizen et al. has been concerned whether certain scenario types were more prone to evoke higher levels of reflection than others (27). The scenarios in this study could be classified as either critically sick children (paediatric scenarios), or complex scenarios relating to situations with vulnerable or geriatric patients with compound issues containing medical, social, legal and/or ethical issues (complex scenarios). This classification allowed for a separate analysis to test Lauritzen´s ideas.

Ethical considerations

Written informed consent was obtained from all students and facilitators. As the investigators are lecturers at the same department, which might imply an asymmetrical relationship towards the participants, particular care was taken to create a positive atmosphere so it would be easier for participants to decline participation. The study has been approved by the Norwegian Centre for Research Data (NSD) no. 425765 and the local data protection officer at OsloMet. According to Norwegian legislation the study is not eligible for review by the regional ethics committee as it is a non-clinical study and contains neither patient nor biomedical data (28, 29). The study is in accordance with the reporting template for health care simulation research which are extensions to the CONSORT and STROBE statements (30). The complete report is available in the appendix.

Results

A second reviewer rated 20% of the content, and inter-rater reliability was calculated to be 0.67 which is considered fair to good agreement (31). However, main objective was to calibrate the primary reviewer for a second review cycle.

All contributions in the debriefing made by the participants of the simulation (the students) where rated for their level of reflection. Neither facilitators, nor students facilitating debriefing during student-led simulation, where rated. A total of 1384 units were rated, of these 682 (49%) where in facilitator-led debriefing and 702 (51%) in student-led debriefing. Results are presented in table 4.

Table 4: Distribution of reflective statements in debriefings when led by facilitator or student

	Facilitator-led		Student-led	
R0 description	32.7%	223 (n)	33.8%	237 (n)
R1 reflective description	44.0%	300 (n)	44.3%	311 (n)
R2 dialogical reflection	14.7%	100 (n)	17.1%	120 (n)
R3 transformative reflection	0.1%	1 (n)	1.3%	9 (n)
R4 critical reflection	0.1%	1 (n)	0.1%	1 (n)
Questions	8.4%	57 (n)	3.4%	24 (n)

The hypothesis was that student-led simulation achieved equivalent levels of reflection in a debriefing, when compared to facilitator-led simulation. To test this results were grouped in a 2x2-table (table 5). Questions were excluded from analysis as they were not rated for reflective level. The Chi-square test showed the difference in reflection level between facilitator-led and student led simulation was not significant with a p-value of >.05 (X^2 (df = 1, N = 1303) = 1.81, p = .178).

Table 5: Levels of reflection grouped in a 2x2-table for facilitator-led and student-led

Level of reflection	Facilitator-led		Student-led	
R0-R1	83.7%	523 (n)	80.8%	548 (n)
R2-R4	16.3%	102 (n)	19.2%	130 (n)

When grouping scenarios according to theme, 509 (42.7%) units where in the paediatric scenarios and 793 (57.3%) in the complex scenarios. There were facilitator-led and student-led simulations in both groups. Results are presented in table 6.

Table 6: Comparison of reflective statements between paediatric and complex scenarios

	Paediatric scenarios (n=11)		Complex scenarios (n=11)	
R0 description	35.4%	209 (n)	31.7%	251 (n)
R1 reflective description	45.3%	268 (n)	43.3%	343 (n)
R2 dialogical reflection	13.4%	79 (n)	17.8%	141 (n)
R3 transformative reflection	0.5%	3 (n)	0.9%	7 (n)
R4 critical reflection	0.0%	0 (n)	0.3%	2 (n)
Questions	5.4%	32 (n)	6.2%	49 (n)

The same approach was applied to assess differences between paediatric and complex scenarios (table 7). The Chi-Square test showed differences in levels of reflection between paediatric and complex scenarios to be significant with a p-value of <.05 (X^2 (df = 1, N = 1303) = 6.58, p = .010).

Table 7: Levels of reflection grouped in a 2x2-table for paediatric and complex scenarios

Level of reflection	Paediatric scenarios		Complex scenarios	
R0-R1	85.3%	477 (n)	79.8%	594 (n)
R2-R4	14.7%	82 (n)	20.2%	150 (n)

Discussion

This study showed comparable levels of reflection between facilitator-led and student-led post-simulation debriefing, with no statistically significant differences. On the other hand, differences were found when comparing paediatric and complex scenarios. Complex scenarios had significantly higher levels of reflection in the debriefing than paediatric scenarios.

Student-led simulation

A possible explanation for the comparable levels of reflection between groups is that paramedic students have developed their ability to arrange and debrief simulations through gradually increased participation in simulation activities, a learning process described by Lave and Wenger (13, 32). Therefore student-led simulation is probably appropriate for simulation-experienced students. This assumption is echoed by an explorative qualitative study on student-led simulation by final-year nursing students. The study identified three success criteria: That students were familiar with simulation, had sufficient content knowledge beforehand, and belonged to an emotionally safe learning environment (15). Other studies have demonstrated that anxiety with PAL is prevalent amongst undergraduate students, whilst postgraduate students embrace it (11). Thus, student seniority might affect anxiety related to PAL. It seems like sufficient simulation experience, sufficient content knowledge, a safe learning environment, and student seniority may be key elements for student-led simulation.

It is unclear what causes reflection in student-led debriefing. A study on eight grade school children has previously demonstrated higher level of reasoning and better explanations when discussions are led by teachers. Without teacher presence pupils tended to have more exploratory and generative discussions (33). Although not generalisable to university students, it indicates that discourse patterns might be of a different nature. A possibility is that students who facilitate the debrief better understand fellow students' perspectives and challenges, and therefore manage to focus the discussion on the pertinent parts and in this way engage in deep discussions. Taking into consideration that content knowledge possibly is a pre-requisite for student-led activities, it might be that students just stick to talking about things they are knowledgeable on, while disregarding things they don't know much about. Research is needed to explore discourse patterns in student-led debriefing

This study uses a similar approach and analytical framework as Kihlgren et al. (24). The main difference is that Kihlgren et al. included only selected parts of the debriefing, those pertaining to the topic of leadership/followership, whilst this study has included the whole debriefing. Also, additional modifications to the analytical framework have been done, as noted in table 2. Kihlgren et al. found in their study ≈10% at the R0-level, ≈80% at the R1-level, and ≈10% at the R2-level of reflection (24). They found no instances of R3- or R4-levels. When comparing to this study, it may seem they had substantially less R0 ratings, more R1 ratings and less R2 ratings. Comparison shown in table 8.

Table 8: Comparison of ratings between studies

	Kihlgren et al, 2015	Facilitator-led	Student-led
R0 description	≈10%	32.7%	33.8%
R1 reflective description	≈80%	44.0%	44.3%
R2 dialogical reflection	≈10%	14.7%	17.1%
R3 transformative reflection	None	0.1%	1.3%
R4 critical reflection	None	0.1%	0.1%
Questions	Not reported	8.4%	3.4%

Since Kihlgren et al. only analysed sections of the debriefing and this study analysed the debriefing in its entirety, a direct comparison is unreasonable. Since OsloMet uses the Steinwachs model for debriefing (22), a possibility is that the initial descriptive phase could generate a higher frequency of R0-level ratings, as these are descriptive by nature. This would be captured in this study, but not necessarily by Kihlgren et al. Analysing only parts of the debriefing can omit content from the descriptive phase and skew their results. On the other hand, this study shows higher percentages of R2 ratings than Kihlgren et.al. There is no reason to believe that students in this study are more reflective than those studied by Kihlgren et al. On the contrary, Kihlgren et al.´s participants were medical doctors in their internship year, whilst students in this study were third-year paramedic students. Thus, Kihlgren et al.´s participants had studied about twice as long as third-year paramedic students, and could be expected to have matured more which presumably would be demonstrated by more higher-level reflections. Several possibilities could explain this. One is the inter-rater reliability when

applying the reflective framework across studies. The researchers' dual role as teachers of the subjects they are researching raises a distinct possibility of bias in this study. This could lead to a tendency to give higher ratings, as this subsequently reflects back to the role as lecturers. Another possibility could be the difficulty gradient. One could imagine that challenging scenarios as measured against participants expected knowledge level would evoke higher levels of reflection, than scenarios which present easier problems. It might be that Kihlgren et al.´s participants simply found their scenarios to easy, and thus had little to reflect upon. Vice versa could be the case for the students in this study. Unfortunately, there is no measure of scenario difficulty gradient. Lastly, it could be specific traits within the scenarios. It might be that the scenarios in this study are designed with more dilemmas, which could lead to higher levels of reflection. For studies wishing to compare reflective levels, this demonstrates the need for a common definition of what part of the debrief to include for analysis. This could potentially be the whole debrief defined as opening to closing sentence, the analytical and/or application phase in the Steinwachs model, or based on a selected theme. The conundrum of scenario difficulty gradient or presence of dilemmas might be challenging to resolve. It is therefore uncertain whether the analytical framework for reflective levels is suitable for comparison across studies.

Impact of scenario design on reflective levels

Husebø et al. asked what features of facilitators questions elicit deeper level responses from participants (34). However, facilitators questions nor participants reflexive ability might not be the most important factor for eliciting higher levels of reflection at all. Kihlgren et al., upon discovering lack of R3- and R4-levels of reflection in their debriefings, question whether there are features in the scenario design itself which triggers higher levels of reflection (24). Their scenarios were of emergency medical situations (anaphylaxis and septic shock), and they question if they were of an instrumental character where learning goals are associated with R1- and R2-levels of reflections (24). This study consists of scenarios that could thematically be split in two. On the one hand paediatric emergency medical cases (paediatric scenarios), with situations like breathing problems, sepsis, or anaphylaxis. On the other, cases consisting of situations in geriatric or vulnerable patients with a mix of medical, ethical, practical and/or legal dilemmas (complex scenarios). Based on these ideas, it was believed the paediatric scenarios could be of similar instrumental nature, with clearer advice found in medical literature, as those in Kihlgren et al.´s study. In contrast, it was believed the complex scenarios could possibly carry features in the swampy zones of professional practice

(20), and therefore possibly trigger more higher levels of reflection. When assessing for this, statistically significant differences were discovered. Complex scenarios achieved more higher-level reflections and proportionally less lower-level reflections, than the paediatric scenarios. The research seems to support Kihlgren et al.´s thoughts that scenario features may play a role in eliciting higher reflective levels (24). Further research addressing the relationship between dilemmas within scenarios and reflective levels in debriefing would be useful to clarify this.

Limitations

A limitation in this study is lack of randomisation and use of a control group, which makes it more prone to bias and confounders, and no causal relationship can be established (35). Although the facilitator-led and student-led scenarios had scenarios within the same thematic area, scenarios were different making comparison difficult. It was not possible to blind reviewers for whether the debrief was led by a facilitator or a student, as the transcription content carried clear evidence of what kind of simulation had taken place. Data collection was done overtly, and participants themselves initiated and stopped recordings. This could have contributed to a Hawthorne-effect (36) influencing behaviours and reflection levels. This should not negate the ability to compare groups, as this would presumably affect them equally. These results can only be applied to simulation-experienced paramedic students at OsloMet. Generalisation to other contexts or to simulation-naïve students should be done with caution.

The ability of the frameworks to capture actual reflection, and thus the validity of the results, can be questioned. According to Fleck, any tool measuring reflection measures only what is overt, and not what is in the persons mind (23).

An instrument like this is the victim of issues with inter-rater reliability. This has been attempted mitigated by a secondary reviewer and calibration of the primary reviewer. In addition, to prevent false high ratings, all R3- and R4-level ratings received another review jointly by both reviewers. Regardless of this, low inter-rater reliability cannot be excluded. Two independent raters for the whole dataset was outside the scope of this study, as it was based on a master thesis where individual work is a given constraint.

This study has only investigated one aspect of student-led simulation, and this alone is insufficient for deciding to apply this as an approach to simulation. It is reasonable to assume learning also has taken place for students organising simulation. Having to construct own scenarios and seen multiple solutions with debriefings to the same scenario, they have likely developed greater understanding on their topic. Only students undergoing simulation have been the focus of this investigation, and future studies should address the learning of the student's providing simulation. There seems to be a lot of creativity and joy that comes to light through scenarios made by students, and this has not been captured in this work. When reading through transcripts, the authors noted a meta-simulation discussion in almost every debrief. These discussions where about scenario construction and play, possible pathways the case-story could have followed, and discussions on improvement. An avenue for further exploration is the potential association with self-organised simulation and gained competency in simulation facilitation, and importantly if this could lead to increased simulation activity throughout a career.

Conclusions

This study has shown that simulation-experienced paramedic students can lead post-simulation debriefings with comparable levels of reflection as trained and experienced paramedic facilitators. As the students debriefing are the results of their self-arranged simulations, it is reasonable to assume simulation experienced students also can plan and deliver simulation events on their own. The results should not be interpreted as an undermining of the need for trained facilitators. On the contrary, it highlights the success of trained facilitators as they have been key in providing simulation-abilities to the students in the first place. These results are important as they offer an additional approach to simulation in health care education. Student-led simulation could require less teacher resources reducing the costs of running simulation. This could lead to increased simulation frequency.

Furthermore, this study has found that scenario design might influence post-simulation reflection levels. More research is needed to explore which features within scenario design trigger higher levels of reflection.

This study adds to the repository of studies looking into levels of reflection in debriefing following simulation events.

Declarations

According to Advances in Simulation´s manuscript criteria, the following declarations are given.

Ethics approval and consent to participate

Written consent given by all participants. Study approved by the Norwegian Centre for Research Data (NSD) with notification number 425765. Study is not eligible for review by Regional Ethics Committee as there was no medical human or biological tissue data.

Consent for publication

Not applicable.

Availability of data and materials

The dataset is available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

C.R.C. is primary researcher and author, and has provided the main contributions to all parts of this article. J.V.A. has assisted in data-collection, been secondary reviewer in the data analysis, contributed to the reflective framework development and proof-read the manuscript. P.D. has supervised the research project and provided academic input throughout. This has included framing the research focus, providing the analytical framework, guidance on research methodology, advice in analysis and proof-reading the manuscript.

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Authors' information

Both C.R.C. and J.V.A. are university lecturers at Oslo Metropolitan University and teach at the Bachelor Paramedic Science degree program. C.R.C.´s area of responsibility is the simulations and skills activities at the program. P.D. is a Senior Scientist at Copenhagen Academy for Medical Education and Simulation (Denmark), Professor of Healthcare Education and Patient Safety at the University of Stavanger (Norway), and external Lecturer at the University of Copenhagen.

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9.1 Appendix A: Consent from

Vil du delta i forskningsprosjektet

«Debrifing ved fasilitatordrevet og studentdrevet medisinsk simulering, en komparativ analyse»

Dette er et spørsmål til deg om å delta i et forskningsprosjekt hvor formålet er å *sammenligne debrifingene som skjer etter simulering organisert av fasilitatorer og simulering organisert av studenter.* I dette skrivet gir vi deg informasjon om målene for prosjektet og hva deltakelse vil innebære for deg.

Formål
Forskningsprosjektet er i forbindelse med en mastergrad i Pre Hospital Critical Care. Formålet er å undersøke om studenter som har gjennomgått en rekke episoder med simulering etter hvert selv er i stand til å gjennomføre og debrife simuleringer, med tilsvarende læringsutbytte som debrifinger ledet av en profesjonell fasilitator. Problemstillingen er:

> *Gir studentdrevet simulering og debrifing tilsvarende grad av deltakelse i debrifingen og tilsvarende grad av refleksjon rundt hendelsen, sammenlignet med simulering og debrifing ledet av en profesjonell fasilitator?*

Det fokuseres på debrifings-aspektet og masteroppgaven ser om refleksjonsnivået er forskjellig når debrifing-samtalen ledes av en student sammenlignet med en profesjonell fasilitator. I tillegg til refleksjonsgraden, søkes det å kartlegge om omfanget av hver enkelt students bidrag i debrifingen øker, når det ikke er en profesjonell fasilitator til stede. Dette er konkretisert fire forskningsspørsmål:

1. *Er refleksjonsnivået omkring simuleringens læringsmål tilsvarende for fasilitatororganisert og studentorganisert simulering?*
2. *Er refleksjonsnivået omkring andre temaer fra simuleringen tilsvarende for fasilitatororganisert og studentorganisert simulering?*
3. *Er det tilsvarende omfang av studenters deltakelse i debrifing når fasilitator ikke er tilstede?*
4. *Er det en sammenheng mellom graden av deltakelse i debrifingen og refleksjonsnivået i samtalen?*

Hvem er ansvarlig for forskningsprosjektet?
Universitetet i Stavanger (UiS) er formelt ansvarlig for prosjektet. *Datainnsamlingen gjennomføres i samarbeid med OsloMet. Prosjektet gjennomføres av Carl Christiansen, som er universitetslektor ved OsloMet og mastergradsstudent ved UiS. Professor Peter Dieckmann fra UiS er ansvarlig veileder.*

Hvorfor får du spørsmål om å delta?
Du er spurt om å delta fordi du er student ved bachelorprammet i prehospitalt arbeid – paramedic ved OsloMet, eller fordi du er lærer / fasilitator på denne utdanningen. Årsaken er at datainnsamlingen gjøres i forbindelse med emnet PARA3100 – akuttmedisin B. Forespørsel om deltakelse sendes til alle studenter og fasilitatorer i dette emnet høsten 2021.

Hva innebærer det for deg å delta?
Deltakelse innebærer å bli filmet inne i rommene på simulerings- og ferdighetsenheten (SF-enheten). Filming skjer i forbindelse med de vanlige undervisningsdagene og betyr ingen ekstra innsats eller tid fra deg.

Det er scenariotreningen og debriefingssamtalen som filmes. Kameraene og mikrofonene er allerede installert på rommene og du vil ikke vite når de brukes til aktivt filmopptak. Filmingen vil således være skjult.

Filmopptakene vil deretter bli gjort om til skriftlig tekst. Det er kun tale-delen som omskrives (transkriberes) til tekst. Under transkriberingen vil informasjonen anonymiseres. Det vil si at samtalene vil bli skrevet for eksempel: «Student A forteller at ...».

Det er frivillig å delta
Det er frivillig å delta i prosjektet. Hvis du velger å delta, kan du når som helst trekke samtykket tilbake uten å oppgi noen grunn. Alle dine personopplysninger vil da bli slettet. Det vil ikke ha noen negative konsekvenser for deg hvis du ikke vil delta eller senere velger å trekke deg.

Om du deltar eller ikke, vil på ingen måte påvirke din studiesituasjon. Du vil få tilbud om den samme undervisningen og vurderingen, uavhengig av din studiedeltakelse. Dersom du ikke ønsker å delta i studien, så vil de rommene du befinner deg på ikke bli filmet.

Ditt personvern – hvordan vi oppbevarer og bruker dine opplysninger
Vi vil bare bruke opplysningene om deg til formålene vi har fortalt om i dette skrivet. Vi behandler opplysningene konfidensielt og i samsvar med personvernregelverket.

Opptaket er kun tilgjengelig for veileder, mastergradsstudent og for profesjonell transkribør. All datahåndtering gjøres i henhold til retningslinjene for sikker håndtering av forskningsdata ved OsloMet. Dataene lagres trygt og utilgjengelig for utenforstående. De skriftlige transkripsjonene av opptakene vil være helt anonymiserte. Det vil ikke være mulig å spore de tilbake til deg. Resultatene fra prosjektet vil kunne bli publisert. Alt innhold vil på det tidspunktet være anonymisert og ikke sporbart til deg.

Hva skjer med opplysningene dine når vi avslutter forskningsprosjektet?
Opplysningene anonymiseres når prosjektet avsluttes/oppgaven er godkjent, noe som etter planen er *sommeren 2022. Da vil også alle opptak slettes. Når prosjektet er over, vil det ikke lenger lagres noen personidentifiserende opplysninger.*

Hva gir oss rett til å behandle personopplysninger om deg?
Vi behandler opplysninger om deg basert på ditt samtykke. På oppdrag fra *Universitetet i Stavanger* har NSD – Norsk senter for forskningsdata AS vurdert at behandlingen av personopplysninger i dette prosjektet er i samsvar med personvernregelverket.

Dine rettigheter
Så lenge du kan identifiseres i datamaterialet, har du rett til:
- innsyn i hvilke opplysninger vi behandler om deg, og å få utlevert en kopi av opplysningene
- å få rettet opplysninger om deg som er feil eller misvisende
- å få slettet personopplysninger om deg
- å sende klage til Datatilsynet om behandlingen av dine personopplysninger

Hvis du har spørsmål til studien, eller ønsker å vite mer om eller benytte deg av dine rettigheter, ta kontakt med:

- *Universitetet i Stavanger / OsloMet* ved *Carl Christiansen på telefon 95 25 10 65 eller epost carlro@oslomet.no (mastergradsstudent)*
- *Universitetet i Stavanger* ved *Peter Dieckmann på epost peter.dieckmann@uis.no (veileder)*
- *Personvernombud ved Universitet i Stavanger, epost personvernombud@uis.no*

Hvis du har spørsmål knyttet til NSD sin vurdering av prosjektet, kan du ta kontakt med:

- NSD – Norsk senter for forskningsdata AS på epost (personverntjenester@nsd.no) eller på telefon: 55 58 21 17.

Med vennlig hilsen

Peter Dieckmann
Veileder

Carl R. Christiansen
Mastergradsstudent

Samtykkeerklæring

Jeg har mottatt og forstått informasjon om prosjektet *«Debrifing ved fasilitatordrevet og studentdrevet medisinsk simulering, en komparativ analyse»]*, og har fått anledning til å stille spørsmål. Jeg samtykker til:

- ☐ å delta i *forskningsprosjektet ved å la meg bli filmet på SF-enheten*
- ☐ at mine opplysninger behandles frem til prosjektet er avsluttet

Dato: .....

Navn i blokkbokstaver: .....

Signatur: .....

9.2 Appendix B: Protocol for Transcription

Technical information

Scenario:	Scenario number and scenario name
Day:	Date of recording
Type:	Student-led or fasilitator led
File name:	Filename of videorecording

Definition of speakers

Speakers are defined as either "*Facilitator #*" or "*Student #*". A distinction is drawn between those who learn in the simulation (students) and those who enable the simulation and debriefing (facilitators).

Students are characterised by their red uniforms. They are the learners of the simulation.

Facilitators is anyone *not* wearing a red uniform. This could be plain clothes, white hospital clothing or other clothes used to fill various actor-roles during the simulation. The function of the facilitator is to enable the simulation and to promote a structured debriefing session afterwards. Facilitators might have contributed throughout the scenario as actors within the scenario. Some students may fill the role as facilitators. For the purpose of the transcription, these students will be annotated as facilitators.

Example:

Unit	Speaker	Content
1	Facilitator 1	Has anyone ever sent a report of concern?
2	Student 2	Yes, it was very uncomfortable.
3	Student 1	The threshold is very high. But child protective services are there to help the child, but also the parents. Even if it is not always portrayed like that.

Transcription

Unit	Speaker	Content
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
…		
…		

Rows and row numbers to be added as necessary.

9.3 Appendix C: Coding manual

The coding manual is heavily inspired by an unpublished master thesis, shared by supervisor Peter Dieckmann. It has since received some further development.

Definitions

Speaker	Speakers are defined as either "*Facilitator #*" or "*Student #*". A distinction is drawn between those who learn in the simulation (students) and those who enable the simulation and debriefing (facilitators).
Student	*Students* are characterised by their red uniforms. They are the learners of the simulation.
Facilitator	*Facilitators* is anyone *not* wearing a red uniform. This could be plain clothes, white hospital clothing or other clothes used to fill various actor-roles during the simulation. The function of the facilitator is to enable the simulation and to promote a structured debriefing session afterwards. Facilitators might have contributed throughout the scenario as actors within the scenario. Some students will during student-led simulation fill the role as facilitators. For the purpose of the transcriptions and the analysis´s, these students will be annotated as facilitators.
A turn	When a speaker (facilitator or student) verbalises a statement or question, this is considered a turn. Verbal or non-verbal interruptions of acknowledgment from others, such as nodding, "mmm" or "yes", is not seen as a new turn. A new turn is defined with the start of another speaker's statement or question.
Unit of content	A unit of content is everything which is said from a speaker in one turn.
Rating	Every unit of content (every turn) is given one rating, according to the reflective framework.
Multiple ratings within a unit of content	If multiple ratings can be given within the same unit of content, because different sentences can result in different ratings, then the highest rating will be selected for the whole unit.

Uncertainty of rating	If there is uncertainty between two rating levels, then the lowest rating will be selected to avoid overestimation. If there is uncertainty what rating to give at all, then the unit of content will be excluded from the analysis.
Questions	True questions are not rated. Explanations, rhetorical questions, and other statements disguised as questions are rated according to the revised reflective rating framework.

Table for analysis with definitions

Unit	Speaker	Content	Rating	Features
1				
2				
3				
4				
5				
6				

Column: Unit	Unit of contents are sequentially assigned unique identifying numbers.
Column: Speaker	Describes which speaker is talking.
Column: Content	The unit of content. What is being said.
Column: Rating	Rating of the reflective level, as rated by the investigator.
Column: Features	Space for annotation of reflective features identified within the unit of content.

Analytical framework

The material for analysis is group discussions, debriefings, between facilitators and students following an episode of medical simulation. The debriefings are filmed and transcribed. See protocol for transcription (appendix B) for details. The focus of analysis is primarily the

students utterances. However also the facilitators talking is included in the transcript to provide context and understanding of the whole dialogue.

Units of content are analysed with regard to level of reflection.

Levels of reflection

The analysis of level of reflection is done using Kihlgren´s modification of Flecks framework. The framework has received additional modifications during the first cycle in the rating process. Specifically, the features of the reflective levels have received either additions or modifications. See methods section for specifics. The final revised framework as used is summarised in the following table:

Flecks framework with Kihlgren´s adaptions (36, 37)

Definition	Features
R0 – description "A description or statement about events without further elaboration or explanation."	- Non-reflective - Descriptive - Clarifying - No reasons or justifications given - Short utterances such as ''Yes, it was''* - Evaluation without explanation**
R1 – descriptive reflection "Description including justification or reasons for action, but in a reportive or descriptive way. No alternate explanations explored, limited analysis and no change of perspective."	- Descriptive with explanation - Evaluation with explanation** - Reasons and justifications for actions or choices** - Explanations or ideas that are already possessed - Explaining or referencing guidelines and practices known beforehand by the participant* - Suggestion for change - Probing answer **
R2 – dialogic reflection "A different level of thinking about. Looking for relationships between pieces of experience, evidence of cycles	- Questioning assumptions - Referencing to experiences - Relating experience to theoretical concepts

of interpreting and questioning, consideration of different explanations, hypothesis and other points of view.”	- Interpreting and hypothesizing - Considering or suggesting different explanations or alternatives ** - Considering implications of observations, interpretations, and suggestions - Generalizing from experience - Probing question with explanation ** - Probing answer with explanation **
R3 – transformative reflection “ Revisiting an event with intent to re-organise and do something differently. Asking of fundamental questions and challenging personal assumptions leading to a change in practice.”	- Fundamental questioning of assumptions and motivations - Fundamental change of perspective - Considers need to change practice - Aware of and questions own motives
R4 – critical reflection “Where social and ethical issues are taken into consideration. Generally considering the (much wider) picture.”	- Ethical - Political - Relating to society, culture and the world as a whole

*Additions suggested by Kihlgren et al.

** Addition or adjustment made for this study

According to Flecks original framework, category R1 could be sub-classified into R1.1-R1.4 with the following components: Description and explanation; description and theory; evaluation; and storytelling. However, they all fall in the overall R1-level of reflection. For the purpose of this study, there is no need to distinguish reflective levels into sub-classes. Hence, only the overall R1-level is used.

Example of transcription

Unit	Speaker	Content	Rating	Features
1	Facilitator	How did it go?	Not rated	-
2	Student 1	Well… It went alright. It was a bit there when we got the message then, then it was like this: okay, 18 months, pain, I do not quite remember what the message was but at least pain after a fall.	R0 description	Descriptive Evaluation without explanation
3	Facilitator	Yes?	Not rated	-
4	Student 1	It was also like; yes, he may have fallen, but it all depends what it´s like when you get there. He is quite small and can take a bit ... It must have been a big fall then if he is in such severe pain.	R1 reflective description	Evaluation with explanation
5	Facilitator	Was there anything else that got you thinking, whilst on the way to the patient?	Not rated	-

9.4 Appendix D: Overview of higher-level reflections

For transparency, all higher-level reflections are published to give the reader insight into the rating practices of the reviewers.

List of reflections at the R3- and R4-levels

Debriefing	Unit of analysis	Rating	Features
Debriefing 6, facilitator-led, student 1	It's a fine balance between interfering with a dignified death, and making sure they are actually at the end of life. It was difficult to come to a decision, but after a while when the nurse at the nursing home became obviously unsure, it was easier to conclude we needed to make our own observations and assessments.	R4 – critical reflection	Ethical
Debriefing 9, facilitator-led, student 1	It was as student 4 says it was. I'll admit that I didn't actually think about what might cause of the hypoglycaemia. That the body uses energy on something else, and that means you can quickly have another blood sugar drop. That you really need to be reassessed by a doctor within reasonable time. If its Saturday night and the GP does not come until Monday morning, then perhaps the time interval between assessments becomes too long. But also the fact that she has just recovered from hypoglycaemia, and is a bit irritable. Regardless, there is a chance she would have accepted conveyance to A&E. She seemed petite, and it's like… how much should we coerce her to go to A&E.	R3 – transformative reflection	Fundamental change of perspective

Debriefing 11, facilitator-led, student 4	I did not catch she had asthma. I kind of forget that small children also have asthma, or especially in the cities. My mind was set in it being …. Like its just some chocolate and candy and soft drinks, like this, it's not... Where are the nuts. There was no swelling or anything.	R3 – transformative reflection	Fundamental questioning of assumptions and motivations
Debriefing 12, facilitator-led, student 1	And when you said that… I thought yes, of course. That argument trumped it, for conveyance to the highest level of care rather than to a lower level. It just has to trump somehow.	R3 – transformative reflection	Fundamental questioning of assumptions and motivations
Debriefing 15, student-led, student 1	Yes, it is difficult to use relatives as translators. Especially if it is a child... perhaps especially if the mother needs to say something of a very intimate nature, and this must be translated by the child. And the child learns that the mother is in distress, or pain or could be pregnant… and the child might not know it, and things like that. It is…	R4 – critical reflection	Ethical
Debriefing 16, student-led, student 3	That could be a thought while you're at it. I didn't think about it at the time, so I guess I contributed in the decision to stay, but for the future… if we feel unsafe on scene, then we should just leave.	R3 – transformative reflection	Considers need to change practice
Debriefing 18, student-led, student 2	A bit unsure, I didn't think too much about it at the time. In retrospect though, I think it's good to have prepared another dose of adrenaline before you leave, so that if he gets worse along the way, you can quickly	R3 – transformative reflection	Considers need to change practice

	give another dose. There was so much noise and distractions on scene, so we really wanted to get out of there.		
Debriefing 22, student-led, student 2	My thinking was that you didn't get anywhere with exactly what you did, so then I thought I could try because… OK I'm a man… at least I felt that I got a better response from him. But then I realized... err... I probably took a bit over, I also caught myself saying OK now I have to withdraw.	R3 – transformative reflection	Fundamental questioning of assumptions and motivations Aware of and questions own motives
Debriefing 22, student-led, student 2	I totally agree. [This is a response to a long dialogue with contributions from students 1 and 3, and by agreeing student 2 has made a fundamental change in opinion from previous statements.]	R3 – transformative reflection	Fundamental change of perspective
Debriefing 22, student-led, student 1	I was sort of thinking that now I have built up enough confidence and feel I can do a few things too. And then you just came and did it, that's why I think I felt a bit… On the other hand, tasks are not that clear-cut either. But the distribution of tasks became awkward for the rest of the case. Like who should call, and with what thoughts we had. We´ve always been good at keeping control of the team and we agree, but now it got a little different. When you called, which should have been my job, there were things I wanted to ask about.. that I ment asking... Yes.	R3 – transformative reflection	Fundamental questioning of assumptions and motivations Aware of and questions own motives

Debriefing 22, student-led, student 2	I agree. We should probably have discussed what we wanted to achieve by calling. We did summarize... like, what observations have we taken and what does this mean. So I think we probably had a common understanding of the situation. But not on what we wanted to achieve with the telephone conversation. We just wanted hospital admission, and I had no idea why I called either.	R3 – transformative reflection	Aware of and questions own motives Fundamental change of perspective Considers need to change practice;
Debriefing 22, student-led, student 2	So, really, maybe we should have switched roles. And if so, accepted that I took over the assessments. That would probably have been just as. But still let you make that phone call and all that. I did catch myself stepping on you...		Fundamental change of perspective Considers need to change practice;

Statements are translated to English by the author. For brevity and clarity, statements are also paraphrased.

9.5 Appendix E: Adherence to reporting guidelines for simulation-based research

This thesis complies with the reporting guidelines for health care simulation, which are extensions to the CONSORT and STROBE statements (35).

Participation orientation

Element	*Facilitator-led*	*Student-led*
Orientation to the simulator Orientation to the environment	Students have had a minimum of 35 days at the simulation and skills lab prior to this research. Students are well acquainted with simulation and medical equipment, and modus operandi of simulation play.	

Simulator type

Element	*Facilitator-led*	*Student-led*
Simulator make and model	Mostly students acting as patients, for some scenarios simple BLS manikins from Laerdal Medical (Resusci Junior with advanced airway and ALS Baby).	
Simulator functionality	Isimulate REALITi monitor-/defibrillator simulator providing spO_2, $etCO_2$, BP and ECG.	

Simulation environment

Element	*Facilitator-led*	*Student-led*
Location	In standard simulation facilities at a university simulation centre.	
Equipment	Standard paramedic level portable emergency equipment: Response bag, oxygen, drugs, trolley-bed, PPE, monitor/defibrillator (Isimulate) and telephone.	
External stimuli	Music or noise in the background on select cases, where relevant for scenario.	

Simulation event/scenario

Element	*Facilitator-led*	*Student-led*
Event description	Four different scenarios: 1) Child with septic shock	Four different topics, and students develop own scenarios:

	2) Child with hypoglycaemia 3) Nursing home resident with complex needs 4) Frail geriatric patient refusing help after fall	1) Geriatric patient with complex needs 2) Vulnerable patient group 3) Difficulty of breathing in children 4) Reduced level of consciousness in children
Learning objectives	Learning objectives focusing on assessment, decision-making and treatment of the medical condition, including ethical, legal, and practical aspects. Learning objectives are derived from learning outcomes from the module description. Learning objectives are defined first, and scenario is scripted to target the objectives.	Learning objectives defined by students themselves, but within the given topic.
Group vs. individual practice	Groups of 4-5 students	Groups of 3 students
Use of adjuncts	Props vary, pending scenario. Moulage make-up for actors, uniforms / clothing appropriate for role, background noise appropriate for scenario and various props relevant for scenario content.	
Facilitator/operator characteristics	Clinically active paramedics, with three-day facilitator course, and from one to four years' experience as part-time facilitator at the university.	Third- and final year paramedic students having undergone at least 35 with simulation and skills training at the university.
Pilot testing	Scenarios run 10 times a year, and refined over the previous six years.	None.

Actors/confederates/standardized/simulated patients	Mostly students acting as patients, for some scenarios simple BLS manikins. Facilitators might act as consultants or counterparts for select scenarios.	Mostly students acting as patients, and students acting as next-of-kin, member of public or other health Care professions. For some scenarios simple BLS manikins.

Instructional design

Element	*Facilitator-led*	*Student-led*
Duration	Total time set for briefing, scenario play and debriefing either 45 or 60 minutes, depending on scenario.	45 minutes in total set for briefing, scenario play and debriefing.
Timing	Data-collection was video-recording of the debriefing, which was performed immediately following the scenario play.	
Frequency / repetitions	Students played scenarios only once.	Students played scenarios only once. Students organising the scenario, arranged it six times in a row.
Clinical variations	No variation within each scenario, but all scenarios differed amongst each other.	No variation within each scenario, but all scenarios differed amongst each other.
Standards / assessments	No assessment.	No assessment.
Adaptability of intervention	At facilitator´s discretion, but in practice little need as student group is relative homogenous.	At organising students discretion, but in practice little need as student group is relative homogenous.
Range of difficulty	Only minor opportunity for facilitator to vary difficulty within the scenario script. Homogenous student groups have relative consistency in	At organising students design and discretion. This area has not been assessed on a scenario-by-scenario basis.

	performance, and scenarios are calibrated to meet this.	
Nonsimulation interventions and adjuncts	Simulation is part of a 10 ECTS module in emergency medicine running over 10 weeks. Module consists of lectures, workshops, skill-stations, written assignments, individual study time and 8 simulation days per student. Reading list is of approximately 750 pages. On the actual simulation days, only simulations are delivered without any additional interventions.	
Integration	Scenarios are scripted on learning objectives, which are defined by the modules learning outcomes.	Topics are allocated to students based on modules learning outcomes and curriculum content.

Feedback and/or debriefing

Element	*Facilitator-led*	*Student-led*
Source	Feedback given from facilitator and peer-students (both participating and observing).	At organising students' discretion, but in practice feedback is given from facilitating (peer-) students, and peer-students (both participating and observing). No lecturers/teachers present.
Duration	45 or 60 minutes is allocated for simulation event in total (briefing, simulation, and debriefing). Debriefing time at facilitators discretion. Median length 18.0 minutes (range 10.5-22.3 min).	45 minutes is allocated for simulation event in total (briefing, simulation, and debriefing). Debriefing time at facilitating students' discretion. Median length 14.9 minutes (range 8.1-26 min).
Facilitator presence	One facilitator present for the whole duration.	Three students collaboratively organising simulation event. Including facilitating, acting as patients, and filling other roles.

		Shared facilitator responsibility. Debrief could be led by a student alone, by two, or all three jointly. At students' discretion.
Facilitator characteristics	Clinically active paramedics, employed on an hourly basis as simulation facilitators. Activity ranges between 100-440 hours of simulation- and skill-related work per year. All have a three-day course on how to facilitate simulation and debriefing.	Third- and final year paramedic students without formal training on how to facilitate simulation. Have undergone at least 35 days with simulation and skills training.
Content	Focus for learning is primarily medical topics, including pathophysiology, assessment, decision-making, and management. This might also incorporate legal, ethical, or practical aspects. No explicit focus on human factors or environment.	
Structure/method	Facilitators trained in using the Steinwachs (46) model for debriefing. Scenario scripts also have a debriefing guide written according to the same model.	No instruction given. Approach to debriefing at students discretion.
Timing	Debriefing held immediately after simulation, without a break.	
Video	Video not used for debriefing purposes, only to collect study data.	
Scripting	All scenarios are scripted in a standard format. Written language is Norwegian. Scripts available upon request to authors.	All scenarios scripted, but in various formats at students' discretion. Scripts unavailable, as they were not collected.