



"I Wish It Was Like This All the Time": Promoting Self-Efficacy and Self-Regulated Learning Through a Student-Run Formative Objective Structured Clinical Examination in Norway

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“I WISH IT WAS LIKE THIS ALL THE TIME”: PROMOTING SELF-EFFICACY AND
SELF-REGULATED LEARNING THROUGH A STUDENT-RUN FORMATIVE OBJECTIVE
STRUCTURED CLINICAL EXAMINATION IN NORWAY

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“I wish it was like this all the time”: Promoting self-efficacy and self-regulated learning through a student-run formative objective structured clinical examination in Norway

Abstract

Background: Formative assessments give students feedback on performance to enhance learning. Peer-assisted learning has also been shown to enhance learning. Although peer-assisted formative objective structured clinical examinations (fOSCE) are used in medical education; how, when and what students learn during participation have not been fully explored.

Methods: We piloted a student-run fOSCE where 11 fourth-year medical students and seven mentors from academic staff were purposefully recruited as participants. Students were trained in OSCE-case writing and feedback principles. They authored OSCE-cases with guidance from faculty mentors; set up and run a fOSCE where they took turns as examiners and students; and gave structured feedback. Approximately five weeks later, students had a summative end-of-term OSCE. The students' experiences during the study were explored via individual interviews. Data was analyzed inductively through a qualitative content analytic approach, resulting in descriptive categories and interpretations relating to the phenomenon of students' learning.

Results: The student-run fOSCE provided an uncommon learning environment that was safe, student-controlled and where learning was fun, enjoyable and gave a sense of mastery. Learning was active and authentic, with clinical cases, challenging problem-solving, and retrieval practice; giving students the right level of attentiveness. Participants described feeling assessed as their distant future selves - physicians; and as their near future selves - summative OSCE exam takers. Part of the spectrum of learning was also students becoming more aware of their knowledge and competencies; and getting boosts of self-confidence and motivation. The usual roles, relationships and power differential between students and academic staff were altered during the learning process.

Discussion and conclusion: Participation in the student-run fOSCE promoted self-efficacy by mirroring to students their hidden capabilities; and stimulating empowerment, motivation and a sense of mastery. Self-regulated learning was fostered through giving students the responsibility for their own and their peers' learning, providing instances of self-reflection and -assessment; and showing them the outcome from being active learners with the right level of attentiveness. As learners and examinees, medical students bring unique insight to OSCE case creation. Data from this study support the incorporation of new student-driven active and authentic learning activities into the curriculum.

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The ultimate goal of medical education and medical education research is to provide the patients of the future with excellent health care providers. This provides endless motivation. Let’s do it!

1. Chapter 1: Background

Formative assessments are low-stakes evaluation opportunities primarily designed to give students feedback on their performance and relevant task-specific information supporting their learning (Konopasek, Norcini, & Krupat, 2016). In medical education, timely and specific feedback on clinical skills performance provides medical students with important formative information that they can use to identify areas lacking in knowledge and skill, and this shapes their paths towards being independent clinicians (Ende, 1983; Hattie & Timperley, 2007). Medical students, both locally and internationally, call for more feedback and more opportunities for formative assessment (Anderson, 2012; Hamberg, Damen, & Bakken, 2015). It is also known that assessment activities enhance the process and phenomenon of learning, called the “*testing effect*” (Larsen, Butler, & Roediger, 2008; Roediger & Karpicke, 2006). Medical students should be given the opportunity to engage in learning activities that are based on evidence on how they actually learn (Biggs & Tang, 2011; ten Cate, Snell, Mann, & Vermunt, 2004), such as formative assessments with a focus on learning and feedback.

The objective structured clinical examination (OSCE), which is a versatile multi-station-type examination, has been widely used internationally for the assessment of clinical skills in health professions education for the past 40 years (Harden, Stevenson, Downie, & Wilson, 1975). The OSCE is used at the individual and group level to assess undergraduate and graduate students’ clinical skills for formative and summative purposes (K. Khan, Ramachandran, Gaunt, & Pushkar, 2013). At the medical school at the Norwegian University of Science and Technology (NTNU), the OSCE was implemented in 2017 as the main clinical examination type for first-, third- and fourth-year undergraduate medical students in a six-year program.

Peer-assisted learning is widely used in primary, secondary and higher education. Peer-assisted learning has been seen to have a positive effect on examination scores, to be efficient and to enhance learning for both peer-teachers and learners (Glynn, MacFarlane, Kelly, Cantillon, & Murphy, 2006; R. Khan, Payne, & Chahine, 2017). In medical education, peer-assessment and -feedback has been seen to enhance formative OSCE learning experiences by students learning from each other in a more active way than when being taught or assessed by faculty members, and by both student examiners and students gaining confidence in themselves (Basehore, Pomerantz, & Gentile, 2014; Hudson & Tonkin, 2008; Young, Montgomery, Kearns, Hayward, & Mellanby, 2014). Lee and co-authors (Lee et al., 2018) describe a medical student-initiated peer-assisted formative OSCE as a feasible, sustainable and cost-effective activity. There are, however, only a few studies that look at formative OSCEs and subsequent summative exam performance, and even fewer which explore the learning that is reported to take place (Chisnall, Vince, Hall, & Tribe, 2015; Farahat et al., 2016; Pugh, Desjardins, & Eva, 2018).

The survey study by Pugh and co-authors begins to explore how formative OSCEs affect residents' learning as an assessment *of* learning and an assessment *for* learning (Pugh et al., 2018). However, there is still a need for more scholarly work to explore the effect on undergraduate medical students' learning. Especially when the students themselves independently create and run the formative OSCE. Increased knowledge could be useful for curriculum developers who consider initiating peer-assisted and student-led learning and assessment activities. We explored the phenomenon of medical students' learning during peer-assessed formative assessments, through piloting a student-run formative OSCE with case-authoring and peer-feedback. How and when does learning occur for fourth-year medical students

during a student-run formative OSCE with case-authoring and peer-feedback? And what do they perceive that they learn?

2. Chapter 2: Data and Methods

2.1 Short introduction

This study was carried out at the Faculty of Medicine and Health Sciences at NTNU, Trondheim, Norway. A group of fourth-year medical students were recruited to engage in writing OSCE cases, learn about feedback and run a formative OSCE with their self-authored cases; taking turns being either an examiner or a student, and giving feedback to peers. During the OSCE-case design phase they were mentored by faculty employees with experience in OSCE-case writing, but otherwise this initiative was student-run. Qualitative research methodology was utilized to explore and understand what, how, and when medical students learned through the student-run formative OSCE.

2.2 Research setting

The Norwegian University of Science and Technology (NTNU) is Norway's largest university, with approximately 42,000 students; and the medical school at NTNU is run by the Faculty of Medicine and Health Sciences ("Norwegian University of Science and Technology. About the university - NTNU," 2019). The Faculty utilizes a six-year integrated medical school curriculum with a spiral learning (Harden, 1999) approach. Medical students revisit central topics multiple times, the complexity is increased each time, and new knowledge is built on what was

previously learned. Problem-based learning is used extensively, as well as traditional lectures, team-based learning, clinical small group teaching, and other methods.

During the fourth year of medical school, medical students engage in several clinical rotations, and the study year is divided into two separate terms. One half of the students do term A in the Fall, while the other half do term B; and then they switch terms in January. Both terms A and B have a summative end-of-term OSCE before the switch of terms is made. The Faculty of Medicine and Health Sciences at NTNU is organized into teaching units for each major subject. During term A of the fourth-year, the principal subjects are Dermatology, Rheumatology, Psychiatry, and Orthopedics; and in term B the main subjects are Gynecology, Obstetrics, Pediatrics, and Child and Adolescent Psychiatry.

2.3 Materials and Methods

2.3.1 Research design

This qualitative content analytic study explored medical students' learning experiences during a student-run formative OSCE. Qualitative methodology allowed for inductive exploration of the phenomenon of learning in a way that informed the research questions (Creswell, 2012). Medical students received two two-hour seminars on OSCE case writing and feedback principles before they started creating their own OSCE cases. Students chose which OSCE cases to write from a menu of options made up of the Faculty's OSCE blueprint from the relevant subjects from terms A and B. Academic staff employed at the Faculty mentored students during the OSCE case writing process, however they were not present at the formative OSCE.

With help from research assistants from the Center of Assessment in Medical Education (CAME) at NTNU, eleven medical student participants organized and ran a formative OSCE during a four-hour time period. Two different OSCE-circuits were organized, each containing seven OSCE-cases (see Figure 1). The cases used were a mix of eleven student-made OSCE cases and three OSCE-cases previously used on summative OSCEs in term B. These older cases were included to make up the numbers. Each case was run in the same manner as for the summative OSCE at the Faculty, with two minutes for reading the case notes and eight minutes to perform the scenario. Students took turns either being an examiner or an examinee. After each case the student examiner and examinee gave each other structured feedback.

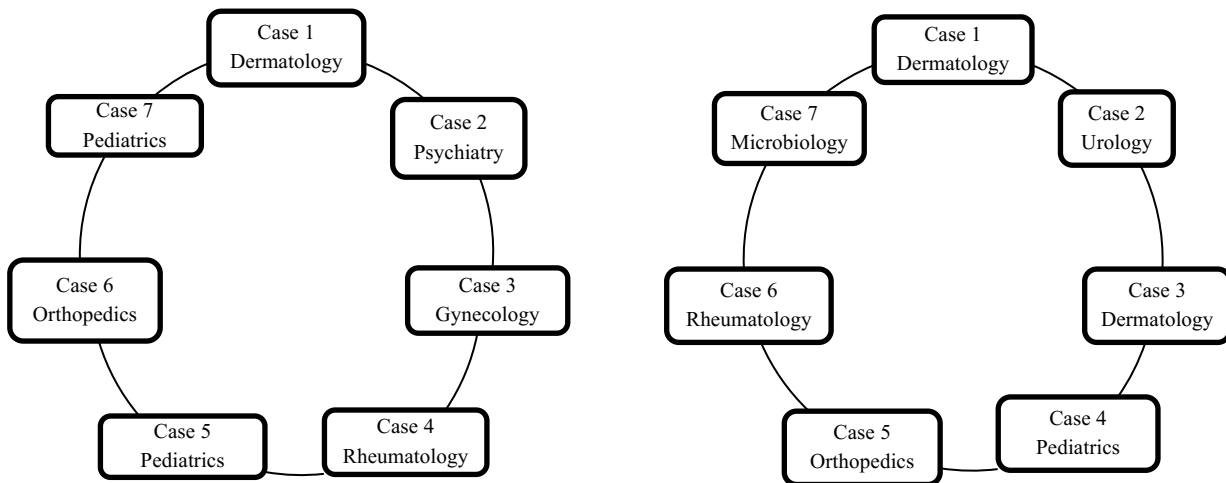


Figure 1. The student-run formative OSCE, circuit 1 and 2

Because of the withdrawal of one student participant, a research assistant at CAME volunteered to be an examiner on two cases and the principal investigator participated as an examiner in one out of 14 cases. Simulated patients participated in seven out of the 14 cases.

During the break between the two circuits, when students switched roles, and after the formative OSCE was completed; the participants were asked to reflect on which knowledge gaps they identified, and how they would go about filling those gaps before the summative OSCE. Students revised and improved the OSCE cases they had authored after the formative OSCE and handed them in to the relevant teaching unit for future use on the summative OSCE.

2.3.2 Sampling process and participants

Purposeful sampling was utilized to recruit fourth-year medical students and mentors from the academic staff for the study. Purposeful sampling was used because it allowed for exploration of multiple viewpoints and a deep understanding of a phenomenon in a way that was relevant for answering the research question (Patton, 2002). Fourth-year medical students were ideal candidates for piloting a student-run formative OSCE, as they at the start of the study were half way through medical school, had experience from having a summative OSCE during the third-year, and had experience from getting feedback on clinical rotations.

Eligible student participants from term A, approximately 55 students, were contacted via a recruitment e-mail with information about the study and the consent process. Initially, the recruitment was slow, and an amendment was made to the study protocol to include students from term B. All fourth-year medical students, approximately 115 students, were subsequently contacted with a new recruitment e-mail. Volunteers consented electronically and answered questions about demographic characteristics such as gender, age, and previous background in higher education. Recruitment ended after nine term A-students and three term B-students had

volunteered and consented for participation. One student, from term A, left the study before the formative OSCE.

The chiefs of the major clinical teaching units involved in teaching during term A, were informed about the study and the suggested role of the faculty mentor. Later, after the modification to the research protocol, the chiefs of the main teaching units for term B, were informed about the study. A total of seven faculty mentors from the teaching units of Dermatology, Rheumatology, Orthopedics and Psychiatry for term A, and Pediatrics and Gynecology for term B; agreed to participate and signed an electronic consent form. Faculty mentors were offered remuneration per completed clock hour on the basis of the hourly wage rate for the salary grade which the person was entitled to, according to Norwegian State regulations.

2.3.3 Data collection

Data was collected by conducting individual semi-structured interviews (Seidman, 2013). To understand the process and development of learning over time, medical student participants were interviewed at two different time points, before and after the summative OSCE. Individual faculty mentors were interviewed once, and the interviewees were recruited by purposeful opportunistic sampling after the study was initiated, depending on their involvement in mentoring the students' case-writing. This method was chosen to capture a breadth of experiences over time, and to acquire highly descriptive, highly detailed accounts and narratives of the learning process.

The first student interviews, approximately of 60-75 minutes duration each, resulted in 11 interview transcripts. The faculty member interviews took place during the OSCE case-mentoring time period, resulting in five interviews of approximately 35 to 45 minutes duration each. The

second student interviews were approximately 30-minutes each and resulted in 10 interview transcripts. One student refrained from the second interview because of being on paternity leave.

The semi-structured interview guide for the first student interview covered the students' experiences (a) of learning so far during the study, (b) with peer-teaching, -learning and -feedback, and c) of being tested in topics before learning them. The second student interview dealt primarily with students' reflections on the student-run formative OSCE and learning, after the summative end-of-term OSCE. The faculty interview guide covered the mentors' experiences with student OSCE case-authors and the mentoring process. Follow-up questions and probes were tailored to each interviewee's responses. Interview guides are enclosed in the Appendices.

All interviews were audio-taped with permission; and conducted in Norwegian by the principal investigator. Interviews took place in private, either at the Faculty or at a location of the participant's choosing. Notes were taken during all the interviews. Three trained transcription assistants transcribed the interviews in Norwegian. The principal investigator read through all the transcripts for quality assurance and made sure that transcripts corresponded with the audio-files.

2.3.4 Data analysis

A conventional content analytic approach (Hsieh & Shannon, 2005) was utilized to develop descriptive categories and themes, stemming directly from the data, and explaining the students' experiences with learning associated with the formative OSCE. The open coding, code book development, construction of categories, and their interpretations were done by the principal investigator in collaboration with Professor Vidar Gynnild, Department of Education and Lifelong Learning, at the Faculty of Social and Educational Sciences, NTNU. This second

coder approach, or '*triangulating analysts approach*' (Patton, 2002), was chosen in order to enhance the analytic process and internal validity of the data analysis (Merriam & Tisdell, 2016).

A subset of interviews was selected for open coding of the raw data. Each analyst worked separately reading through two student interviews and two mentor interviews making notes and comments about sections that seemed important for the phenomenon of learning. These observations formed the basis of a preliminary codebook with corresponding definitions that was piloted by the principal investigator on another two student interviews. The codebook was then revised again in collaboration and the final codebook was used in direct coding of the entire dataset, in an iterative analytic coding process, with the support of *Dedoose 8* web application (Dedoose, 2018). This coding was performed mainly by the principal investigator. The coded data was reanalyzed looking for initial emerging categories of learning pertaining to the research question. Categories emerging from the medical students data and the faculty mentors data were triangulated to enhance the accuracy and credibility of the study (Creswell, 2012). Once the initial categories were devised, the data was analyzed again, and through an iterative process, initial categories were revised and refined to formulate final main descriptive categories and interpretations.

2.3.5 Ethical approval and data safety

The study was approved by the Norwegian Center for Research Data (NSD) on July 18, 2018; and by the Institutional Review Board (IRB) at Harvard Medical School on August 6, 2018. A modification was approved by the Harvard Medical School IRB on September 21, 2018, and a '*Report of New Information*' was approved on December 13, 2018.

This study was regulated by the rules and regulations of the Institutional Review Board at Harvard Medical School and the Norwegian Centre for Research Data, as well as the European Union General Data Protection Regulation of May 2018. The interviews and transcripts were de-identified of personal data and saved confidentially on a password protected computer on a safe server at NTNU. To avoid identification of students or faculty members participating in the study, the students and faculty members were assigned as a number on each transcript. The number was connected to the identity of the participant and personal demographic data via an identification key. The identification key was stored confidentially and separately from the personal demographic data, in a different secure area of the same NTNU server. Only the principal investigator had access to the identification key and the secure server areas. The transcription assistants and other study personnel did not have access to the identification key or any other person identifiable data. There have been no known breaches in confidentiality during the study.

3. Chapter 3: Results

3.1 Demographic characteristics of study participants

Approximately 64 % of the student participants were male and 36 % were female. The median age of all student participants was 24 years, with an age range of 22 to 32 years. Students were asked if they had any previous experience in higher education before attending medical school, and 64% answered yes to this question (see Table 1 on the next page).

Table 1. Demographic characteristics of student participants

	Term A	Term B	Total student group
Number of participants	8	3	11
Age range (years)	22-26	22-32	22-32
Mean/median age (years)	24.1/24	26.3/25	24.7/24
Gender	75 % males	33.3 % males	63.6 % males
Previous experience in higher education	Yes 62.5 %	Yes 66.6 %	Yes 63.6 %

The student participants made 15 OSCE-cases during a four-week time period. Cases were from a range of topics. Eleven cases were used in the student-run formative OSCE (see Table 2). Two cases in pediatric medicine tested clinical reasoning skills and were inspired by students' previous experience in the clinical simulation lab of the main teaching hospital, St. Olav Hospital.

Table 2. Overview of OSCE cases made by the student participants

Subject	Students	OSCE cases made	Topics (number of cases)
Dermatology	3	7	Chronic venous insufficiency and ulcers: History taking**, clinical examination, images (3) Suturing** (1) Biopsy of atypical nevus (1) Urticaria: History taking**, images (2)
Psychiatry	2*	1	Bipolar disorder/mania: History from family member**
Rheumatology	2	2	Radiological signs of ankylosing spondylitis** (1) Injection into the knee joint: Communication with patient and practical procedure** (1)
Orthopedics	2	2	Carpal tunnel syndrome: History and examination** (1) Acute injury to the knee joint: Examination** (1)
Pediatrics	2	2	Child with acute lymphatic leukemia: Clinical reasoning** (1) Child with symptoms of sepsis: Clinical reasoning** (1)

Gynecology	1	1	Bleeding in early pregnancy/ectopic pregnancy: History taking and acute management**
Total		15	

*One student withdrew from the study by own accord

**Piloted during the student-run formative OSCE

3.2 Study results

Study participants, students and faculty mentors, described features of the learning environment, the type of learning, and the learning outcome during the individual interviews. The five main findings in terms of descriptive categories were uncommon learning environment, active learning, authentic learning, rich learning outcome, and empowerment. These are described in further detail in parts 3.2.1 to 3.2.5. Each main finding is divided into subcategories, a-e. All findings are illustrated with quotes from the individual interviews. The first student interview is named interview A; i.e. Student 1A or Student 8A. The second student interview is named interview B; i.e. Student 1B or Student 8B. All students and three of five faculty mentors who were interviewed are represented with quotes.

3.2.1 Uncommon learning environment

The medical students encountered a learning environment during their participation in the formative OSCE study that was different than their usual one. These new surroundings were fun, safe and student-controlled. The learning that took place in this environment was driven by them and their peers.

a. Peer-learning, -teaching and -feedback

Students authored most of the OSCE cases that were tested on the student-run formative OSCE. Some students collaborated with each other, during OSCE case creation, and formed small study groups. While others worked alone and relied mostly on the mentor for guidance and advice. The students who collaborated described engaging in a cycle of group learning, individual work and peer-feedback while working together. One of these students explained:

There is a lot of learning in collaborating with peers. You work together in one subject area with different cases in mind. Then you go home and work on your own case, and then you go back into the peer-group to get feedback and being able to raise the question: "I met a challenge here with this case, do you have any idea how I can solve this?"

(Student 8A)

This peer-to-peer learning meant that all participants had to be taught by and get feedback from unusual teachers - their peers. Student participants explained that this peer-driven model of teaching and evaluation felt both natural and logical. They were not embarrassed that a peer knew more than them and welcomed the feedback. One student described:

The peer-to-peer teaching was very good. You might think: "Oh, this student is in my year but know so much more than me" and be stressed by that thought. But I didn't feel like that. It was very natural that a peer taught you things, and they were excellent teachers.

(Student 10A)

Peers were described as good teachers because they were at the same level as the learners, they had the same perspective on learning and the same goals in mind. Peers also knew the nitty gritty details of how to do practical procedures because they just learned these themselves. Thus,

peer-feedback was perceived as being credible and coming from a source that could be trusted. Academic teaching staff was seen as distant from the initial phases of learning, and out of touch with the details. One student described:

Maybe a doctor in the clinic says: "It's important that you check for this during an examination". And then you think "Yes, that's a good point, I have to remember to check for that". But when you get home it's like: "Oh, how do I really do it practically, how should I position the arm?". Stupid things like where to hold the arm when doing an examination. It's kind of these banal things that your peers know are difficult because they have puzzled with those things themselves. So, you get very useful feedback from peers because they have just learned stuff. (Student 9A)

Peer-feedback was also described as good because it was given directly after the students' performances. The student got on-the-go evaluations of their knowledge level and could move on to the next task with reduced cognitive load. On summative OSCEs feedback is given in written form and is not sent out until results are announced one to two weeks after the exam. Students described that feedback is better if given close to their performance, as it was during the formative OSCE. A student recalled how it was to get instant feedback:

Yeah, I thought it was useful to get immediate feedback, because then you didn't fall out of focus. And you could like finish a case and not think too much about it. Because then you knew what went well and what went poorly, and you could just like move on. (Student 11A)

In contrast to the regular learning environment, feedback went both ways on the formative OSCE. Not only did the student examinee get feedback, the student examiner also got comments

and advice on the content and success of the OSCE case. Both of these evaluations would later be used in quality improvement, either as data on how to fill knowledge gaps or to improve the case. Students appreciated the chance to not only be on the receiving end of feedback:

I got to give feedback as well [on that case], for there were some inaccuracies in the case text that I thought should be corrected. So, I thought it was nice that you get to reflect and give feedback [to the examiner] about things that you think could be improved. (Student 8A)

b. Exposing vulnerability

The formative OSCE was a safe learning space where a student could ask for help, guidance and hints, without feeling embarrassed or exposed. The respondents described a trusting atmosphere with friendly peer-examiners, where there was no judgment between the participants because everyone was there to learn:

I quickly told the others, and didn't feel that it was embarrassing or anything, when I was halfway through one of the OSCE cases I couldn't do, I just told the examiner that: "Ok, now I need a little help, I'm a little lost, do you have a hint?". And, yes, it was possible since it was such a safe frame around it. (...) Everyone was very happy to have this opportunity to test themselves and see what went well and what that didn't go well. It was a very friendly and trusting atmosphere. (Student 2A)

Students could allow themselves to be vulnerable because there was no faculty present who they otherwise would feel judged by. Some students mentioned that academic staff presence would have been acceptable if they had participated primarily to add a real-life perspective to

cases, and not in order to examine. But overall, this absence was seen as appropriate and clearly beneficial for the learning environment. One student explained:

I think that's what makes the formative OSCE good, you kind of get some practice turning your brain inside out, and it's together with people you know a little and have good rapport with, it's not only those deadly serious [faculty members] who are there. Because I thought that the faculty mentors were participating, and I was a little bit afraid that they would see how little I knew and stuff. But they weren't there, so no danger (laughter).

(Student 1A)

c. Fun

Students described having a lot of fun during the formative OSCE and enjoying the whole process. The experience felt light-footed; like entertainment or a game. That is, resembling fun past-times that otherwise belonged in their private lives:

It was just crazy fun, and that is a little weird, but I felt it was like a game. It was like playing, almost like an "escape room". You are put in there, and you are not allowed to come out (laughter) until you have done all the right things. And if you sort of get a bit more into it and don't think of it as an exam, but that you are a doctor, because that's what we want to be, then it's really a crazy good experience, weirdly enough. (Student

10A)

Because of this element of enjoyment, students described that the formative OSCE did not feel like regular learning and that they wish they had more opportunities like this. As one student described in the first interview:

The formative OSCE almost seemed like something you would do voluntarily, just like learning for your own sake. So really, I wish it was like this all the time; it would have been a lot of fun. (Student 11A)

3.2.2 Active learning

Students described learning through a host of active and engaging interactions. Rather than passively absorbing information, they were asked to engage in creative and social learning activities with their peers, thereby learning through experiencing things. The active learning happened before, during, and after the formative OSCE; through engagement with the subject matter, having the right level of attentiveness during the formative OSCE, and being set up for active learning in the future.

a. Engagement with the subject matter

The students were tasked with creating OSCE cases that other peers would be tested in and should learn from. In order to carry out this responsibility successfully, students had to do a deep-dive into the subject matter at hand and make sure that they understood it. Having this goal drove students to active engagement with new knowledge and they studied with greater motivation. One student described how learning like this worked:

I think the formative OSCE works very well as a way of learning. If you have to make your own exam case, you have to understand the subject, and you have to understand what is important and what you want to test. And while one is working with understanding it and developing that case, then one learns along the way, in a slightly more active

process. (...) That makes it more natural to study, and I get more interested in what I read when I have a goal in mind. (Student 5A)

Students had to be knowledgeable about the subject matter of the OSCE case in order to get the proper discussion going with either their peers or the mentor. Instances of discussion with the mentor presented themselves as engaging learning opportunities for the students where they could get a real-life point of view on the case. Students described how they wanted to avoid a situation where they were just at the receiving end of knowledge, and not contributing to it. One student stated:

You learn a lot from just having to study and immerse yourself in the subject matter of the case. But I also got a reality check on what is in the text book and how that compares to real life through collaborating with the mentor. Because they have the experience and can tell me how it usually works. I think it is good to learn from discussing, and you can only really do that when you have studied and, in a way, feel like you are at the same level [as the mentor]. Because if not, it would be like being lectured, that you simply get told stuff, and I do not really think that you learn a lot from that. Because if you can reason and come up with counter-arguments and have a conversation about it, it will be something else. (Student 3B)

b. The right level of attentiveness

The formative OSCE offered a learning arena where the student had to be focused, attentive and ready to perform on tasks. The state of attention the students were in during the formative OSCE was not like the pressure of a summative exam, where the student panics; and

not like a lecture, where the student is passive. Rather, the formative OSCE promoted the right level of attentiveness to learn actively:

Firstly, I think that one is very attentive while there at the formative OSCE, but you're not like panicking like during a real OSCE because there you don't remember anything, you're just walking around in a trance through the exam and then you're done. You're more attentive at the formative OSCE compared to a regular [problem-based group session], or especially compared to a lecture where you're just sitting in the back. (...) You learn better when you're focused and having this formative OSCE was a very good way of keeping the focus and be like a little "turned on" during a learning situation.
(Student 11A)

This heightened level of attentiveness was promoted by students being in a test-like environment. They had to improvise and try to retrieve and revive prior knowledge that laid dormant in order for them to solve the cases they were faced with. Lateral thinking was needed, and students had to be alert and on their toes. One participant described:

You know, where I learned the most was probably during the formative OSCE day, and I think that is because I wasn't as well prepared for it as for an ordinary exam, and because I had to improvise and actively search for something that I knew from before. It wasn't just like me being prepared for a certain scenario, knowing this check list by heart from before that I just performed. But I had to try to find a solution there and then, and that was very exciting. (Student 2B)

c. Getting ‘hooks’ to attach knowledge to

During the formative OSCE, all students were tested on things they had not yet encountered in lectures, problem-based learning groups or in clinical rotations. This ‘testing before learning’ approach promoted the active search for prior knowledge, as mentioned above; and it also gave the students a preview of what they would learn next. Students described this as “*making hooks*”; a Norwegian idiom that means acquiring a kind of starter-knowledge on which to attach more knowledge to later. These ‘hooks’ set the students up for repetition, retrieval, and active engagement with new material at a later date:

Yes, I'm looking forward to starting a new term now. I think I will benefit from having heard about some things before. (...) And without necessarily having learned it so well, you at least know something about it from before. And I think that helps a lot, you kind of have this hook for when you start learning more. (Student 3A)

3.2.3 Authentic assessment

The student-run formative OSCE represented a test-like environment closely resembling the summative exam, and it was oriented towards practical cases and skills by the students’ own will. Participants described feeling assessed as their distant future selves - as physicians; and as their near future selves - as summative OSCE exam takers.

a. Feeling physician-ish

Students described testing and participating in OSCE cases that felt meaningful, useful and very relevant for their future practice as physicians. They got to practice clinical problem-solving, reasoning, and communication. Students described feeling a little like they were

physicians during these cases - physicians in a clinic ordering tests, evaluating test results and feeling like they had to build a line of reasoning - like they think real doctors do. The two pediatrics cases on the formative OSCE were designed as clinical reasoning tests and were particularly effective at helping the students feel as though they could project themselves into real-life roles. One student described the thought process that evolved during one of those cases:

Respondent: What I felt when I sat there was that I could just sit and ask questions and try to get closer to a diagnosis in a sick child. (...) It was an incredibly good way of practicing clinical reasoning skills that I thought was incredibly fun. I felt physician-ish when I was sitting there (...).

Interviewer: What made you feel like a physician?

Respondent: It was that I was able to combine all the knowledge I feel I have worked with, especially maybe during the last 18 months, after the clinical part of medical school started. And combining all that knowledge in a case, being able to sit and judge what I thought was right and important to do from the clinical information I got. It's my impression that this is perhaps like typical doctor's thinking, so I think it was an incredibly good case to test reasoning ability and stuff. (Student 5A)

When students realized that they managed to perform well on unexpected cases with clinical relevance they got a boost of their motivation and self-confidence. It was like the formative OSCE experience opened up a window to their future selves and they could see that being a doctor was within reach. One student describes the feeling after the formative OSCE:

I noticed that I got a real boost in my self-confidence after the formative OSCE last Friday. I was like: "I'm good, I can do this!". And it makes me happy thinking like: "I'm

so happy that I will be a doctor, because I can do this, I handle it". I started other studies originally, but now I'm in medical school, and I'm so crazy happy for that (laughter), because I feel like it's "me". A doctor is what I want to be, and now I realize that I'm good at it too. So, then I am like: "What a good day". (Student 4A)

b. Feeling like summative OSCE-takers

The formative OSCE was an authentic test-like experience that had an impact on the students' summative OSCE experience. The formative OSCE made students feel feelings that they recognized from high-stakes summative exams in the past. This happened because the physical surroundings of the formative OSCE and the way the cases played out were very similar to the real thing. Students felt attentive and slightly anxious before they started the formative OSCE circuit, although they knew that this was a low-stakes mock-exam geared towards learning. These stressful feelings were seen as positive as they contributed to the authenticity of the experience. One student recalled the feeling during the formative OSCE:

My experience [at the formative OSCE] was similar to my feeling during oral exams in general. I'm pretty like on edge and feel a bit like sick and nervous and everything at once right before it starts. But when I just get into the room and I'm allowed to start talking then it's ok, then I calm down. I had that "[exam] feeling", now during [the formative OSCE], but I was maybe a little bit calmer in between, and maybe not as anxious about the next station. But that feeling before the exam was almost the same [as the summative exam] and it was a little nice to actually feel it (laughter). (Student 3A)

Students described that having the formative OSCE a month before the real thing made the summative OSCE safer to go into. They could be calmer and feel more in control before and

during the exam. Performing well in the formative OSCE a while before the real thing led to a higher trust in students' own abilities when faced with the high-stakes exam. One student reflects on the impact of the formative OSCE on the feeling going into the summative exam:

Yeah, I think it went well on the exam, and I'll see when the results are announced. And I think the formative OSCE helped me prior to the exam. That I trusted myself more the last days before the exam. There was less of this unrestful feeling about whether you know what you're supposed to know or not. I got to test myself a month before and I felt that it went well without studying intensively, so you lower your shoulders a bit and think that now, a month later, it has to be a bit better. (Student 7B)

Not only the formative OSCE had an impact on the summative OSCE experience, but also learning more about the inner workings of OSCEs in general had an appealing ability. Exams, which so far in medical school had felt out of reach and unsafe, were suddenly more concrete and graspable. This transformed the students' summative OSCE experience. One student described:

I carried a lot of these [exam-related] thoughts, that you might not get if you didn't "peek behind the curtain", with me before and after the summative exam. Being allowed to get closer to the exam has made it less frightening. All this knowledge that you can get about the exam makes you more relaxed and perform better, I think, because it doesn't make this "exam monster" something distant and impalpable, it moves it closer and "lifts the fog", to be a bit poetic. (Student 6B)

While most students described that the formative OSCE study had a positive impact on either their feelings going into the summative exam or their academic results afterwards, it was also mentioned in the second interview that this newfound sense of wellbeing before the exam

might have led to less studying, and consequently a poorer performance. Although this experience was painful, it raised self-awareness and there was perhaps some personal learning gained from it. A student recounted the experience:

Respondent: I think that the formative OSCE was very useful for the feeling before the real exam, I felt more secure going into it. But I see that I did less well on this exam than I did on the last summative OSCE. I passed, but with a slimmer margin than before. And it might be because I felt safer and consequently studied less (laughter), or it could be other things. But I passed and fulfilled the requirements for moving on, so, I don't have to feel bad about it. I had a much more comfortable time leading up to the exam, I managed to stop studying at 8 pm and relax and exercise and do other stuff that I enjoy despite it being close to the exam. So, in a way, it is not so dangerous to study less. But if I had failed, I would be pissed off (laughter), but fortunately I didn't. (...)

Interviewer: So, what did you learn from this?

Respondent: That it is very useful for me to be nervous, then I mobilize a lot more even if it is very uncomfortable and it hurts other things in my life (laughter), it is very useful for my studies. (Student 1B)

3.2.4 Rich learning outcome

Students described a richness of experiences and learning outcomes, including a favorable time versus outcome ratio, during their participation in the formative OSCE study. A whole spectrum of new learning was described; from becoming more aware of exam creation and

practicing practical skills, to uncovering their own hidden knowledge. Indeed, the formative OSCE was described as a comprehensive learning experience.

a. Favorable time expenditure

Most students and faculty mentors described that they felt they got a lot out of their participation in the study compared to the time spent. A couple of students felt that the time spent on creating the OSCE case was not as useful as actually doing the formative OSCE. But overall the sentiment was that learning in this manner did not cost a whole lot of time or effort:

Compared to what people who didn't volunteer for the project might have thought, that it would take a lot of time, that wasn't what we experienced. At least personally I didn't spend a lot of time on it. It was like this thing I did on the side, in addition to all the other stuff, and I thought it was a lot of fun. (Student 8A)

b. Practical skills learning

The students created the formative OSCE from scratch, and many cases were related to practical skills and procedures. Indeed, the formative OSCE was useful as a vehicle for testing and learning examination techniques and practical skills. For instance, being tested in suturing technique or examination of a newborn baby. Discovering areas of deficiency and reflecting on these reinforced learning from their usual learning environment. Students described in interviews how they wanted the formative OSCE to be as practical and clinical as possible. One student explained:

I think that the formative OSCE was fantastic, I'm very happy that I participated, and I feel like it has given me a lot. Not just exam preparation, but in general I think it was one of the most educational days in medical school. It was the first time in quite a while that I

was able to reflect on what I have learned so far during medical school and what I know and what I must work on and what should be important. And because it was a practical exam, I always had the sense that everything I did had great importance for my future career. (Student 2A)

c. Experiencing OSCE creation

During the study students experienced first-hand the requirements of OSCE-design. They described being surprised over how difficult it was to make a high-quality OSCE-case that performed the way they wanted on the exam. Students became aware that some of the critique that they had expressed previously about poor OSCE cases might have been oversimplified. Indeed, they themselves did some of the same errors that faculty members have done in the past. This led to humble surprise. One student explained the change in sentiment that occurred:

I found it fun making the OSCE cases. It was fun and more difficult than I thought it would be. We were perhaps a bit 'cocky' when we started out and thought: "We are going to make some really good cases, and then they'll see". The cases we made turned out ok, but they were suspiciously similar to old ones made previously by faculty members.

(Student 9B)

The faculty mentors were somewhat surprised that the students did not realize the level of complexity surrounding OSCE-case development beforehand. One of the mentors described experiencing this as an aha-moment:

I was surprised that the students were not aware that there is a lot of work behind an OSCE case. That they think that this is something we conjure up and do in passing. So, it

was an aha-moment for the students, but also an aha-moment for me that they were not aware of it. (Mentor 1)

Although OSCE case writing was generally perceived by the students as more difficult than what they had imagined up front, they were not daunted from doing it. Indeed, it seems that students learned during the process that they brought unique insight into exam creation because of being the intended audience for the exam. OSCE case creation might even be easier to do for the exam takers because they are close to the knowledge, skills, and competencies that are being evaluated. Academic staff might overcomplicate things when they make OSCE cases. A student described:

Yeah, it is difficult to create a case that is suitably difficult, and that makes students able to demonstrate what they know. But I think it is easier as a student. When you are at the same level as those around you and everyone know just as little and form the same opinion of the important and unimportant, then I think it is easier to make a case. When [the specialists] work with the topic every day, they see all the unusual cases and experience the unusual as quite common, and then it's easy to get lost and become a little blind [when making OSCE cases]. So, maybe it's not so stupid with these student-made OSCE cases. (Student 1A)

d. Learning about feedback

Feedback was reflected on and discussed during the feedback seminar. For several students there was one thing in particular that stood out as important new learning – namely what good and informative feedback requires and contains. This recognition led to further discussion in the student group about the quality of feedback given during medical school and that it perhaps

was lacking. Students realized that they had to be able to offer peers informative feedback during the formative OSCE, and not empty phrases:

I thought it was a very useful seminar. It was very brief, with stuff that many would think like: "Oh well, this was a bit like duh, of course one must justify feedback and stuff". But we had discussion about how we had experienced feedback before (...). And we reflected over: "Do we really get good enough feedback in medical school?". And I thought it was very important to be made aware of how to give good feedback so that we realized that we actually have this seminar to point out that during the formative OSCE one must be able to give well-founded feedback, more than like: "That went well", or "You are clever" or "It went fine". That one actually justifies why the candidate was good or not good; and does it in a respectful manner. (Student 11A)

During the feedback seminar and in the interviews, students mentioned that they do not get enough feedback on their performance from academic staff. It was also reported as uncommon for students to ask other students to give them feedback. Students described how they did not want to be seen as know-it-alls if they offered peers advice and feedback without being explicitly asked for it. Students realized during the group discussions that they could promote feedback culture in medical school by being daring and asking for it themselves. A student described how this might play out:

I really liked what was said at one seminar that we have to create a feedback culture in medical school by starting to ask for feedback from others, and that was like a revelation - it's the way one has to do it. You have to start to ask for feedback yourself, and then others will see that: "Oh, but this was really great, I must start doing that too". And then

you've started it, right? It's kind of like daring to expose yourself a little by asking: "Give me some feedback". I thought afterwards: "I'll actually start doing this". (Student 4A)

Although, this learning about feedback was not seen as immediately or unequivocally beneficial by all students. Some thought learning about giving good feedback was a bit vague and should have been taught in a different way. Students tried to practice what they had learned about good feedback during the formative OSCE, but the learning did perhaps not achieve the intended outcome of content-rich feedback for all of them. One student described their experience like this:

But I have to admit, that although feedback is important, I'm personally unsure about the value of the feedback seminar. It was just a little too much like a lecture, and even if I understand the message, it is more difficult to apply, actually. It is difficult to give good feedback, you have to practice over time. So, how much of an effect that one seminar had on the feedback we gave during the formative OSCE – I'm not certain about that. I noticed that several students tried to think about the things we learned when they gave feedback, but there was still a lot of: "No, that was a fun case", "That was a good case" (laughter), you know? So, I'm a bit unsure of the impact. (Student 8A)

e. Awareness of hidden capabilities

Students described being positively surprised over uncovering how much they knew without realizing it when they tested themselves on the formative OSCE. During medical school a lot of knowledge had been stored away and needed to be rediscovered. But when put to the test they retrieved the knowledge they needed, fit the pieces of the puzzle together and managed to solve difficult cases that they beforehand thought were impossible. Two students described:

I was a little surprised by the knowledge I was able to bring to light, because I am so used to thinking that the goal is in a month, so that one can already bring out so much, that was motivating. (Student 7A)

I remember the first case I had; it was a newborn baby with an infection. I hadn't had pediatrics and so I went in there with some mixed expectations. I didn't know if I would be able to solve that case without having had pediatrics before. But the whole problem was actually one that can be transferred to patients of all ages, and there was a very common way to go through the case, trying to solve it. We really had all the prerequisites we needed to solve this task without having had pediatrics before. (Student 2A)

Participation in the formative OSCE helped students face unfamiliar situations with confidence. They realized – through actual practice – that they could pull up latent knowledge and apply it to help them succeed in a new, unknown situation. This discovery increased self-confidence and boosted motivation to learn more. Students described how they during the formative OSCE went from feeling insecure about their abilities to feeling proficient - in short, they got a new sense of mastery. A student explained that this is not always the case after participating in regular learning activities of the medical school:

What is good about the formative OSCE is that during all of medical school one goes around and feels like one doesn't know anything, like during clinical rotations, we know nothing (...). But then you do this [case on the formative OSCE], and you get this feeling of mastery that you probably never would get during a clinical rotation or in another setting. And that was good, that was cool, and then you're more motivated to study and improve after the formative OSCE, yeah. (Student 10A)

3.2.5 Empowerment

Students and mentors described events during the formative OSCE study that altered the roles and relationships between student and academic staff. These experiences started to even out the usual power differential between them. Students gained insights, knowledge and experience, and thus were empowered to teach and critique their seniors.

a. Temporary promotion

During the formative OSCE project medical students took on unfamiliar roles when they were tasked with making their own exam. And students were welcomed in to environments where they usually had never entered before. It was like the students were temporarily promoted to faculty members when they adopted the perspectives and roles of OSCE creators, examiners, and peer-teachers. Students described how being the principal case author, collaborating with a faculty mentor, led to invaluable insights into how everyday clinical reasoning processes were difficult and ambiguous; and that sometimes the people you look up to cannot provide all the answers. One student recalled:

[The mentor] was a bit uncertain about a few things so he called a subspecialist but didn't get any very clear answers from that source either, it was quite vague: "The patient could have this symptom, maybe this, yes, no, it depends". (...) It was nice and good learning in this for me, to see that when you lift your eyes and look past the exam things aren't always so clear and simple. And the mentor did not have all the answers. But we tried to solve these issues together. (Student 6A)

Another consequence of this new role reversal was that students were put in a position to teach their mentors. Both mentors and students described that knowledge, particularly about

OSCEs, passed from the student to the faculty member during their collaboration. One student recalled what happened:

I think it was a positive experience to get to know the faculty employees who will create real OSCE cases in the future. And I think they also got something out of it, at least when I gave my comments and said that this should be its own scoring element instead of two and stuff. (Student 4B)

Although the students described this role reversal quite humbly, as above, the mentors described much more vividly what they learned from the students. The faculty mentors, who had experience writing OSCE cases for the past two to three years, agreed that the medical students brought useful and unique insights into OSCE case creation. They got pointers on how to make good OSCE cases and new ideas for OSCE cases. Students have the real-life experiences of being under time pressure during the exam, and it was useful for the mentors to tap into this source of practical exam-related knowledge. This collaboration was described as a two-way gain:

I have been an examiner, but I haven't been in the student's position. So, what was useful for me was to have a conversation with someone who has experienced this personally. And ask: "Do you think this is too difficult?", "Do you think this is too easy?". I felt this mutual usefulness, like we played off each other's strengths in a way, so that I also learned something from it. (Mentor 5)

The students could also see new solutions to issues the faculty members had struggled with and they gave creative replenishment to an otherwise slightly stale academic environment. Two of the mentors described what they experienced:

There is no doubt that for those in the academic community who are making OSCE cases, one thing is that the [student-run formative OSCE] is labor-saving, but you somehow expand your ability to think creatively about the OSCE case as well. We all walk around in our own footsteps a little bit. When you have made some OSCE cases you continue to build them all from the same mold. (Mentor 2)

What I learned from the students was about this excellent case and how they created it, because it was created in a good way, and I thought: “Yes, this was just really great”, because at the teaching unit we had already talked about it and struggled with how we would design it, and then the student came up with a great solution. So, I think this is a win-win project. (Mentor 1)

b. Knowledgeable critics

Students gradually realized that gaining insight into the inner workings of assessments gave the power of knowledge, and they could now back up their exam critique with facts. This new feeling was not in conflict with them realizing the difficulty of OSCE case creation, as mentioned in section 3.2.4 above. Indeed, living through the difficulties was empowering. Students described that during the summative OSCE they felt angry and irritated about poorly made OSCE-cases. They felt like they could have done this much better themselves, and at a level that was more appropriate. They compared what happened in real-life with what they had learned to be the gold standard of OSCE cases and felt disillusioned. One student described:

I was really very disappointed about the summative OSCE that was made for us. Because of doing this formative OSCE project, I was irritated during the exam and thought: “How

bad is this? ". (...) I felt that we didn't get to show what we knew, and I think there were stuff on that OSCE that should have been tested on a written exam. And the practical skills testing and the real purpose of the OSCE were not followed through. (Student 3B)

Students also experienced this when they learned about feedback and got to see examples of feedback that faculty members had written to students after OSCEs in the past. They realized that they now were in a position to be critical about feedback they had been given and justify their complaints. One student explained:

I thought it was nice to see previous feedback that the OSCE examiners actually wrote, because it shows that they not necessarily have a clue either, and they are the ones you like look up to and who set the standard. But now you start to realize that maybe they are not on the right track either. So that's like a bit interesting and worth to carry forward - that you can actually be critical to what they say. Not everything has substance and meaning. (Student 3A)

4. Chapter 4: Discussion

4.1 Discussion

This study provides insights into major components that shape medical students' learning when they participate in student-run and peer-assisted formative assessment activities. More specifically, we explored the how, what and when of learning during a student-run formative OSCE with case-authoring and peer-feedback at NTNU. In this study, learning was described as rich, active, and authentic. Part of the deeper, and perhaps more surprising, insights we gained, were the students' emerging feelings of empowerment and that learning took place in a safe,

enjoyable, and student-regulated environment that was unlike their usual surroundings. Looking at the results through a lens of self-efficacy and self-regulated learning, the results suggest that the representations of learning in this study promote the development of both concepts.

Medical students' narratives were laden with positive emotion. They used words and told stories to describe excitement, enjoyment, and surprise. The cause of enjoyment seemed to be complex, consisting of a mixture of play and learning, tapping into the peer-driven, active and authentic parts of the learning that took place. Through students' experiences of learning, a backdrop consisting of safety, increased motivation, feelings of mastery, and a new sense of power was painted. In this study medical students described positive and encouraging feelings of mastery and motivation when they became aware of their own abilities to retrieve previously learned knowledge and solve complicated and unexpected problems. It was like the formative OSCE put up a mirror where the students could see themselves more clearly as competent future physicians.

Positive emotions in learning are powerful. Enjoying performing a task related to learning can increase engagement, motivation, and indeed enhance concentration while learning. Negative emotions, such as anxiety, boredom, and insecurity, on the other hand, impede learning and add to extraneous cognitive load (Pekrun, 1992). Medical school and resident training environments have traditionally been quite hierarchical and emotion-free environments (Crowe, Clarke, & Brugha, 2017); and medical students around the world have reported being subject to humiliation, and that hiding emotion and weaknesses have been imperative (Frank, Carrera, Stratton, Bickel, & Nora, 2006; Seabrook, 2004). Although this study's primary focus was learning, and not the emotional environment of medical school in particular, the student participants expressed spontaneously that it was easier to feel safe and dare to expose vulnerabilities in a learning

environment when there was no academic staff present and no fear of failure. Friendly peer-teachers and -examiners facilitated a trusting atmosphere, much like what was found in a study of peer-assisted learning by Hudson and co-authors (Hudson & Tonkin, 2008); where peers created a comfortable and non-intimidating learning environment.

Student participants in this study described positive feelings of temporary promotion to roles that they never had been in. Students took ownership over the student-run formative OSCE and were free to design cases as they wanted. Students also found themselves in a position where their competency was asked for and needed by academic staff; and they could be knowledgeable critics of the system that controlled them. They are after all knowledgeable about exam-taking and this study shows that they bring unique insights into exam creation. The process of demystification of exams and feedback processes increased transparency and added to the sense of empowerment. Empowerment in learning and education gives more enjoyment, motivation and self-confidence – and contributes to students’ ownership of learning (Chan, Graham-Day, Ressa, Peters, & Konrad, 2014). Students were described as well-equipped teachers, because they were at the same level as the learners and knew the details of practical procedures, for instance. This resonates with what has been found in other studies. In a qualitative study exploring medical students’ experiences with peer-teachers (Lockspeiser, O’Sullivan, Teherani, & Muller, 2008), it was stated that “(...) *students valued learning from near-peers because of their recent experience with the materials and their ability to understand the students’ struggles in medical school*”. In a study from McMaster University (Reiter, Rosenfeld, Nandagopal, & Eva, 2004), peer-feedback was rated higher in quality than what was received from faculty evaluators during an undergraduate OSCE.

During the formative OSCE feedback was given directly after the student's performance by a person who had observed the action. Telio and co-authors (Telio, Ajjawi, & Regehr, 2015) propose that feedback is most effective when the receiver and the provider have a supportive educational relationship with each other, what they call an '*educational alliance*'. The learning environment in this study facilitated the development of this alliance, by being trusting and reciprocal. Indeed, also the observer got feedback on the success of the OSCE case and hints on where there were room for improvement, and this added to the mutual and egalitarian educational relationship.

The construct of self-efficacy, developed by Albert Bandura, is the personal belief that one will, or will not, master a task, reach a goal, or solve a problem that one is faced with (Bandura, 1986). Self-efficacy is influenced by the type of task at hand, previous experiences of successes and failures, and observation of others. The results from this study strongly imply that the motivating, empowering, and uncommonly positive experiences during the formative OSCE study, outlined above, promoted self-efficacy in the medical students. Student participants gained self-efficacy by mastering the authentic challenges they were faced with, by gaining power and authority, and by being successful peer-teachers. In a guideline written for the Association for Medical Education in Europe (AMEE), authors Sandars and Cleary state that self-efficacy, and thus the beliefs a person holds about their own competency, are important drivers for preserved effort when endeavoring to complete a task in the face of difficulty, stress, and exhaustion. A learner with high self-efficacy will prevail, driven by the belief that this task can be done; while a learner with low self-efficacy beliefs will often show unsuccessful amounts of effort and might give up early if the task is perceived as too difficult. Thus, promoting self-efficacy is important for motivating learners to learn (Sandars & Cleary, 2011).

In the fast-evolving world of medical knowledge, doctors and other health professionals should be equipped to be adaptable, persevering, curious, and self-regulated learners in order to keep up with the rapid development (Cutrer et al., 2017). Self-regulated learning theory, developed by Barry J. Zimmerman, among others, describe learners who are self-aware and take responsibility of their own learning (Zimmerman & Schunk, 2001). They welcome opportunities to test themselves in order to identify their knowledge gaps. Self-regulated learners proceed to set learning goals for themselves, and they are structured, concentrated, and self-disciplined in order to reach these goals (Nilson, 2013; Zimmerman, 1990). Formative assessments, which gives opportunities for self-assessment as well as providing constructive and informative feedback geared towards learning; are seen to support the development of self-regulated lifelong learners (Clark, 2012; Konopasek et al., 2016; Nicol & Macfarlane-Dick, 2006). In this study, students described how practicing in surroundings that were very similar to the high-stakes environment, meant that the formative exam practice felt authentic and had an impact on their performance in the summative OSCE. Authentic assessments are instances of assessment that recreate or clearly represent the knowledge, skill or competencies that the student will have to know, understand or perform in real life (Biggs & Tang, 2011; Villarroel, Boud, Bloxham, Bruna, & Bruna, 2019). The student participants appeared to crave authentic practice and students described during interviews how this experience had made the summative OSCE safer to go into because they had had the chance to discover what they did and did not know in a close to real life environment.

In addition to letting students engage in formative assessment and discovering knowledge gaps, self-regulated learning was fostered in this study through entrusting students with the responsibility of their own and their peers' learning, and through tasking them with designing a formative OSCE from scratch. Students described that these premises for the study provided

them with clear goals, but they had to find the way forward themselves; although with some qualified help from experienced faculty mentors. Students mentioned that both the OSCE and feedback seminars, and the formative OSCE itself, provided opportunities for self-and group reflection exercises, which are important parts of the development of self-regulated learning (Zimmerman, 2002).

Students engaged in a range of learning activities and described how they realized the learning outcome that was produced by them being active learners with the right level of attentiveness. Active learning has been seen to increase engagement with and understanding of what is to be learned. Active learning is to be directly involved in learning by reflecting, discussing, experiencing things and solving problems (Bonwell, 1991; Graffam, 2007). Students participating in this study described how they were immersed into a cycle of active and experiential learning, where they had to be focused and attentive, throughout their participation in the study. They were given opportunities for reflection and discussion; and they had to deep-dive into the topic of their OSCE case and learn new knowledge because their peers' learning depended on it.

The student-run formative OSCE also introduced an unexpected level of difficulty through the mixture of cases from both fourth-year academic terms, which contributed to the active learning aspect. The 'testing before learning' approach forced students to engage attentively and actively in retrieval of prior knowledge and practice their reasoning skills. This approach introduced '*desirable difficulty*', a term coined by Bjork in 1994 (Bjork, 1994). Bjork found that learning that is effortful takes more time, but it is more long-lasting. Students described that it was fun and motivating to engage in unknown cases and clinical reasoning

processes, and that it set them up for delayed learning through memory ‘hooks’, although this testing before learning required increased effort on the students’ part.

Self-efficacy is not separate from self-regulated learning. Indeed, the belief that one can master a task adds important self-motivation to learning, and self-efficacy and self-regulation reinforce each other (Zimmerman, 2002). Learners with a high degree of self-efficacy and self-regulation have a higher degree of academic achievement (Zimmerman & Schunk, 2001). Adding to this the importance of developing lifelong learners highlights how these vital aspects of learning - self-efficacy and self-regulation - should be promoted in higher education.

Students and faculty mentors described richly the how, when, and what of learning that took place during this study. Students expressed that they wished that learning was like this all the time, pointing towards a possible discrepancy of enjoyment and content between this brand-new learning environment, and that with which they are familiar from before.

4.2 Limitations

There are a few important limitations to this study, and they are outlined and described in the following. The principal investigator was the project manager for the implementation of the OSCE at the medical school at the Faculty of Medicine and Health Sciences at NTNU between July 2015 and July 2017 and served part-time as the OSCE quality coordinator until March 7, 2019. The principal investigator was in charge of analyzing data from all the summative OSCEs at the Faculty, for creating psychometric data on exam quality and has given examination committees advice on high-stakes pass/fail-decisions for individual medical students in the past. The principal investigator gave both seminars on OSCE case writing and feedback principles

during this study, was present during the student-run formative OSCE to help out with organization and acted as an examiner on one case. There is a possibility that the student and faculty participants were affected by social desirability bias because of the principal investigator's roles; that is, not feeling completely free to give negative, as well as positive, narratives and feedback in interviews. Steps were taken to hinder this, such as promising full confidentiality of responses, and stating before, during, and after interviews that no utterances, whether negative or positive, would affect the student's or the mentor's academic standing or the principal investigator's opinion about them. In addition, the principal investigator withdrew from all OSCE standard setting activities for the entire study year of 2018/19 to avoid possible conflict of interest with student confidentiality and student trust during the study period.

This is a content analytic qualitative study and results are therefore not directly generalizable. However, the results and interpretations are data driven and described in such a way that they should be useful for a wider medical education audience, especially in similar environments to the one where the study took place.

4.3 Future implications and research

The results of this study showed that student-driven formative assessment activities are feasible within the time constraints of the medical school curriculum at NTNU. The results also showed how students enjoyed this type of learning, and that the learning was rich, relevant, and promoted vital aspects of lifelong learning. Preparations are now under way to offer the student-run formative OSCE to all medical students at NTNU who have summative OSCEs - that is students in the first, third and fourth year of medical school - from the Fall of 2019. So far

approximately 500 students and 34 teaching units have volunteered to participate (personal communication, T Slørdahl, April 11, 2019).

Future research might include looking quantitatively on student-run formative OSCEs and summative OSCE results. Or it might entail new qualitative studies delving deeper into the medical students' experiences with learning in other parts of the medical school curriculum.

5. Chapter 5: Conclusions

This qualitative study explored the experiences of learning that medical students had through participating in a student-run formative OSCE with case-authoring and peer-feedback. Through engaging in active, authentic and empowering learning activities, in a learning environment that was student-controlled and enjoyable, medical students' self-efficacy and self-regulated learning were promoted. These are important features of successful lifelong learners.

Medical students have a lot of exam related knowledge. They are aware of what is required of them in terms of knowledge, skills, and competencies; and can explain with the right level of detail how to do practical procedures, for instance, because they just learned these themselves. Combining these skills makes the medical student both a suitable exam creator and a successful teacher for their peers. The student-run formative OSCE was an important initiative to activate these capacities, which in turn promoted self-efficacy for the students.

In a world where knowledge is rapidly evolving, we should equip learners with the tools that make them self-regulated and lifelong learners with a high degree of self-efficacy. Data from this study therefore supports introduction of more student-driven, peer-assisted, active, and authentic learning activities into the medical school curriculum.

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Appendices

1. Interview guide student interview A

Interview topics:

- Student experience of learning during the project – before summative exam
- Writing objective structured clinical examination (OSCE) cases with a peer and collaborating with a faculty mentor
- Learning about feedback
- Participating in a new way in the making of an exam
- The day of the formative OSCE

Introduction: Thank you for doing this interview with me today. This interview is part of a research project looking at the student experiences with the formative student-run OSCE. The interview will take approximately 60-90 minutes, depending on how much we have to talk about. Everything we talk about will be treated confidentially and anonymously. What we talk about will have no influence on your grades or your standing with me or other faculty members. And, I would like to stress that you should feel *absolutely free* to tell me everything that comes to mind, either negatives or positives. The interview is audio-taped, and I will also take some notes during our conversation. Do you have any questions before we start?

- Walk me through why you decided to participate in this formative OSCE project.
 - Explore: Motivation.
- Tell me about the OSCE you had this spring (third-year OSCE). How was that for you?
- How was it for you to participate in the seminar where we all met for the first time, and where we talked about how to write OSCE scenarios?/Tell me what happened (...)

- Explore: Surprises. Reflections. New knowledge.
- Walk me through what you did when you created the OSCE scenario(s).
 - Explore: Reasons for choosing subject and theme(s). Distribution of work – group, individual. Sources used. Experience from the collaboration.
- Tell me, how was it to work with the faculty mentor? Take me through what happened, step by step.
 - Explore: Influence on case scenario. Conflicts? Reflections.
- If you look back at the OSCE scenario(s) you made, after doing the formative OSCE and being an examiner, what do you think about it/them now?
 - Explore: Revision needed? Why? What happened to make you say that?
- Ok, let's go back to the second seminar, where we talked about feedback. Take me through what we did and talked about.
 - Explore: Surprises. New knowledge. Reflections.
- How was it for you to give and get feedback on the formative OSCE?/Walk me through giving and receiving feedback from peers.
 - Explore: Experiences, reflections.
- Tell me about one time you got feedback in a clinical setting prior to this formative OSCE project.
 - Explore: Reflections about new knowledge.
- Ok, so let's talk more about the day of the formative OSCE. Could you walk me through what happened that day, from beginning to end?
 - Explore: Morning meeting. Station by station. Reflections on what happened.

- How was it for you to experience OSCE stations/scenarios from subjects you have not had any lectures in yet?
 - Explore: Testing before learning. Reflections on going in to the next term/semester with this new knowledge. Experience with own reasoning skills.
- Ok, so now you have about 5-6 weeks until the summative OSCE. What are your plans for studying?
 - Explore: How to use new knowledge. Study methods.
- Overall, how has the formative OSCE project been for you?
 - Explore: Attitudes peer-to-peer teaching.
- Ok, this interview is coming to an end. Is there anything you would like to tell me that would make me understand more about your experience (of learning) in the project?

Thank you so much for participating in this interview! I would like to close with saying that everything we have talked about is confidential, and the transcript from this interview will be de-identified of your name and personal data. What we talked about will have no influence on your grades or your standing with me or other faculty members. I will now transcribe the interview and start the analysis. Please do not hesitate to contact me if anything is unclear after today. Do you have any closing questions regarding this interview?

2. Interview guide student interview B

Interview topics:

- Reflections on learning
- Experiences from the summative OSCE

Introduction: Thank you for doing this interview with me today. This follow-up interview is part of a research project looking at the student experiences with the formative student-run OSCE. The interview will take maximum 30 minutes, depending on how much we have to talk about. Everything we talk about will be treated confidentially and anonymously. What we talk about will have no influence on your grades or your standing with me or other faculty members. And, I would like to stress that you should feel *absolutely free* to tell me everything that comes to mind, either negatives or positives. The interview is audio-taped, and I will also take some notes during our conversation. Do you have any questions before we start?

- How was it for you in the summative OSCE? Walk me through what happened.
- Tell me, what are your thoughts about the student-run formative OSCE now – after the summative OSCE?
- Personalized question - If something particular came up in the first interview, explore further.
- Could you tell me about how you experienced the mix of cases from term A and B on the formative OSCE?
 - Explore: Why? Positives and negatives.

- I'm interested in exploring learning. Looking back at the whole project, do you feel there was some learning?
 - Outcome? When? How did you learn? What instance was most important for learning? What was learned? Probe into concrete and abstract.
- OK, this interview is over soon. Is there anything else that you would like to tell me that would help me understand more about your learning throughout the study?

Thank you so much for participating in this interview! I would like to close with saying that everything we have talked about is confidential, and the transcript from this interview will be de-identified of your name and personal data. What we talked about will have no influence on your grades or your standing with me or other faculty members. I will now transcribe the interview and start the analysis. Please do not hesitate to contact me if anything is unclear after today. Do you have any closing questions regarding this interview?

3. Interview guide faculty mentors

Interview topics:

- Mentoring medical students
- Objective structured clinical examination (OSCE) cases made
- Learning process

Introduction: Thank you for doing this interview with me today. This interview is part of the research project looking at the student experience during the student-run formative OSCE. The interview will take approximately an hour, depending on how much we have to talk about. The main focus of the interview is on the medical students' learning. Everything we talk about will be treated confidentially and anonymously. And, I would like to stress that you should feel *absolutely free* to tell me everything that comes to mind, either negatives or positives. The interview is audio-taped, and I will take some notes during our conversation. Do you have any questions before we start?

- Walk me through what happened when the medical students first contacted you.
- What feedback did you give the medical students about the OSCE case(s)?
 - Explore: How did you tell them? Students' reaction.
- Tell me, what happened with the case during your collaboration?
 - Explore: Development or change in the OSCE case. Students' reflections.
Learning process. Reasoning skills.
- How did the student-made OSCE case(s)/scenario(s) turn out in the end?
 - Explore: Quality. Ready for a summative exam in the future? Student's point of view – different than faculty members?

- Tell me how this OSCE case-mentoring process was for you.
 - Explore: Differences between student authors, and faculty authors. Novice to expert. Any surprises?
- Did you learn anything new through this project? (If not mentioned spontaneously)
 - Explore: What, how. Reflections on experiences, peer-to-peer teaching.
Reflections on direct student-to-faculty member mentoring.
- Ok, this interview is coming to an end. Is there anything you would like to tell me that would make me understand more about your experience?

Thank you so much for participating in this interview! I would like to close with saying that everything we have talked about is confidential, and the transcript from this interview will be de-identified of your name and personal data. I will now transcribe the interview and start the analysis. Please do not hesitate to contact me if anything is unclear after today. Do you have any closing questions regarding this interview?