

## Original Article

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# Co-regulation of learning in a department of paediatrics

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**ABSTRACT**

**INTRODUCTION.** Co-regulated learning (CRL) is a process in which the learner's regulation of learning is guided by social transactions. The change in learning techniques during the transition from university to workplace learning and the rapidly changing learning environment make awareness of CRL extremely relevant. This study examined CRL among medical students and residents and identified the factors affecting CRL.

**METHODS.** We applied an explorative approach using direct observation and semi-structured focus group discussions (FGD). The first author made direct observations that produced explorative data about actual behaviour. However, this was not sufficiently sensitive to capture the participants' full perceptions of CRL. Therefore, we conducted semi-structured FGD that involved interactions and reflections among the participants.

**RESULTS.** This study suggests that CRL occurred in multiple situations and was affected by many factors. The stimulating factors identified were a supportive learning environment, feedback based on observations and questioning by a supervisor, dyad work and interactive, bimodal presentation of emergency cases at the morning conference. Time pressure, heavy workload and shortage of specialists were inhibiting factors.

**CONCLUSION.** We identified several factors affecting CRL. A focus on the augmentation of stimulating factors and reduction of inhibiting factors may help medical students and residents develop CRL.

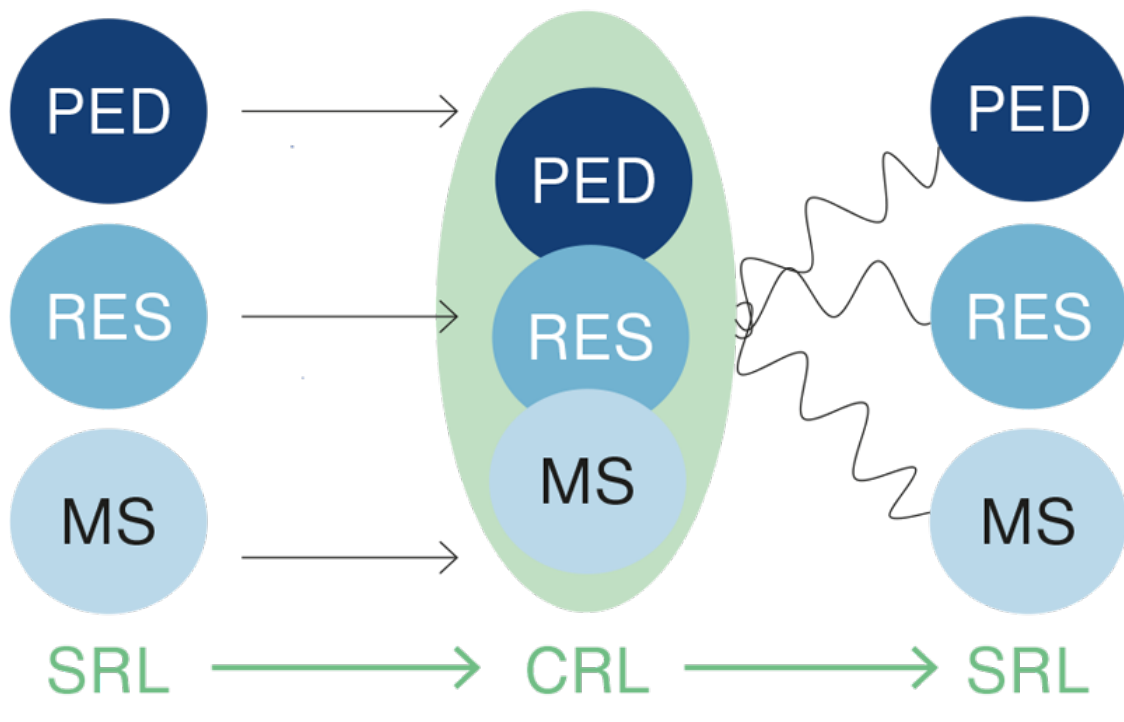
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Medical students, residents and their supervisors need to be aware of how workplace learning differs from university learning [1]. Workplace learning means learning from experiences involving patients in clinical practice, whereas learning at a university is mainly without patient contact [2-4]. However, in both environments, the regulation of learning is of paramount importance. Both medical students and residents are therefore required to develop or change learning techniques during their transition to workplace learning. Focus on the regulation of learning has developed since self-regulated learning (SRL) was described by Zimmerman in the 1980s [5-7]. SRL is defined as an individual and constructive process in which the learner regulates behaviour to achieve internal goals [8]. In this paper, we define workplace learning on the spectrum from informal to formal learning with an emphasis on informal aspects, recognising the significance of learning from other people [9].

This standpoint emphasises the importance of recognising the difference between SRL and co-regulated learning (CRL) in which individuals working together coregulate a shared process of learning. In Denmark, medical students and residents typically work closely together in clinical departments supervised by staff physicians. However, medical students and residents must have various learning goals, some of which overlap. Medical students are expected to develop their professional and medical competencies for their upcoming functions during residencies. Likewise, residents are expected to develop all their competencies, e.g., during their daily work as supervisors for medical students. This relationship makes a focus on CRL relevant. CRL is defined as a metacognitive process in which the learner is guided by social transactions to achieve regulation of learning (Figure 1) [5, 7].

**FIGURE 1** Learning can be either self-regulated and co-regulated. Co-regulated learning (CRL) may occur during a meeting between a paediatrician (PED), a resident (RES) or a medical student (MS). CRL triggers thoughts that may lead to self-regulated learning (SRL). The green area represents CRL. The blue horizontal arrows represent the problem, which is the reason why the different people attend the meeting. The green horizontal arrows represent that a person's SRL may lead to CRL and that this social interaction may create thoughts that, in turn, affect SRL. The twisted arrows represent the thoughts triggered by the meeting that potentially lead to SRL.



During CRL, the social relationship between learners needs to be trustful and supportive [6-8]. CRL may occur when social interaction forces a person to meta-reflect about thoughts, behaviours and actions [7]. This is in line

with the Vygotskian view where social and psychological processes are closely intertwined [7]. Vygotsky proposes a student-centred learning theory and a zone of proximal development (ZPD) [10]. The ZPD creates fertile soil for learning and cognitive development guided by supervisors or peers [10].

According to Vygotsky, learning processes should be studied in their natural context [11, 12]. However, a gap seems to exist in our knowledge regarding how medical students and residents co-regulate their learning during workplace learning [5, 6]. We expected that CRL might occur in many situations and that the participants would be able to describe influencing factors. This study examined the occurrence of CRL among medical students and residents in a clinical setting in a Danish department of paediatrics. The research questions were:

How, where and when does CRL occur?

Which factors influence CRL during daily clinical activities?

## METHODS

We used an explorative, qualitative and descriptive approach with direct observations and semi-structured focus group discussions (FGDs). Data were collected at the Department of Paediatrics, Regional Hospital Viborg, Denmark. By convenience contact, NSS informed each of the participants face-to-face about the study and invited them to participate. All participants gave informed, written consent for participation.

This study was conducted in two steps:

### Step 1 – direct observations

NSS performed direct observations which produced data about actual behaviour [13]. The observations were made to uncover how, where and when CRL occurred. A stimulated recall procedure was used to help participants report their thoughts during the observations. The observations were written down and analysed by thematic analysis, with themes derived from the data, first independently by NSS and TB and then by a consensus procedure.

However, the analysis revealed that direct observation was not sufficiently sensitive to capture the participants' full perceptions of CRL or to reach a sufficiently deep understanding of their experiences with CRL. Thus, the observations were used when developing step 2 of this study.

### Step 2 – focus group discussions

We conducted semi-structured FGDs based on a question guide, involving interactions and reflections among participants to obtain a deeper understanding of factors influencing CRL [14, 15]. We used the reported learning situations recovered from the direct observations to construct questions for the FGDs. The FGDs were conducted by NSS who started the FGD by explaining the nature of CRL and the importance of social interaction. The questions were open-ended, e.g.: *What is the importance of learning with others? What is a good learning environment? Which factors affect your opportunity for CRL?* The FGDs were audio-recorded, transcribed verbatim and analysed using deductive coding [16]. The group of participants comprised medical students and residents to ensure diversity and obtain a wide range of opinions [15]. NSS and TB analysed and discussed the transcripts. The COREQ checklist regarding reporting of qualitative research was used [17].

*Trial registration:* not relevant.

## RESULTS

Included were medical students (n = 11) who were rotating through the department and residents (n = 14)

employed in the department at the time of the study. During direct observation, a total of 23 different participants were observed by NSS during 30 workdays, producing 33 specific social CRL observations (Table 1). Three FGDs were held (Table 2), including 12 different participants. Each FGD lasted 60 minutes.

**TABLE 1** How co-regulated learning occurred: description of observed co-regulated learning, number of participants involved and example observations supporting that these are signs of co-regulated learning.

Description of how CRL occurred	Example observation supporting that these are signs of CRL	Participants involved in CRL, n					total
		res/paed	res/res	res/ms	paed/ms	ms/ms	
Watching and discussing a colleague's communication with a patient	Interactive feedback based on watching progression over time	1	0	2	1	0	4
Discussion of a patient case at conference	-	0	0		2	1	3
Interactive, bimodal presentation of emergency cases at morning report	The stepwise revealing and discussion helps the learner develop his/her clinical reasoning processes [1]	0	0	1	1	1	3
Guiding from a more experienced colleague <sup>a</sup>	This interactive process may occur when the learner is asked to summarise the patient to the supervisor before specifying the problem with which the learner needs help	7	2	3	3	0	15
Application of guidelines	A help to understand where to find and then apply information may generate CRL [2]	2	1	1	0	0	4
Performing a procedure with a senior colleague and receiving feedback <sup>a</sup>	The feedback helps the learner to understand and remember the procedure	1	2	1	0	0	4
Total observed social interactions	-	11	5	8	7	2	33

CRL = co-regulated learning; FGD = focus group discussion; ms = medical student; paed = paediatrician; res = resident.

a) This was noticed during observations and FGDs.

**TABLE 2** Number of participants in the three focus group discussions. No one participated in more than one focus group discussion. Saturation was reached as we gained no additional information during the third focus group discussion.

Focus group	Medical students		Residents		Total
	men	women	men	women	
No. 1	1	1	1	1	4
No. 2	1	2	0	1	4
No. 3	1	0	1	2	4
Total	3	3	2	4	12

In step 1, we observed that CRL occurred daily and during all types of activities (outpatient clinic, rounds, etc.)

Being questioned by colleagues is extremely important in the learning process (1-4, Table 3). Also, feedback based on the supervisor's observation facilitated learning (1 and 2, Table 3) as it addresses the importance of CRL: the focus on social supervision. Learning is enhanced by a supportive work and learning environment (3-8, Table 3). In addition, some medical students found it difficult to work independently and mentioned the benefits of dyad work (9, Table 3). Therefore, working in dyads may be a stimulating factor for CRL. There was agreement within all FGDs that bimodal presentation of emergency cases at the morning conference created social learning situations (10 and 11, Table 3)

**TABLE 3** Stimulating and inhibiting factors of co-regulated learning and citations that underpin these. Only influencing factors mentioned in  $\geq 2$  focus groups are mentioned.

CRL	Citations
<i>Stimulating factors</i>	
Observation and feedback from supervisor	<p># 1: <i>Direct observation: A learner needs guidance to find information on haematuria</i> The moderator asked: "Did you learn differently when guided to find the general instructions than if you had been given the answer?" Resident 1 answers: "Yes, because I have looked for the instructions myself, and couldn't find them. Now I can use this information later"</p> <p># 2: <i>FGD, medical student 2</i> "A supervisor asked how to inform a patient before actually doing so. It means, I have primed my memory to learn because I know important information is coming"</p>
Supportive learning environment	<p># 3: <i>FGD, medical student 4</i> "Supervision and the fact that it is okay to ask questions mean a lot to me during learning"</p> <p># 4: <i>Direct observation: A learner's 1st lumbar puncture supervised by a colleague. Afterwards, the supervisor gave feedback</i> The moderator asked: "What did you think when you were given feedback?" Resident 7 answered: "The feedback helped me understand the procedure better"</p> <p># 5: <i>FGD, resident 6</i> "Generally, all votes count. At the morning conference, a culture exists that it is okay not to know everything and to ask for elaboration or advice. This trust helps you learn and makes it easier to succeed"</p> <p># 6: <i>FGD, resident 3</i> "It is always nice to have good colleagues to support you. It makes hard situations easier to deal with"</p> <p># 7: <i>FGD, medical student 5</i> "There are many situations, where CRL may occur during patient video cases, the daily work in the clinic and dyad work. The department is very good at making learning situations relevant for us"</p> <p># 8: <i>Direct observation: A 1-year-old girl with insufficient growth. A supervisor explains to a resident why it does'nt make sense to measure IgF1 and gives an instruction</i> Resident 5 said: "I need to read more about IgF1 and children in the instruction later during the shift"</p>
Dyad work	<p># 9: <i>FGD, medical student 3</i> "It is easier to give feedback when you work together for a period. You see the progression and that helps you give better and more operational feedback. Also, it creates a safe and not overloading way to learn"</p>
Repeated application of structured, interactive presentation of cases (today's case)	<p># 10: <i>FGD, resident 2</i> "Today's case is a good and different way to learn. The stepwise presentation gives opportunities to think and thereby consider many different diagnoses"</p> <p># 11: <i>Direct observation: Talking about today's case after the morning conference</i> Medical student 8 said: "The buzz group made me learn as I could think the process over by myself at first before others provided their input"</p>
<i>Inhibiting factors</i>	
Time pressure and heavy workload	<p># 12: <i>FGD, resident 2</i> "If I am at the emergency department on a busy day, my focus is on discharging or admitting patients - not on my learning"</p> <p># 13: <i>FGD, medical student 3</i> "Time is a factor. Not because this department has a stressful or busy environment, but the more patients we attend the less time we have for each"</p>
Shortage of specialists	<p># 14: <i>FGD, resident 5</i> "There can sometimes be ,fights' about gaining the attention of the specialists"</p> <p># 15: <i>FGD, resident 3</i> "Sometimes I can get a feeling of lacking supervision because of a shortage of paediatricians"</p> <p># 16: <i>FGD, medical student 3</i> "It is not always you can find a supervisor who subspecialises in the patient's main problem"</p>

CRL = co-regulated learning; FGD = focus group discussion.

Inhibiting factors of CRL included learning under a heavy workload or under time pressure ( 12 and 13, Table 3). Finally, during the FGDs, logistical problems were mentioned repeatedly due to situations with a shortage of specialists ( 14-16, Table 3).

## DISCUSSION

This study aimed to improve our understanding of CRL among medical students and residents and our understanding of factors affecting CRL. The results showed that CRL occurred in various situations at the workplace among specialists, residents and medical students. CRL occurred in interaction between two or more people. It occurred during all types of activities (outpatient clinics, rounds, etc.) and at meetings with people at

all levels of education (medical students, residents and paediatricians).

The study revealed a set of factors affecting CRL. The primary stimulating factors were a supportive learning environment, feedback based on observation and questioning by a supervisor. Achieving this requires effective supervision which is stimulated by joint reasoning [3, 5, 18, 19]. Obtaining supervision, discussing a patient at a conference or asking a colleague for help will help you learn more if you have already considered problems and questions by yourself and thereby primed your memory beforehand. These findings are in line with those reported in previous studies [1, 6, 7], which showed that feedback serves as reinforcement in CRL. Furthermore, bimodal presentation of emergency cases at the morning conference and dyad work are examples of situations where CRL occurred [4].

These findings are in line with the findings by Hadwin et al. [7] as they are highly interpersonal interactions. This may support the notion that the social aspect of learning has greater importance than suggested by Zimmerman [2] and it is in line with the definition of informal learning launched by Eraut [9]. Conversely, the major inhibiting factors of CRL were time pressure and shortage of specialists. As many other studies have found that time pressure is an inhibiting factor for SRL, it is no surprise that time pressure is also an inhibiting factor for CRL [3, 19].

All the mentioned affecting factors had an impact on medical students' and residents' CRL. The lack of difference between the two groups may possibly be explained by the limited number of participants. Conversely, the factors may have affected both groups and the difference in learning may be associated with differences in the learning strategies and learning goals [3].

A learner focus on SRL and CRL may increase both groups' ability to become lifelong learners as effective learning requires an understanding of various learning strategies depending on the time pressure and the setting [5]. We know that social interactions and communication may stimulate learning [10, 12], and guidance in active learning is needed [10]. The learner needs real-life work-based activities and a beneficial learning environment to stimulate the learning process [3]. The findings in this study support that CRL in workplace learning may occur in almost every interaction with others if stimulated appropriately. To enhance CRL, the departments need to provide learners with opportunities to develop their generic skills in active learning [1]. Longitudinal clerkships for medical students may be more effective than short-block rotations as they may better create a supportive learning environment by minimising shifts to new departments [5]. Having a mentor or coach has been shown to have a positive effect on SRL and may also be beneficial for CRL [3]. To enhance CRL further, departments and supervisors should focus on specific feedback on observable behaviour after a specific situation rather than focusing on overall goal settings [1, 6].

A main strength of this study is the explorative two-step approach: 1) observation of authentic behaviour with a report of associated cognitive processes and 2) deeper analysis of influencing factors by FGD. The personal approach to the invitation and the fact that every participant was invited one week before the FGD and received a personal reminder on the day of the FGD also strengthened the study [16]. Reaching saturation during the third FGD was also a strong point [14]. Interviewing medical students and residents in an actual department of paediatrics was another strength as it enhanced the ecological validity of the study.

This study also carries a number of weaknesses. All data were collected at a single paediatric department and therefore generalisability is a concern [14]. The departments of paediatrics affiliated with the University of Aarhus share professors, associate professors and learning goals for medical students and therefore may have partly similar learning environments. Thus, the results of this study may be generalisable to other paediatric departments if they use the mentioned learning situations (dyads, bimodal presentation of emergency cases at the morning conference, questioning and feedback based on observations). Another weakness is the limited

sample of only 12 participants in total in the FGDs. Furthermore, in the nature of FGD, all data from the participants are narrative and may have been affected and biased by other participants [16]. We counteracted this effect by trying to establish a safe and trustful environment during the FGDs.

Participants might be unwilling to speak their minds freely if they feel that what they say can be turned against them [14]. We attempted to counteract this problem by maintaining an emphasis on anonymity. CRL is an abstract theoretical construct that may be difficult to understand and talk about in practical terms. This means that CRL may be underreported in daily work [5]. Furthermore, it is a weakness that we did not attempt to assess the nature of CRL among staff faculty in this study: However, this may be a relevant challenge for subsequent studies.

## CONCLUSION

This study suggests that CRL may occur in multiple daily clinical activities and may be affected by a range of factors. Three important stimulating factors were identified: a supportive learning environment, feedback based on observations and questioning by a supervisor. Important inhibiting factors were time pressure and a shortage of specialists. However, the research questions need to be examined further in departments with diverse learning environments and possibly other types of learning situations to build a more complete understanding of CRL.

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