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There is more than 'I' in self-directed learning: An exploration of self-directed learning in teams of undergraduate students

Tamara E. T. van Woezik[a] (ID), Jur Jan-Jurjen Koksma[b] (ID), Rob P. B. Reuzel[a] (ID), Debbie C. Jaarsma[c] (ID) and Gert Jan van der Wilt[a] (ID)

[a]Radboud Institute for Health Sciences, Radboud University Medical Centre, Nijmegen, the Netherlands; [b]Radboudumc Health Academy, Radboud University Medical Centre, Nijmegen, the Netherlands; [c]Lifelong Learning, Education and Assessment Research Network (LEARN), University Medical Center Groningen, Groningen, the Netherlands

ABSTRACT

Preparing future professionals for highly dynamic settings require self-directed learning in authentic learning situations. Authentic learning situations imply teamwork. Therefore, designing education for future professionals requires an understanding of how self-directed learning develops in teams. We followed (bio-)medical sciences students ($n = 15$) during an 8-month period in which they worked on an innovation project in teams of 4–6 students. Template analysis of 39 transcripts of audio-recorded group meetings revealed three mechanisms along which group dynamics influenced self-directed learning behaviour. First, if expressions of emotions were met with an inquisitive response, this resulted in self-monitoring or feelings of responsibility. Second, openness in the group towards creativity or idea exploration stimulated critical thinking. Third, disputational talk frustrated learning, because it adversely affected group cohesion. We conclude that emotions, openness, and relatedness are important drivers of self-directed learning in teams and hence should be given explicit attention in designing collaborative learning for future professionals.

Introduction

Lifelong learning has become an important aim for higher education, especially in training for complex professions such as medicine (Mahan and Clinchot 2014; Delany et al. 2016). The medical curriculum often includes the development of a critical and reflective attitude that is needed for self-directed professionals in their highly dynamic field (Miflin et al. 2000; Murad et al. 2010; Chitkara et al. 2016). Self-directed learning is best promoted in authentic learning situations, meaning that the learning situation reflects professional practice (Jennings 2007; Goldman et al. 2009; Taylor and Hamdy 2013). Authentic learning in medicine means, among other things, that students work together in teams, a setting that professionals will often encounter. Self-directed learning is probably fostered in this setting, because learning in a social environment will stimulate discussion and reflection (Bolhuis 2003). Understanding more about how self-directed learning develops in teams could help designing for education in a collaborative setting. Before we elaborate on this aim of our study, the concepts of self-directed learning and authentic learning will be explained in more detail.

Self-directed learning (SDL) is commonly defined as the (1) ability and (2) attitude of students to develop and pursue their own learning objectives and to evaluate their learning process and results (Knowles 1975; Candy 1991; Taylor and Hamdy 2013). First, in terms of cognitive ability, SDL is closely related to self-regulated learning (SRL), which

Practice points

- In teams, openness and relatedness foster self-directed learning.
- Openness towards ideas stimulates critical thinking.
- Interpersonal behaviour and group cohesion promote self-directed learning.
- Disputational talk adversely affects group cohesion and learning.
- Teachers can aid in positive group process by asking reflective questions.

is a way of learning that helps learners to complete predefined learning goals that are usually set for a certain course. SRL involves learning strategies such as critical thinking and elaboration, and monitoring the learning process, as does SDL. SRL and SDL differ in the sense that SDL involves more long-term processes often overarching a course, and therefore translates to an attitude towards learning (Sandars and Walsh 2016). SDL includes goal setting, and self-monitoring to evaluate and steer the learning process (Lloyd-Jones and Hak 2004). Moreover, SDL may entail several learning strategies, but is considered flawed when critical thinking and meta-cognitive self-regulation are absent (Candy 1991).

Second, what is referred to as the attitude for SDL consists of some characteristics and behaviour that seem important for the development of SDL in the individual learner (Guglielmino 1978; Fisher and King 2010). We define this attitude in terms of affect, openness and motivation. Affect means to be in touch with your emotion or to show behaviour that is connected to emotions. Affect can have a positive influence on SDL when it involves interest or excitement, as well as negative influence in case of negative feelings such as anxiety (Brookfield 1995; Meyer and Turner 2002; Redwood et al. 2010). Second, openness in terms of being open to experience, having a growth mindset, and being creative is shown to be important to stimulate critical thinking and self-evaluation which are needed for SDL (Mercer 2011). Lastly, motivation in terms of intrinsic motivation is important for setting learning goals, which, as mentioned above, is key for SDL (Abd-El-Fattah 2010; Stockdale and Brockett 2011).

The ideas of learning in an authentic context and social context are closely related (Yardley et al. 2012). First, SDL is promoted by means of authentic learning situations, which often include working together in teams. Educational formats aimed at strengthening SDL such as projects, simulations or problem-based learning all involve a social component. Important to SDL in authentic learning situations is that social interaction determines learning because of the influence on individuals' affect and motivation (Johnson and Johnson 2009). Second, one could argue that all leaning is social (Thoutenhoofd and Pirrie 2015). Hence, SDL may be conceived as a means to come to an understanding of the world, while constructing knowledge in relation to this world (Li et al. 2010). An important implication is that context constitutes the development of SDL. That is, the self-directed learner is embedded in organizational structures and groups.

In spite of this, studies of SDL have long focused on the individual learner (Merriam 2001). This individualistic approach to SDL poses some problems, given that a learner does not work nor act individually (Schmidt 2000). Previous studies on SDL show that the social environment could play a role in SDL development (Levett-Jones 2005; Lee et al. 2010). For learning in general, we see that social mechanisms influence learning processes and outcomes through their impact on psychological safety (Beachboard et al. 2011; Hommes et al. 2014). For instance, outcomes of team activities are influenced by social dynamics because these can deter or increase motivation and depth of discussions (Dolmans and Schmidt 2006). Moreover, research on working in teams shows that social processes influencing openness remain throughout a professional career (de Groot et al. 2014). Therefore, SDL of the individual learner may not be easily generalized to the group learning process and outcomes in education (Hommes et al. 2014).

If we want to make sure that future medical professionals do use SDL when they work in teams, we should start with that in medical education. A way forward is to understand more about how learning develops within teams. If we want our students to be self-directed learners, we need to take into account both formal mechanisms such as study time and schedules, as well as social mechanisms such as group cohesion and psychological safety in teams (Hommes et al. 2014). Understanding how SDL behaviour of individuals is influenced by group dynamics will help

teachers and educators to properly guide students towards learning in a team. In this exploratory research project, we, therefore, explored how SDL develops in students learning in small groups.

Aim of the research project

We pursued two aims. First, we wanted to describe students' SDL in small group learning, in the context of medical education. Second, we aimed to explore how group dynamics impedes or promotes SDL behaviour in small group learning.

Method

Context

In this study, we choose to investigate SDL in the context of the so-called 'Innovation project', where first year students of medicine and biomedical sciences of the Radboudumc, Nijmegen, the Netherlands, over an 8-month period work in teams to identify and define a health(care) problem, and develop an innovative solution to it. To be able to do so, they need to engage with stakeholders in the field (physicians, patients, industry, healthcare management, etcetera), which ensures that the Innovation project closely resemble an authentic situation. Importantly, the project assignment comes without detailed predefined guidelines; students manage their own projects and hence direct their own learning processes. This setting is suitable for our research on SDL in groups, because it requires group work, goal setting and monitoring over a long period of time.

Teams consist of 4–6 students and 45% of the teams are mixed teams with both medical and biomedical students. Teams are free to choose a topic for innovation, which is commonly based on their own ideals and ideas, or encounters with health(care) problems of relatives or friends. For example, a group of students designed a game to help children remember their asthma medication. Another team designed a device to help patients who need eye medication to better position the dispenser and control the dosage. They collaborate with real-world partners, perform a context analysis based on stakeholder interviews and try to realize part of their innovative idea. Students need to use SDL strategies: they reflect on their experiences and effectiveness, and on this basis they identify learning goals for the meetings that relate to their long-term goals for the entire project. In the end, each team delivers an innovation in the form of a prototype or model. In addition, they write a group report explaining their innovation, and they individually write a reflection essay about their own learning process and the group process. The final grade for the project is based on the results of both the report and the essay.

Guidance is available from teachers with some expertise on the student's topic, the so-called 'Innovation-experts', whom students can approach for support. This person also grades their final project and the group process at the end of the course. Next to that, the students find a 'Customer' in the real world: a company or individual stakeholder in the area of the innovation and thus can inform or help the students with the development of their innovation. To guide the students during the project, they can participate

in workshops once a month throughout the course. Workshops include: Belbin roles to help understand roles in teamwork (Belbin 2014), stakeholder analysis, interviewing skills, and project management.

Selection and recruitment of participants

During the first workshop of the Innovation project course in November 2016, we invited all students to participate in this study and be observed during team meetings throughout the 8-month project. We wanted to intensively follow the groups of students, so to make sure a researcher would be able to attend most meetings of the student teams, we aimed to include at least three teams and a maximum of seven teams. Students were only recruited if the entire group agreed to participate in the study. They filled out an informed consent form and received contact information of the first author. Students then approached the first author via e-mail or WhatsApp, to keep her updated about their appointments. When the first author did not hear from the students for more than a month, a reminder was sent along with the question whether they still wanted to participate in the research project. During the group meetings of the students, the first author made audio recordings of the conversation and kept short notes. Permission to make recordings of the group meetings was asked beforehand and the start of each recording was always explicitly mentioned to the students. The protocol for this study was approved by the ethical review board of the Netherlands Association for Medical Education (NVMO), file number 677.

Data collection

This research was set up as a qualitative study, based on audio recordings. This study followed the guidelines for qualitative research of Giacomini and Cook (2000). Following previous research, we expected most of the learning behaviour to occur explicitly (Chi 2009). Since some aspects of the group process may not manifest themselves verbally, such as a frown indicating disagreement or a hum indicating a moment to pause for reflection, the first author was always present to make additional observations. The audio recordings were transcribed before analysis, including breaks and hesitations. Student names were replaced by numeric identifiers. The students' voices were traced to make sure each student had the same identifier throughout the transcripts. This way, we could follow not only the group, but also the individual student in the group over time, to see patterns in group dynamics and students taking on roles or changing roles.

The student teams met once every 2 weeks on average, with short peak moments when some of the teams met two times in 1 week, especially in the beginning and at the end of the project. During the meetings, students could have several activities: they may discuss the progress of the project, share information, make plans, set appointments, experiment with ideas, write on their report, spend time getting to know each other, complain, share hardship, etc. We recorded 39 meetings of the students in total, which amounted to over 23 h of recorded time. The students had some more meetings, but those were on times when the researcher could not be present or the meeting

of different groups was overlapping. For reasons of being minimally intrusive, we decided to let only the first author (TW) make the observations.

Data analysis and template development

We used template analysis to code and structure the data (Waring and Wainwright 2008; Brooks and King 2012), which led to the template displayed in Supplementary Appendix. Template analysis is a method that can be adapted to different epistemology and ontology (Braun and Clarke 2006; Brooks et al. 2015). A social constructivism paradigm was employed to frame the results. From this point of view, SDL is conceptualized as a means to come to an understanding of the world, while constructing knowledge in relation to this world (Li et al. 2010). Given this epistemology and in line with our research aims, a major concern is how the social context constitutes the development of SDL (Thoutenhoofd and Pirrie 2015). This means that the focus was on interactions between students and episodes in their conversation, instead of individual learning behaviour. Since data were collected when the participants were in a conversation, the codes reflect this interaction. For instance, 'Emotional guidance' is a code reflecting a reaction on someone's expression of emotion, and 'Planning and implementation' took place in group discussions, not individually.

A first version of the template was initially developed in a separate pilot study in the same course 1 year earlier, which was similar to the present study and conducted in the context of the Innovation project as well. This template was initially constructed through open coding of three transcripts. These codes were then aligned to literature by taking the definitions of SDL and related learning behaviour from different questionnaires: MSLQ (Pintrich et al. 1993), SDL-SRS (Fisher and King 2010), SDLRS (Guglielmino 1978), PRO-SDL (Stockdale and Brockett 2011); and literature: Brookfield (1995), de Groot et al. (2014), Lloyd-Jones and Hak (2004), Meyer and Turner (2002), Redwood (2010). This resulted in an initial codebook of 43 codes.

In the next step, the transcripts of the current project were read, and reflexivity notes were kept. After becoming familiar with the data, two researchers (TW and a colleague with an educational background but no formal affiliation to the project) coded four transcripts by use of the template. Differences occurred for quotes relating to motivation or goal-setting behaviour. Discussion about these differences resulted in, for instance, adding a code 'Self-concept' to acknowledge that students contemplated whether they would be able to complete the project or other learning goals. Another example is removal or adjustments of some codes: We decided, for instance, to use 'Love of learning' and removed the closely related 'Desire for learning'. Next, the template was used by TW, JK and GW for three additional transcripts. Remaining differences in coding were discussed and settled (TW, JK, RR, GW). This led to the final version of the template. All 39 transcripts of group meetings were coded using this template.

We used Atlas.ti® software version 8 to code and analyse the transcripts. To understand more about the processes, we conducted a sequencing analysis in Atlas.ti. This method helps to understand what the most prominent

relations between the different codes are. The group's final grades for the project report, the reflection report and final grade for the course were also taken into account.

Reflexivity

The authors JK, RR, GW and TW all had an active role in the Innovation project as teachers and sympathized with the ideology of the course. For JK, RR and GW, the Innovation project was an idea that they had piloted in a smaller setting, before the project became an integral part of the (bio)medical curricula. Scaling up to the entire student population did involve some compromises, such as departing from assignments set by clients, but that did not influence their commitment. AJ as researcher was not involved in the Innovation project but affiliated with the larger research project. A social constructivist paradigm guided us in the process of meaning-making. This includes that we think that both the interactions in the transcripts, as well as the meaning we give to the transcripts, is co-created. The environment and learner influence each other, but also the researcher and his/her environment influence each other. To give insight into how this meaning is constructed, we think it is important to show parts of the transcripts and explain how we interpreted this.

Results

Participants and gathered data

Three groups of students agreed to be part of this project. They contacted the researcher when they had a meeting. A description of the groups can be found in Table 1. Two out of the three groups were mixed teams with both students from biomedical sciences and medicine. One team consisted of only medicine students. The percentage of males (26%) and the percentage of medicine students (66,6%) was comparable to the larger student population with 30% males and 65% students of medicine.

We coded 39 transcripts in total and could code about 34.19% of the text with our template. The other parts of the text involved small talk: things that happened with the students the day before or what would happen the next day(s). Topics they would talk about were food, friends, problems with public transport, or other topics that evidently were not related to the project, the team, and learning in general. Discussions that did relate to learning, e.g., about other courses or their busy schedule, were coded. Table 2 summarizes how often the groups were observed.

Furthermore, students appeared to have talked freely as many recordings involved social talk or gossip, which would probably not occur had the students been highly alert about the recordings or the presence of the researcher. They usually did not engage the researcher in their conversations, although sometimes they would ask about the research or how the researcher was doing. At some points students reminded one another or themselves about the recordings, as can be seen in Transcript 1.

Transcript 1.

	R1: Oh, all that reflection, you get so tired at some point, if you do that all day. It makes me cranky. You are just making stuff up-
	R3: Yes, exactly! It's all a load of bullshit - R5: Yes. R1: Yes. I mean, I can have a conversation here and be sincere, but if I have to put it all on paper, I'm basically writing the same thing over and over - R3: Yes, and then every time the story repeats: 'What kind of impression' - R1: Here we go again.
Research	R4: This is all being recorded, guys! [laughs]. R3: Thanks a lot.. Well, let them hear it!

Description of SDL in small group learning

The first research aim was to understand the degree to which SDL occurs in the context of small group learning. An overview of the codes in the template is displayed in

Table 1. Description of groups.

Group	Respondent	Sex	Study	Rating project	Rating reflection report	Final grade (out of 10)
1	R1	Female	Medicine	Adequate	Good	7
	R2	Female	Biomedical sciences	Adequate	Good	7
	R3	Female	Biomedical sciences	Adequate	Good	7
	R4	Male	Biomedical sciences	Adequate	Adequate	6
	R5	Female	Biomedical sciences	Adequate	Adequate	6
	R6	Male	Medicine	Adequate	Adequate	6
2	R7	Female	Medicine	Good	Adequate	7
	R8	Female	Medicine	Good	Good	8
	R9	Female	Medicine	Good	Good	8
	R10	Female	Medicine	Good	Adequate	7
	R11	Male	Medicine	Good	Adequate	7
3	R12	Female	Medicine	Good	Good	8
	R13	Female	Biomedical sciences	Good	Excellent	9
	R14	Male	Medicine	Good	Good	8
	R15	Female	Medicine	Good	Adequate	7

Table 2. Number of recorded group meetings per month.

	2016 November	December	2017 January	February	March	April	May	June	July	Total
Group 1	2	3	0	1	2	0	1	4		13
Group 2	1	1	1	0	0	1	2	2		8
Group 3	1	2	1	2	0	4	3	4	1	18
Total	4	6	2	3	2	5	6	10	1	39

Table 3. Occurrence of categories in percentages, in all sessions, per group.

Category	Group 1	Group 2	Group 3
Self-monitoring	13.05	9.81	17.45
Knowledge acquisition	11.65	13.35	12.04
Interpersonal behaviour	9.87	21.45	12.73
Affect	9.72	8.85	9.49
Critical thinking	6.70	8.37	8.38
Openness	6.53	7.24	6.02
Disputational talk	5.82	3.70	2.65
Education context	4.76	3.86	3.77
Motivation	3.00	3.69	5.30
Self-concept	2.65	2.90	3.06
Responsibility	2.47	2.74	1.74
Organisation	1.76	1.45	2.86
Other	22.02	12.59	14.51
Total	100.00	100.00	100.00

Table 3. This table also shows the degree to which the codes have been recognized in the different groups, expressed as a percentage of all quotations of each group. A more detailed overview of the template can be found in Supplementary Appendix. *Self-monitoring*, *knowledge acquisition* and *interpersonal behaviour* were coded most often.

Group dynamics and SDL

The second research aim was to understand more about the way group dynamics promote or impede SDL in small groups. The sequencing analysis in Atlas.ti shows many relations, for instance *self-monitoring* (e.g., what do we need to know?) and *critical thinking* (e.g., is that assumption valid?) are often seen to induce *knowledge acquisition* (e.g., using different sources of information to learn), but this is also the case for *responsibility* (e.g., a student feeling he or she needs to do something). These relations are not unidirectional: students can go back and forth between the different kinds of behaviour. For example, expressing feelings of stress (*affect*) may lead the students in a group to discuss this and support one another (*interpersonal behaviour*), whereas direct questions for feedback about the group processes (*interpersonal behaviour*) may lead to sharing feelings of stress or frustration (*affect*). In view of the aim of our study to identify mechanisms of SDL, we have focused on relations where group dynamics influenced this kind of learning as captured under *self-monitoring*, *knowledge acquisition*, and *critical thinking*. We also included mechanisms by which the individual had an influence on the team in terms of SDL. On this basis, we have identified three main mechanisms, where:

1. Affect induces interpersonal behaviour leading to self-monitoring or responsibility
2. Openness sustains critical thinking
3. Disputational talk frustrates learning.

We explain these mechanisms in greater detail below.

Affect and interpersonal behaviour

Affect tends to show in the groups of students by expressing emotions of stress or anger. Students show their emotions in the group by talking about the stress they experience, their fears about the outcomes of the project, or how they sometimes lose motivation. The reaction to these remarks differs and varies between the groups of students. In some groups, the reaction is mostly personal and targeted

at making someone feel better. In other groups, the reaction is mostly directed towards the learning process. Usually affect marks the start of a SDL process, with both kinds of reaction leading to SDL behaviour in the end.

For instance, in one group a student tells that she has trouble staying motivated for the project. She is upset about this, because she does not enjoy the project, whereas her peers are enthusiastic about it. Moreover, the group has become quite close, having dinner together and meeting up outside university. When the student speaks up about her problem, the group follows up on that by exploring what is going on exactly. They then come to a conclusion about how they can help the student. This way the group assumes a shared responsibility, as seen in Transcript 2.

Transcript 2.

Motivation	R15: But that was my role, you know, with the [Belbin roles]- [..] it said: 'Doesn't get motivated' or so.
Responsibility	Then I thought: 'Yes, that's right'. Rest: [laughs].
Critical thinking	R13: But when you're working, do you like it, or do you think, like: 'Oh, what am I doing?'
Affect	R15: No.
Affect	R13: You don't like it? Well, that sucks.
Affect	R15: But that's why it's difficult for me to start it. R12: Yes.
Responsibility	R15: That's why I need a strict plan.
Interpersonal behaviour Responsibility	R13: But could we give you a task for instance, like: you absolutely need to finish this?
Affect	R15: Yes. That would be nice [laughs].

In another example, a student also mentions a loss of motivation, and implies that she misses the pressure from a deadline. She is also upset about not being motivated. Despite her comment, she does convey feelings of pressure in her tone of voice. The group reacts by mimicking the feelings and offering a variety of solutions. They then go on to decide on the next steps to take in the project. In this case, the reaction of the peers is focused on the learning process rather than the personal problem. The conversation is shown in Transcript 3.

Transcript 3.

Affect Motivation	R2: But I don't feel any pressure to work hard, because it's not close yet.
Self-monitoring	R3: Yes. Also, we still don't have a point, or problem.
Openness	R1: But that doesn't really matter, we can just brainstorm a little bit.
Self-concept	R4: But at least it's good that we are doing things, it will help us later.
Education Context	R2: Yes, it certainly will. But we need to make sure that we somehow get in touch with people that know more about this than we do. R1: Networking, networking. R2: Yes, exactly.

Openness sustains critical thinking

The second mechanism involves openness and critical thinking. In Transcript 4, one of the students is questioning the results of their literature search by relating it to her own idea about the topic and trying to make sure they have not missed out on information (critical thinking). It also involves some remarks that relate to openness, as students try to imagine what it would be like and experiment

with some thoughts on that. Thus, the transcript shows how *openness* and *critical thinking* reinforce each other.

Transcript 4.

Openness	R8: Yes, it's the same thing with diabetes.
	R9: Yes, exactly.
Openness	R8: Then you must inject at 12 o'clock in the middle of class, and that's uncomfortable.
Critical thinking	R9: Yes. No, exactly. Injecting is worse than inhaling, in that regard. But it's weird that you can't find much about that. I would expect for diabetes- did you check PubMed by any chance?
	R8: Yes, me too. No, not PubMed.
Self-monitoring	R9: Maybe we can take time to do that.

Sharing information and combining different sources of knowledge is seen in Transcript 5. This exemplifies the relation between *knowledge acquisition* and *critical thinking*, and that *openness* plays a role in this as well. Transcript 5 shows a student expressing critical thinking. The reaction of the other group members starts with knowledge acquisition and turns into openness.

Transcript 5.

Knowledge Acquisition	R10: Yes, they [asthma patients] get anti-inflammatory medication for short periods of time, and then that passes. And then well, they [GP's] don't follow up on that.
Critical thinking	R9: Where did you get this information?
Knowledge acquisition	R10: Lung foundation.
Critical thinking	R9: That is interesting. Because, I mean, if it would be that simple to adjust that.
Knowledge acquisition	R10: Yes, but I do think this only goes for children.
	R9: Yes.
Knowledge acquisition	R10: Because it's more about the fact that they are not diagnosed yet, I think.
Critical thinking Openness	R9: And do you know in which situation- because you found way more than us regarding that, but do you know in which situations they are noncompliant? When they are at school for example? I mean, the parents pay attention to it of course.
Openness	R10: Yes- yes, I think the problem here is that the doctors don't prescribe it for long enough, so then the children stop it. And if they come back, they simply get a new treatment.
Critical thinking	R9: But you would think that parents keep an eye on that.

Disputational talk frustrates learning

The third mechanism concerns disputational talk, which is an interaction that stops the line of thinking, in this case, in a learning process. Students often perceive problems with the organization of education. For instance, when they cannot upload a file to the digital learning environment, or when they try to arrange a meeting, but the schedules of the individual team members leave no opportunity to do that. This may result in feelings of frustration and ultimately escalate in not being able to focus on the task at hand anymore. The next transcript illustrates how the conversation goes from planning to disputational talk. In this case, the students feel overwhelmed by the amount of work they need to do and feel time pressure. The students do not come back to planning for the final report, nor to scheduling a feedback moment.

Transcript 6.

Self-monitoring	R10: Yes, we must arrange how we will go about the report and everything …
	R8: Do you want to do that now, or?
Responsibility	R10: Yes, just here, I think. Of everything that needs to be done.
Self-monitoring	R9: Oh, and perhaps again- or well, maybe it's completely redundant, but another feedback moment?
Self-monitoring	R8: Yes, then we must see if we can make that work on time, otherwise we will just do it with the feedback form.
	R10: Yes, for sure.
Education context	R8: Yes, in any case, I think we must [use the form].
Self-monitoring	R10: But before June 9th? For Professionalism, that you have time to incorporate it and –
Self-monitoring	R8: Yes. I will write it down.
Self-monitoring	R9: When is Professionalism due?
Organisation	R10: June 9th, I think.
Disputational talk	R9: Then we have to hand it in already?!

How students can cope with frustration or other negative emotions also depends on the group. Some students are competent at sharing negative emotions and can move on after that. In other groups, when it comes to deeper emotional or social problems on either an individual level or group level, they tend to refrain from elaborating. Although students receive some consolation from their peers, they do not always discuss the causes or solutions, as shown in the transcript below. In this group, it ultimately escalated, because the students that felt stressed had the idea that the other students did not work hard enough or were not motivated for the project. This led to frustration and misunderstanding.

Transcript 7.

Affect	R2: Well, it wasn't that bad, but when I it kept me up at night, it did stress me out.
Affect	R3: Yes, I had that too!
Affect	R2: And then I couldn't sleep anymore.
	R5: R3, you are always –
Affect	R3: I am always stressed out. Don't get me started!
Disputational talk	R1: I never have any stress.

Discussion

To answer the question how students employ SDL in group work, we followed three project groups of students throughout one academic year. All groups showed SDL to some extent, but there were differences in terms of *self-monitoring* and *interpersonal behaviour*. If we want to guide groups in SDL development, we need to understand these differences. Therefore, the focus of the second research question was on group dynamics, trying to identify patterns of behaviour that could explain why SDL does or does not surface. The results of the present study suggest that a capability to share and discuss emotions (affect) and openness influence SDL positively in terms of self-monitoring and critical thinking, whereas disputational talk sometimes appears to inhibit this process.

Mechanisms

The first mechanism indicates that affect and interpersonal skills play a key role in the process towards SDL behaviour. It is important for students to acknowledge emotions as an

indicator of a problem that needs to be solved. This is in line with previous findings that affect is an important starting point for learning (van Woezik et al. 2019). The present study shows that affect can then lead to effective use of the time in terms of self-monitoring and critical thinking. This corroborates with the finding that emotion and emotion regulation are important for self-regulation (Lajoie et al. 2019). Affect may also indicate events that have meaning, which are necessary for intrinsic motivation and learning (Boyd 2002; Redwood et al. 2010). We did find however, that groups of students deal with this in different ways. Some groups may in fact disregard this signalling function of affect and not benefit from in terms of enhancing self-regulation or critical thinking.

We found that openness plays a role in sustaining critical thinking. It encourages thinking out of the box and elaboration which may lead to new perspectives helping to critically reflect on problems as well as possible solutions. Moreover, openness enables students to challenge group-think, which is in line with previous studies on critical thinking (de Groot et al. 2014; Koksma et al. 2017). These features of openness are in line with a growth mindset, meaning that learning is framed as a process where mistakes are not problematic (Dweck and Master 2008). In this study, we found that interpersonal behaviour is important for establishing such a growth mindset as well as sustaining openness and critical thinking in groups. These findings extend to professional teamwork, where more critically reflective dialogues take place in well-developed communities with high quality interaction (de Groot et al. 2014), and teams work more effectively with a positive affective learning climate (Jansen et al. 2019).

In this study, interpersonal behaviour seemed to vary between the groups. In two of the groups we observed, conversations about stress or other negative emotions led to asking questions and problem-solving behaviour. In the other group, the emotions were only discussed superficially. We saw that this last group fell back to disputational talk more often. Group cohesion appears to be key here: students who approach one another more personally and meet outside university establish a safe environment with room for sharing emotions, giving and receiving feedback, and critical thinking. Previous studies have shown that group cohesion indeed has an important influence on learning outcomes (Beachboard et al. 2011; Hommes et al. 2014). In fact, Beachboard et al. (2011) show that relatedness to both peers and teachers has a positive influence on critical thinking. Based on the present study, we therefore suggest that teachers invest in stimulating relatedness or cohesion in the groups. We know from other research that teachers could do so by stimulating (guided) reflection on the group process level as well as on the contents of the project (Jansen et al. 2019).

Another positive effect of interpersonal behaviour is that it may help to counteract disputational talk about organizational problems in the curriculum. We were surprised to see how much time students spent on talking about such organizational problems and the way these interfered with their learning. In situations with higher stress due to organizational issues, students appear more likely to be distracted or show negative interactions. This inhibits SDL behaviour, which is in line with earlier research (Magno 2010). However, one group

was successful in mitigating potential threats to their learning behaviour based on sharing emotions and reflexivity. Other groups did so to a smaller extent. These effects are in line with the theory on dialogue of Schein who argues that active listening and withholding judgment will help solve problems in teams most effectively (Schein 2003).

Reflections

Limitations of this study are that we could include only a small number of students, who voluntary enrolled in the study, which may have led to a selection bias. However, we have followed the students over a long period of time, which has enabled us to develop a profound image of their interactions and thinking. Moreover, the teams proved to be fairly different in terms of interaction and motivation. The fact that students sometimes openly criticized the project in itself and the curriculum as a whole suggests that the presence of a researcher and a voice recorder has not influenced their behaviour or attitude.

Based on our explorative study, we have been able to formulate some hypotheses regarding the mechanisms at work in small group learning that relates to SDL. We think more research from a social constructivist viewpoint could help to still better understand the interaction between the learner, peers, teachers, and the environment. Here, coping with emotions should be emphasized, as the present study underlines that it plays a large role in learning. This aligns with enactivism: a new paradigm of learning that stems from philosophy of mind, in which more focus is placed on emotion and embodiment in learning (Picard et al. 2004; Stephan et al. 2014; Maiese 2017). Using this paradigm, our model of interaction between group dynamics and SDL could be a starting point for further investigation, answering questions on mechanisms that underlie the effects of disputational talk, or the interaction between self-monitoring, responsibility and interpersonal behaviour.

Conclusion

In conclusion, we investigated SDL in small groups in an authentic learning environment. We moved beyond a focus on individual ability or attitude in SDL, finding important roles for affect and openness. Channelling affect in a positive environment will help to steer behaviour towards SDL. Openness, with relatedness to peers and teachers, plays a large role in this mechanism. First-year students are able to use reflection and interpersonal behaviour to their benefit. Teachers should help students acquire these skills and help them reflect on the group process by establishing a good relationship with the students.

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Glossary

Affect: A combination of emotions and feelings. These can be both positive (i.e., joy) and negative (i.e., frustration or insecurity). Both may have an impact on learning, described as metacognitive affect or affect. The relation between affect and learning may be explained by a physical or embodied approach to cognition.

Authentic learning environment: An authentic learning environment is a learning environment which exists (or may exist) in the real world. Both practice-based learning theory and self-directed learning rely on this type of environment for learning. Such an environment affords practicing skills and knowledge in complex circumstances, helping learners to understand the necessity and meaning of the issue they are learning about.

Notes on contributors

Tamara E. T. van Woezik, MSc, MA, is PhD candidate at the Department of Health evidence, Radboudumc Nijmegen.

Jur Jan-Jurjen Koksma, MSc, MPhil, PhD, is assistant professor at the Radboudumc Health Academy, Radboudumc Nijmegen.

Rob P. B. Reuzel, MSc, MPhil, PhD, is associate professor at the Department of Health Evidence, Radboudumc Nijmegen.

Debbie C. Jaarsma, DVM, PhD, is professor of Innovation and Research in Medical Education, University Medical Center Groningen, University of Groningen.

Gert Jan van der Wilt, MSc, PhD, is professor of Health Technology Assessment at the Department of Health Evidence, Radboudumc Nijmegen.

ORCID

Tamara E. T. van Woezik 🔵 http://orcid.org/0000-0003-1380-5070
Jur Jan-Jurjen Koksma 🔵 http://orcid.org/0000-0002-4682-1758
Rob P. B. Reuzel 🔵 http://orcid.org/0000-0002-7810-231X
Debbie C. Jaarsma 🔵 http://orcid.org/0000-0003-1668-2002
Gert Jan van der Wilt 🔵 http://orcid.org/0000-0002-5856-762X

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