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Regulating Emotions through Cogenerative Dialogues to Sustain Student Engagement in Science Internships: A Case Study

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Abstract: Open inquiry learning and student–scientist partnerships are two effective ways of enhancing students' science learning; however, due to their challenging and intimidating nature, students might encounter emotional breakdowns when engaging with them. To address communicative and emotional issues in high school students' internships with scientists, this ethnographic case study integrated a pedagogical tool called cogenerative dialogues (cogen), which are conversations cogenerated by different stakeholders to reflect on participants' experiences and help them reach collective decisions about the rules, roles, and responsibilities that govern their partnerships. Data sources include video recordings of internship activities, video recordings of cogenerative dialogues, students' journals and interviews, and researchers' field notes, pictures, and artifacts collected during the internship. Drawing on the emotion regulation framework, I demonstrate how cogen could be used as a powerful tool to reveal emotion suppression, share emotion regulation strategies, and transform negative emotions into positive emotions. The results of this case study show that cogen played an important role in addressing specific issues one at a time and sustaining student engagement throughout the internship program. The implications of cogen for sustainability and organizational health are discussed.

Keywords: emotion regulation; cogenerative dialogue; student–scientist partnership; science internship

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1. Introduction

Research has shown that the science, technology, engineering, and mathematics (STEM) workforce plays a critical role in strengthening the economy of the United States (US), but the nation does not have sufficient students who choose STEM for their careers [1]. Research has shown that the decline of students' science interests, motivation, and attitudes is a pervasive phenomenon among middle school and high school students [2]. Moreover, less than 40% of the students who enter college intending to major in a STEM field eventually complete a STEM degree [3]. The decline in student interest and the high attrition rate in STEM majors highlight the need for a higher quality of educational preparation and training to sustain student engagement in STEM education.

Next Generation Science Standards (NGSS) suggest that science inquiry is an effective way to help students learn scientific knowledge and practices [4] because it reflects how scientists study the natural world based on available evidence. Four different levels of science inquiry include confirmatory inquiry, structured inquiry, guided inquiry, and open inquiry [5]. In confirmatory inquiry, teachers guide the inquiry and provide a scientific question, experimental procedures, and even the results of experiments. Thus, in confirmatory inquiry, students just follow teachers' instructions without much student input. In structured inquiry, teachers provide a scientific question and experimental procedures, but not the results of experiments. Thus, students can follow procedures, and they engage in inquiry without knowing the answers beforehand. In guided inquiry, students are provided

with a scientific question but not the experimental procedures or the results of experiments. Therefore, students need to figure out experimental procedures and results on their own. In open inquiry, teachers do not provide much information but let students figure out a scientific question they are interested in, devise experimental procedures, and obtain inquiry results. Among the four types of inquiry, confirmatory inquiry is the practice that requires the least student autonomy and the most teacher guidance, while open inquiry requires the most student autonomy and the least teacher guidance. Thus, open inquiry is the process that mostly closely reflects what real scientists do. In the science community, scientists generate scientific questions based on their interests, design their experiments, and collect data to address their research questions. For students, open inquiry is the most challenging inquiry because it demands a high degree of student autonomy and self-directed learning during the inquiry process.

In addition to open inquiry, establishing a student–scientist partnership is another great way to help students learn science more authentically. Working at the elbow of scientists allows students to experience various dimensions of scientific work holistically, something that is rare and difficult to experience in schools. For example, students can observe scientists' thinking process closely, use state-of-the-art equipment firsthand, and experience the culture and norms of the science community. Research shows that working with scientists can increase students' scientific knowledge [6], enhance students' understanding of the nature of science and scientific inquiry [7], enhance students' attitudes toward and interest in science [8], increase students' confidence and self-efficacy towards science [9], and direct students' career aspirations towards science [10]. However, many challenges also exist in student–scientist partnerships. For example, students might feel intimidated by scientists [11]; scientists' use of jargon and complex scientific concepts could become a barrier to communication [12]; scientists' teaching practices might be ineffective [13]; and scientists might end up having disappointing interactions with students [14]. That is, although working with scientists may bring many benefits to students, it is likely that students will experience conflicting emotions during the process.

Both open inquiry and working with scientists hold great potential to enhance students' science learning. However, students may also encounter challenges and obstacles and experience negative emotions, such as uncertainty, confusion, frustration, depression, self-doubt, low self-esteem, discouragement, and disappointment. Research has shown that emotion plays an important role in influencing students' perception, attention, learning, memory, reasoning, problem solving [15], learning outcomes, and academic achievement [16]. How to help students digest negative emotions in the process of science inquiry, especially when conducting open inquiry with scientists, has become a topic worthy of investigation. Thus, more research is needed to find innovative approaches to assist students in addressing emotional issues that might impede their science learning. To address emotional issues that might arise in open inquiry and in student–scientist partnerships, this study integrated a pedagogical tool called *cogenerative dialogue*, which has great potential to enhance communication between high school students and scientists and sustain student engagement in the science learning process.

2. Cogenerative Dialogues

Cogenerative dialogues (cogen) are conversations among different stakeholders to reflect their collective experiences, with the goal of reaching collective decisions about the rules, roles, and responsibilities that govern their shared activities [17]. In cogen, participants are encouraged to speak up equally, listen to each other attentively, and respect opinions that might differ from their own. In a classroom environment, these different stakeholders may include students, teachers, researchers, administrators, and parents. Since cogen values equity, diversity, and respect, students are especially empowered to speak up freely to balance the power dynamics with other stakeholders. Participants may propose rules that would lead to equitable conversation during cogen, and consensus is sought among the group. Three basic rules of cogen [18] include: (a) each participant

has equal turns to speak, (b) each participant will show respect and listen attentively to the others, and (c) participants will collectively generate an action plan to address any identified issues. To improve students' learning in educational settings, teachers and student representatives may conduct cogen regularly (e.g., class time, lunch time, after school) to debrief previous teaching and learning practices, identify issues that might hinder students' learning, and brainstorm solutions and action plans that can address these issues. Cogen has been used to improve teaching and learning at different educational levels, including graduate education [19], college [20], high school [21], middle school [22], and elementary school [23]. Research shows that cogen can increase students' attendance, achievement on tests, and time on tasks [24] and direct student attention from individual to collective, shared responsibility in class [22].

In addition to benefiting students' learning, cogen can also help prepare preservice teachers and enhance in-service teachers' professional development. By conducting cogen regularly, preservice teachers can debrief their teaching practices with other stakeholders such as mentoring teachers, students, and principals. This feedback and discussion in cogen can help preservice teachers identify issues that impede their teaching progress and find strategies to improve their teaching practices [25]. Moreover, as part of in-service teachers' professional development activities, teachers may conduct cogen with researchers and instructors to improve their learning experience [26]. For administrative purposes, cogen can also be used as a constructive teacher evaluation mechanism, where administrators can conduct cogen with teachers to discuss the evaluation results and ways to improve teachers' teaching practices [27]. Importantly, research shows that cogen can greatly increase science teachers' reflexivity [28]. Moreover, due to the democratic and emancipatory nature of cogen, it can be used as a methodological tool for researchers to understand their participants' opinions and experiences [29]. In this study, cogen was deemed to hold potential to address communicative and emotional issues that might arise during high school students' open inquiry projects with scientists.

3. Theoretical Framework: Emotion Regulation

Emotional ups and downs are a normal feature of life. To take good care of their psychological health, people often draw on different strategies to manage their emotions. The emotion regulation framework [30] discusses how human beings manage their emotions either before or after certain emotion-stimulating situations. That is, people might have a goal to "influence the emotion trajectory" [31]. Normally, an emotion begins with evaluation of external or internal cues. These evaluations lead to response tendencies, which can be modulated before turning into a final manifested emotional response. Specifically, this process model of emotion regulation includes two major processes: *antecedent-focused regulation* (manipulating stimulus input) and *response-focused regulation* (manipulating stimulus output). Antecedent-focused regulation focuses on how people behave *before* the emotion-stimulating situation to regulate their emotions. In particular, antecedent-focused regulation involves four major strategies: (a) situation selection, (b) situation modification, (c) attentional deployment, and (d) cognitive change. *Situation selection* suggests that people will intentionally select a situation that will likely evoke a desirable emotion. For example, to avoid conflicts between work and family obligations, a salesperson might avoid working in the afternoon when they need to pick up their child. *Situation modification* means that people will change certain things in the situation to change its possible emotional impact. For example, if a salesperson notices many customers entering the store at the same time, they might call for extra help from colleagues in order to provide good service to all the customers. *Attentional deployment* refers to the way that people focus or refocus their attention on a certain aspect of a situation to influence their emotional responses. For example, when a salesperson encounters a rude customer, they might focus on tackling the challenge of selling a product to a difficult customer with enthusiasm instead of focusing on the customer's rudeness. *Cognitive change* means that people might reappraise or reinterpret a situation to alter its emotional impact. For example, instead of seeing a customer as a

rude person, a salesperson might reinterpret the customer as a person who might have just encountered some unpleasant events or suffered a personal loss. *Response-focused regulation* focuses on how people change the experiential, behavioral, or physiological components of their emotional response *after* their emotion is well developed. Take the salesperson above for example. If the salesperson felt any negative emotion, they might suppress and conceal their real feelings and fake their feelings (e.g., replace an upset face with a smile) in front of the rude customer. An illustration of the process model of emotion regulation framework can be found in Figure 1.

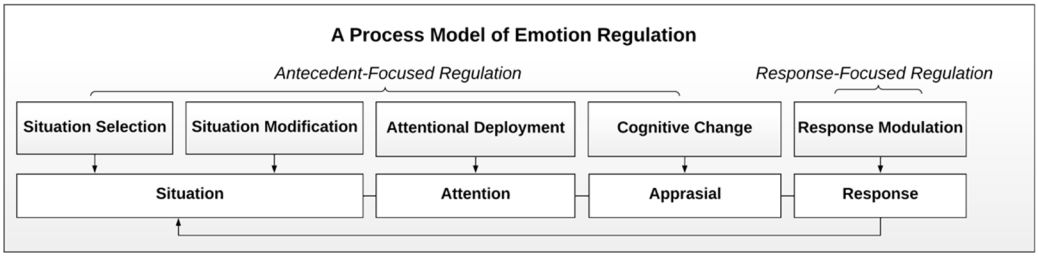

Figure 1. The process model of emotion regulation framework. (Adapted from [31].)

Typically, people regulate their emotions to decrease negative emotions and response tendencies and increase positive emotions and response tendencies. However, for instrumental goals, people might enact "counterhedonic regulation" [32], where they attempt to decrease positive emotions (e.g., trying to appear calm after a victory). The different emotion regulation strategies might impact people's psychological health and physical health differently. For example, *reappraisal* is often deemed as a good strategy to mitigate possible negative emotions and so enhance psychological health, whereas *suppression* might cause problems for physical health. Moreover, emotion regulation can be categorized as either *intrinsic* or *extrinsic* [33]. Intrinsic emotion regulation is when people set a goal of influencing their own emotional state themselves, whereas extrinsic emotion regulation is when people try to influence others' emotional state (e.g., playing peekaboo to make a child laugh).

4. Research Context, Cogen Practice, and Methods

4.1. Research Context

The Work with A Scientist Program was housed at the University of Texas at El Paso (UTEP), a southwestern university at the border of the United States and Mexico. The program was funded by the National Science Foundation to create seven-month-long science internships for high school students and to investigate the communications and interactions between high school students and scientists. High school students were recruited from three Title I high schools (in the state of Texas, "Title I schools" are schools that have more than 40% of students coming from low-income families). In total, 36 high school students were recruited to work with four scientists and their laboratory teams for seven months. In the Work with A Scientist Program, high school students were invited to conduct open-inquiry projects with the support of scientists. Open-inquiry projects require students' autonomy to complete all components of a scientific inquiry, including identifying a scientific question, reading literature, designing experiments, analyzing data, and communicating results to others. During the spring semester (Jan–May), high school students visited UTEP every other Saturday for three hours. For the first two hours, scientists designed lectures and hands-on activities to help high school students understand the basic knowledge and principles of scientific work. For the third hour, scientists and high school students conducted cogenerative dialogues to reflect on their internship work and address issues as a group. During the summer time (June–July), high school students came to UTEP every business day from 9:00 am to 4:00 pm, with a lunch break, for six weeks. Cogenerative dialogues were also conducted twice a week in the summer time to reflect on the quality of the internship and solve issues that occurred during the internship. In

the middle of June and at the end of July, respectively, the students were invited to present their research proposals and project results to the public, including the students' families and friends, school teachers and principals, scientists, and college students.

4.2. The Practice of Cogenerative Dialogues in the Work with A Scientist Program

In the Work with A Scientist Program, we provided training for conducting cogenerative dialogues (cogen) to three groups of participants: cogen mediators, science professionals, and high school students. First, the program director provided three months of training to four cogen mediators (one mediator to work with each scientist and group of students) who were trained educational research assistants. The role of these cogen mediators was to facilitate the dialogues between scientists and high school students. During the three months of training, these cogen mediators read research literature on the importance and values of cogen, discussed the possible benefits and challenges of conducting cogen in the Work with A Scientist Program, and conducted mock cogen sessions with one another. Next, the program director and cogen mediators provided a half-day training session to the four scientists and their research assistants. During the training session, the scientists and their assistants were informed of the rationale and rules of cogen and discussed any questions or concerns they might have about conducting cogen with high school students. Finally, the cogen mediators provided one hour of cogen training and introduction to high school students on the first day of their science internships. Throughout the program, the cogen mediators attended the science internship with their group of high school students, chaired the cogen sessions, and mediated the cogen conversations between the scientists and the high school students.

During each cogen, participants would follow the four key rules of cogen: (a) each person has equal turns to speak up, (b) each person will show respect and listen to each other attentively, (c) an action plan will be created to address any emergent issues in the internship, and (d) participants may request to play videos of the internship activities to recall what happened explicitly for further discussion if needed. If participants violated these rules, the cogen mediator would remind them of the rules. Importantly, a student volunteer would record the turn-taking on a poster so that all of the participants could see how many times each person had spoken. This poster can serve as a reminder for all participants to share equal turns for speaking in cogen. At the beginning of a cogen session, each participant would be invited to write down their discussion ideas, any issues or positive occurrences they had observed in the internship, or any other relevant topics they would like to discuss with the group members. As they were doing so, the cogen mediator would play some background music to help the participants transition from the previous internship activities to the cogen space. Once the participants had finished writing, the cogen mediator would invite them to share their thoughts and discuss how to improve the internship as a team. If there was a legitimate issue agreed on by the group, solutions and an action plan would be discussed. In the next cogen, the solutions and action plan would be debriefed again to see if the issues had been addressed. If not, new solutions and a new action plan would be discussed. At the end of each cogen session, participants would discuss the quality of the day's cogen by randomly checking three items from a list of 40 cogen heuristics [34], such as "I strive to make sense of what others are saying," "Others choose to strive to make sense of what I am saying," "I try to get others to contribute to what is being discussed," or "Others try to get me to contribute during discussions." These cogen heuristics remind participants of the nature and requirements of cogen and invite participants to reflect on their cogen practices and find ways to improve their practices if necessary. In the Work with A Scientist Program, scientists and high school students engaged in cogen to discuss concerns, issues, and positive events that occurred in their internship. Topics included such things as teaching pace, teaching methods, assignments, group dynamics, teamwork, laboratory practice, and physiological needs.

4.3. Data Sources and Data Analysis

As the program director, I supervised project assistants and oversaw the work of data collection and data analysis. To investigate the communications and interactions between high school students and scientists, this study conducted video-recorded ethnography [35] to collect data. Conducting ethnographic studies allows for a detailed analysis of discourse practice in relation to cultural norms and meanings that are enacted in the setting. Data sources included video recordings of internship activities, video recordings of cogen practices, students' journals, students' post-internship interviews, researchers' field notes and pictures, and artifacts used by participants (e.g., PowerPoint slides, worksheets, notes). All of the video recordings were transcribed verbatim. To demonstrate how cogen can be used as a powerful tool to help regulate emotions in a science internship, I chose to use an *intrinsic case study* [36] of a student's (Michelle) emotional breakdown in Dr. Macbeth's laboratory group. Michelle's event was chosen as an intrinsic case study because it includes rich and holistic discourse about emotion and can serve as an exemplar of using cogen to address emotional issues. Importantly, Michelle's case was articulated by participants as one of the most emotional events in the internship. As one student (Jack) commented, "Cogen was incredibly moving this week. Michelle spoke up, voicing her concern that she might drop out because she did not feel that she was mature enough for the program. Dr. Macbeth and the entire lab . . . all reminded Michelle that they greatly appreciate her spontaneity and child-like nature and consider her integral to the success of the lab. I highly appreciate that everyone already feels so close that they can voice such visceral and deeply personal emotions and thoughts." Once Michelle's case had been selected, all relevant data (internship and cogen video recordings, artifacts, field notes, interviews, journals) about Michelle's emotional breakdown was analyzed from the lens of the emotion regulation framework.

To validate the data analysis, I drew on criteria from fourth-generation evaluation [37]. To satisfy the criteria of *prolonged engagement*, our research team engaged in Dr. Macbeth's laboratory group for seven months, built trusting relationships with the participants, and had the firsthand interactions with participants; to satisfy the criteria of *persistent observation*, our research team continuously observed and video-recorded group activities and wrote field notes every time we met with participants; and finally, to satisfy the criteria of *triangulation*, the research team collected multiple sources of data for *data source triangulation* [36]. In this intrinsic case study in particular, the video-recording of cogen practices, Michelle's journals and interviews, and her peers' journals were utilized to triangulate the data analysis reported in the following sections. This study was approved by the Institutional Review Board at the University of Texas at El Paso (approval number: 496306-16). All names in this study are pseudonyms.

5. Regulating Emotions through Cogenerative Dialogues to Sustain Students Engagement

Cogenerative dialogues (cogen) are designed to be a supportive and safe place for participants to speak up freely, equally, and respectfully. In the Work with A Scientist Program, high school students and scientists regularly used cogen to discuss issues they encountered and to brainstorm solutions as a team. Topics included such things as teaching pace, teaching methods, assignments, teamwork, scientific writing, note taking, laboratory practices, and presentation skills. The program invited students to conduct open-inquiry projects with the support of scientists, which some high school students might find challenging. Open inquiry requires a high degree of student autonomy to participate in all of the components of doing research, such as identifying a scientific question, designing an experiment, analyzing data, and communicating results to others. During the open-inquiry process, high school students might feel doubtful, insecure, uncertain, or even lost. In this study, cogen played an important role in helping participants communicate and address whatever issues occurred in the open-inquiry process.

In the following sections, I demonstrate some episodes of a cogenerative dialogue in which one of the high school students, Michelle, expressed that she was having an emotional breakdown and wanted to drop out of the program. Michelle was one of the nine high school students who worked in Dr. Macbeth's laboratory. After hearing Michelle's concerns in cogen, the group's members tried to convince her to stay in the program. Participants in the cogen included the scientist (Dr. Macbeth), the teaching assistant (Ms. Rava), the cogen mediator (Mediator), and the group of high school students (Michelle, Brian, Jasmine, Sally, Yasmin, Addison, Jack, Nick, Nancy).

5.1. Situation Selection: "I'm Gonna Drop Out!"

After a few weeks working in Dr. Macbeth's laboratory, Michelle initiated a conversation in cogen in which she articulated that she felt less than and different to the others and was thinking of dropping out.

Michelle: I think I'm gonna drop out.

Dr. Macbeth: Why?

Michelle: I'm gonna cry. It's because, look at me, Dr. Macbeth. Everybody here is so mature, and I'm here like, the only one.

Dr. Macbeth: What are you talking about?

Brian: I think you're like, smarter than all of us combined. Yeah.

Ms. Rava: You bring the sunshine here.

Dr. Macbeth: For sure.

Ms. Rava: You are our sunshine. Our only sunshine.

Michelle: I just bring the, ah, how do I explain it? I think I will drop out.

Brian: No.

Dr. Macbeth: We don't want you to drop out.

Michelle: Whenever we're doing something like, I get distracted really easily and . . .

Brian: It's okay. I think we all do.

Jasmine: No, trust me, I do, too.

Dr. Macbeth: We don't want you to drop out.

Mediator: Yes, we don't.

Brian: Yes, we don't.

Sally: It'd be really sad.

Ms. Rava: Is it something like, you're feeling internally? Like you feel less than everyone? Because you're not. Or are there other external issues?

Michelle: No, external, just in general. I mean, whenever I look at you guys, everyone is like, doing their work there, and I'm here like, ah, like that, you get me. Not that I'm bored or anything, it's interesting, but I just feel like, I'm not thinking the right way. You guys get me?

Ms. Rava: No.

Brian: What right way is there to think?

Michelle: Like their way of thinking, they already know what they wanna do like, and I'm here like, "Okay, what do I wanna do? What do I wanna do?"

Dr. Macbeth: You know what? That happens to me.

Michelle: But it's different, 'cause you are a serious person.

In the episode above, Michelle expressed many of her concerns while working in the program. First, she expressed her feeling of being different than the others. She said she felt the group was all mature except herself ("everyone is so mature"). Second, Michelle noticed that many other students had good ideas for their open-inquiry project proposals ("they already know what they wanna do"). Third, Michelle expressed that she thought others were more serious than herself ("But it's different, 'cause you are a serious person"). These concerns made Michelle feel that she did not fit into the group well. Apparently, these concerns and feelings caused an emotional breakdown for Michelle. Thus, Michelle started to contemplate dropping out of the program—selecting a situation that might reduce her negative emotions—an *intrinsic* way to regulate her negative emotions.

Although she was having an emotional breakdown, Michelle was able to express her concerns in cogen, even though the prospect of the conversation made her want to cry ("I'm gonna cry"). This shows that Michelle found cogen to be a safe and supportive place to freely speak up about her concerns and was willing to share them with group members. As shown in the episode above, the group members, including the scientist, the teaching assistant, the mediator, and the other high school students, all tried to comfort Michelle and convince her to stay. Dr. Macbeth, Ms. Rava, the mediator, Brian, Sally, and Jasmine all explicitly expressed that they did not want Michelle to drop out. That is, they disagreed with Michelle's plan of dropping out. As part of the cogen spirit, participants agree to respect different voices and speak up freely to express their own opinions. In response to Michelle's dropout plan, the group members expressed many different opinions to address Michelle's emotional breakdown. In the following sections, I demonstrate what strategies the cogen participants used to engage in *extrinsic* emotion regulation.

5.2. Attentional Deployment: "It's about Having Fun . . . None of the Other Stuff Matters!"

To address Michelle's emotional breakdown and dropout plan, Dr. Macbeth first expressed that he did not want Michelle to drop out and he disagreed with Michelle's negative thinking about herself (i.e., immature, different, not serious). Dr. Macbeth noted that Michelle had not considered other important dimensions of the science internship. He pointed out these important dimensions and asked Michelle two questions: "Do you enjoy coming here? Do you have fun when you're here?"

> **Dr. Macbeth:** Hold on, hold on. I have a question for you. Actually, I have two questions. Do you enjoy coming here? Do you have fun when you're here? Then that's all you need to know, because that's what this is about. It's about you enjoying being here with, with us, and it's about having fun with science. That's really all that matters, none of the other stuff matters at all. And I think you're gonna do amazing, and I've seen you be amazing. And you're always so happy and that makes everybody happy, it makes me happy. I enjoy hearing about all the cool stuff that you do and have done in your week, and I enjoy seeing y'all when y'all come in and working with y'all in science and having fun, and we're gonna do all kinds of fun stuff this summer. We're gonna go hang out at the park, we're gonna go to the museums, we're gonna go . . .
>
> **Michelle:** You're making me cry.
>
> **Dr. Macbeth:** Talk to other science people. You know, so if you meet those two criteria, then you belong here. That's all that matters. Nothing else matters. Okay? Promise me you'll stay for a little while, at least. Okay?

For Dr. Macbeth, enjoying the work and having fun in the program were two important criteria for participating in the program. That is, Michelle should not focus on comparing herself with others but on whether she enjoyed the work and had fun in the program. Dr. Macbeth even invited Michelle to talk to "other science people" to confirm his perspective on this matter. That is, for science people like Dr. Macbeth, what matters the most is whether people enjoy their scientific work and comparing oneself with others is not important. Thus,

if Michelle was enjoying the work in the program, she should stay to do what she enjoys and not care too much about whether she is different from others.

In the episode above, it is observed that Dr. Macbeth used an extrinsic emotion regulation strategy of attentional deployment to help Michelle refocus her attention on work enjoyment (instead of on a self-other comparison). As a scientist, Dr. Macbeth represented the expertise and authority of the scientific community. Thus, when he mentioned that "if you meet those two criteria, then you belong here," it was a powerful statement to Michelle, a novice who had just touched scientific work for the first time as a beginner. Michelle's response "You're making me cry" shows how powerful and significant Dr. Macbeth's statement was to her.

5.3. Attentional Deployment: "Just Try to Be Better than Yourself!"

In addition to Dr. Macbeth's suggestion of focusing on work enjoyment, other group members also shared their thoughts on refocusing attention on self-progression instead of self-other comparison. The episode below shows how other group members explicitly invited Michelle to "stop the little voice" of self-other comparison in her mind and focus on other, more important things in the science internship.

Sally: You guys see me as outgoing, but you guys don't know if that's true or not. So that's the thing, be yourself, don't change.

Ms. Rava: And that little voice that tells you those things, you have to stop it whenever it starts. And there's several ways to do it, like some people find a poem to say when that voice starts. Just say, "I'm not listening to you." 'Cause I have that voice too. It's taken a while. When it starts saying things, I recite a poem, that's me. And then it's a way to focus your brain, like, some people do the coloring, same idea.

Brian: Wait, whadda they do with the coloring? Who does it with the coloring [crosstalk]?

Dr. Macbeth: You focus on the colors until you actually, like you did when you were young. Just have a coloring book and color.

Dr. Macbeth: To focus on.

Brian: Like those adult coloring books?

Dr. Macbeth: Uh-huh.

Ms. Rava: 'Cause it gets you, it makes your frontal lobe start working better, and the feelings I guess.

Dr. Macbeth: It redirects your brain.

Ms. Rava: Oh, so that's what you focus on.

Dr. Macbeth: Like stress relief and, and stuff like that.

Ms. Rava: And it takes a long time but it's like, a cognitive behavior thing is when that voice starts up you say, "No, you can't tell me that."

Michelle: Okay, I think we should leave the sad things out. Let's talk about something else, 'cause I'll start crying again.

Yasmin: Don't, don't worry about like, being less than other people, 'cause I've been through that with volleyball, and school, and everything. And you know, you're not always gonna be the best at everything, trust me. Volleyball was bad. I'd come home crying after every game 'cause he didn't play me and I was there all the time, trying really hard like, he would tell me that I was the one that worked the hardest, all the time, and he didn't play me. And you know, I figured, you know I'm not good enough, so I found something else that I'm better at. I told myself I was gonna focus on my academics and you know, even then I'm not

like, the best, but you're always, you're always gonna be better than someone but there's always gonna be someone better than you.

Sally: Someone is always better than you, just try to be better than yourself.

As shown in the episode above, like Dr. Macbeth, other group members tried to deploy Michelle's attention from a self-other comparison to another, more important dimension of the internship—"Someone is always better than you, just try to be better than yourself." Ms. Rava even articulated that she could relate to Michelle's feelings and understood how hard it can be to stop negative thoughts (e.g., thinking of oneself as immature, different, not serious). Ms. Rava provided several examples of how people can explicitly stop these inner voices by doing art practices (e.g., reciting a poem, coloring). To describe a process of switching thinking modes, Sally shared her volleyball experience and described her own emotional breakdown when she compared herself to others. Eventually, Sally was able to regulate her emotions by refocusing on other things, moving from self-other comparison to self-progression. She suggested that Michelle do the same: focus on "just try[ing] to better than yourself" (instead of comparing herself to others).

5.4. Cognitive Change: "I've Had What You Felt Too!"

In addition to attentional deployment, group participants also enacted the strategy of cognitive change to address Michelle's emotional breakdown. According to Michelle's statements, she felt that other students were more mature than herself. However, this cognitive understanding may not be true, as articulated by one of the students, Addison, below.

Addison: Michelle, you see me that I have this together. No, I don't. Um, as a matter of fact I just, I've had what you felt too, um, I was at CCT with EB, you know. I was doing the health science program and I had a meltdown and I dropped out. And I, I didn't feel comfortable with what I was doing, um, there's a lot of things you guys don't know about me . . . Jack knows a lot about me. And everything that you do, if it makes you happy, go for it. If it inspires you, if it makes you want to get up out of bed every day, it's something that you should be doing. It's worth your time. And for some reason why, you're here, and every time I come [to the internship], I swear you always make me really happy. It's true, you do. You always get a smile. I'm always talking to Jack about you. You're always, you're the highlight of my day when I come.

Jack: True.

Addison suggested that what Michelle thought about others might not be true. For example, Addison mentioned that she had had emotional breakdowns too and even dropped out of a program in the past. That is, Addison was no different than Michelle and had felt what Michelle "felt too!" Thus, Michelle should not think that she is very different from others and should change her cognitive understandings about others. Jack's comment of "true" confirmed and supported Addison's statement.

5.5. Cognitive Change: "There Is an Element of Seriousness, but We're Also Not Serious!"

One of Michelle's concerns that made her contemplate dropping out of the program was that she felt that her peers were more serious than her. To address this concern, group members pointed out that this concern was not totally true, as discussed below.

Sally: Michelle, you think we were serious, whenever I look serious, I was just like, I don't know what I'm doing, I'm just following the instructions or doing this and that. And some days when I look serious just to fool the teacher, so they won't ask, "Hey, are you doing this correctly?" Are you coming over to talk and I'm just like, "Nah, nah, I got this, I got this." I don't understand a thing about this, but it's cool. It's cool.

Nick: Yeah, I wish I was like more outgoing. I feel like I'm too serious.

Michelle: I wish I could be like you three.

Ms. Rava: Ohm.

Michelle: Whenever I come here I'm always, I don't know if you have noticed but I'm always looking at you three, you guys, because he's like smart. He's like, always saying the answers. You are there all paying attention and you're all there bringing new ideas and I'm here like, "Okay, I'm nothing." So even if you guys say I inspire you, you're the ones that always inspire me.

Brian: Well, it's mutual.

Nick: Yeah, I think that just means that we need each other.

Yasmin: Don't worry about being different, because I'm like the old lady out of my friends and I, I don't care, I take it as a compliment. Like, I prefer to be with adults, I shop at old people places all the time [laughter]. The other day I literally like, there was some old ladies looking at some pants and I went and looked at those same pants like, what is this. And then I can't even walk into Forever 21 like a normal teenager would. I go downstairs to the Limited or Ann Taylor and I'm just like this, what is this, this is not normal [laughter]. It's not normal, so don't worry about it. Like I, I really enjoy being extremely old at heart. Like that's, that's one thing I love about myself, you know. I'm just such an old soul. So don't worry about being different, it's okay.

. . .

Ms. Rava: I wish you could come see us in our labs, 'cause like, we're serious but then again like, Dr. Kate will be like, "Make up a name for your patient." And we're like, "Lady Gaga. Oh, no, Lady Gaga has so many diseases." So, there is an element of seriousness, but we're also not serious, 'cause there's a time for both. And you should see us with our microplates. We do this like, "Ugh, it smells like sardines." Every cell synthesis, boy you better be cool when you smell a microplate smell like that.

Brian: Tortillas [laughter]. I sense a hint of tortilla. Oh my god.

Michelle: Oh my god.

Ms. Rava: So, I've never thought it was inappropriate 'cause I don't think I've seen anyone inappropriate in lab.

Michelle: I'm happy I have you guys.

Brian: We're happy we have you too.

One of the reasons that Michelle felt that she was different from her peers is that she thought that other students in the group were more serious than her. Thus, Michelle did not feel she was a good fit for the program. However, group members did not agree with Michelle. First, they expressed that people might just look serious but are not in reality. Sally said she sometimes pretended to be serious in front of the teachers. To avoid the teachers focusing attention on her, Sally would pretend that she was on top of all her tasks. In fact, Sally might not understand what she was doing either. Thus, people might not be as serious as others see them. Second, group members articulated that it is okay to be different, either serious or not serious. Yasmin expressed that she was actually proud of being different from others. For example, Yasmin preferred to shop for "old ladies' clothes" (instead of teenagers' clothes), and she enjoyed this difference, comparing to her peers' shopping preferences. Third, group members mentioned that not always being serious is appropriate in scientific work. For example, Ms. Rava shared her example of working with microplates (e.g., naming a patient as Lady Gaga) and expressed that joking around while doing scientific work is okay and not "inappropriate!" After listening to these examples and experiences, Michelle showed appreciation and responded positively ("I'm happy I have you guys"). That is, Michelle seemed to be convinced that she should change her cognitive understanding about being serious.

5.6. Cognitive Change: "I Think You're More Important than You Actually Know You Are!"

Based on Michelle's description of herself, one might find that most of her descriptions were negative (e.g., "I get distracted really easily"; "I'm not thinking the right way"). However, many group members had different perspectives about Michelle. They kept pointing out many great characteristics Michelle possessed, and contributions Michelle was making to the group as a whole, as shown in the episode below.

> **Addison:** [Michelle], You're honestly, you're a wonderful person, and if you're happy and this is something that you feel, this is me, this is where I'm supposed to be, even if it doesn't make sense sometimes in life, it will down the road. I promise. Just give it time.
>
> **Nick:** Yeah, I feel the same exact way. I think you're more important than you actually know you are, because you, whenever you say that everyone else has such a good attitude here, I honestly think, think you have the best attitude. And you make me feel so comfortable being here, because you're not afraid to be yourself. And I'm, I'm terrified of showing people. You inspired me actually.
>
> **Michelle:** Thank you.

In the episode above, Addison and Nick described Michelle as a "wonderful person" who had the "best attitude" and could really inspire people around her. Nick even said to Michelle "I think you're more important than you actually know you are." That is, Michelle might be a much better person than she thinks she is. Thus, these peers' positive recognition of Michelle calls for Michelle to make the cognitive change of seeing herself differently.

5.7. Meta-Dialogues on Emotion: "Crying Is Good for the Soul!"

One interesting observation about the cogen is that group participants also conducted "meta-dialogues" about emotion itself. As Michelle revealed her emotional breakdown and her plan of dropping out of the program, she, with her tears in eyes, expressed many times that she wanted to cry, as seen in different episodes of the cogen. After hearing all the supportive words and encouragement from her peers, she eventually cried in the cogen, as shown in the episode below.

> **Brian:** We're here for you. We wanna help you, we wanna help each other. We want you to be okay, so.
>
> **Michelle:** [crying] I thank you.
>
> **Brian:** Yup.
>
> **Yasmin:** Keep your composure, don't cry [laughter].
>
> **Michelle:** It's because you guys keep talking.
>
> **Sally:** Crying is good for the soul.
>
> **Ms. Rava:** It is. I would, I would go home and I'd just cry just to help relieve myself. Trust me, it helps out a lot of stress.
>
> **Yasmin:** It does. Sometimes I cry just because [laughter].
>
> **Dr. Macbeth:** Just don't on your paper. Exactly watercolors, there you go.
>
> **Sally:** I did that yesterday. Last night I was doing the art homework and I did that and cried all over it. It ruined the whole homework. So I just cried and I threw it away and I was like, "Ah, okay, I'm gonna do it again."

In response to Michelle's crying, group members initiated a conversation about crying. That is, they started to share their own experiences of crying and explained that crying might be beneficial "for the soul." This shows that cogen can serve as a safe place for people to reveal their true emotions and not suppress them (e.g., Michelle's crying). Importantly, cogen participants were comfortable talking directly about emotion, a topic many people are not comfortable talking about.

5.8. Situation Modification: "Maybe We Can Be a Little Nontraditional!"

Another strategy for regulating one's emotions is situation modification, which was also observed in the cogen. Something Michelle expressed was that she admired peers who were "serious" and already knew what they wanted to do for their scientific projects. To plan for the future and prevent similar emotional breakdowns, Dr. Macbeth suggested modifying the current practice for setting up groups—"Maybe we can be a little nontraditional."

Dr. Macbeth: So, maybe we can be a little nontraditional. There's really no guidelines, necessarily, about how the groups are set up.

Jasmine: I like that.

Dr. Macbeth: Maybe we can brainstorm a way to have a nontraditional groupie group, what do you think?

Jasmine: To where, everything can connect to one and we'll research this, research that?

Dr. Macbeth: Exactly.

Michelle: Okay.

Jasmine: And then make a huge poster board and all of us will present it.

Mediator: That's actually a great idea.

Dr. Macbeth: There you go.

Jasmine: Could we do that?

Dr. Macbeth: Why not? We can do anything we want. The experts have spoken.

Michelle: Before it goes away [laughter].

Traditionally in the Work with A Scientist Program, each laboratory would have three small groups with three high school students in each group. To strengthen the bonding among the nine students in the whole group, Dr. Macbeth suggested having a "nontraditional groupie group" that aimed to work on a collective project all together. This suggestion received many positive responses from the high school students, including Michelle.

5.9. An Overview of Emotion Regulation Strategies Involved in Cogen

In the sections above, we can observe that cogen participants used many types of emotion regulation strategies to address an emotional *situation*: Michelle's emotional breakdown. In cogen, Michelle first expressed her plan to initiate a strategy of *situation selection* ("I'm gonna dropout!"). Cogen participants then tried to calm Michelle's emotions by suggesting attentional deployment and shifting Michelle's focus to essential components of the internship ("The internship is about having fun!"; "Just try to be better than myself"). Other suggestions were also made by group members to invite *cognition change* about the situation ("Others actually feel the same way I did!"; "I am actually important to my group"). During cogen, Michelle tried to suppress her emotions ("I don't want to cry here!") as a strategy of *response modulation*. However, others shared *meta-dialogues on emotion* and recommended that Michelle acknowledge, rather than suppress, her emotions ("Crying is good for the soul!"). As a result, the group discussed a possible *situation modification* to modify the current situation ("Our group may do something nontraditional!"). An overview of emotion regulation strategies used in cogen to address Michelle's emotional breakdown is illustrated in Figure 2.

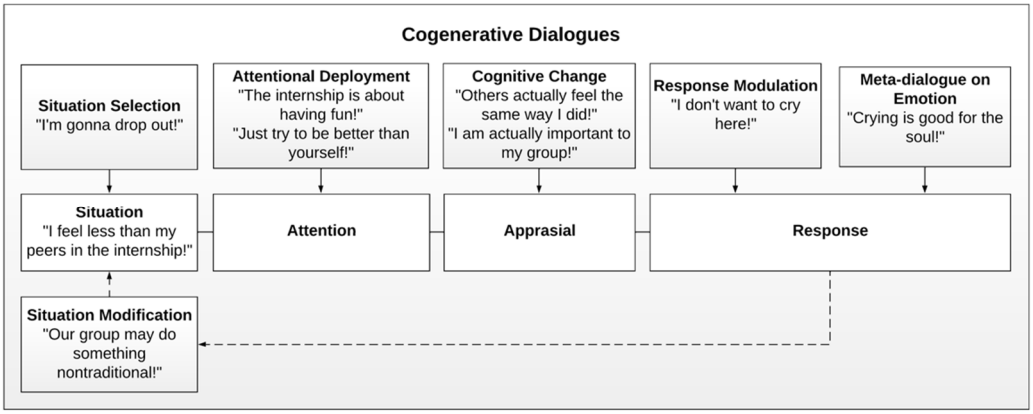

Figure 2. An overview of emotion regulation strategies involved in cogen to address Michelle's emotional breakdown situation.

6. Cogen May Address Emotional Breakdowns and Strengthen Social Bonding

After a few weeks of participating in the internship, Michelle had gradually developed a sense of low self-esteem, and she expressed that she felt less than her peers. Eventually, Michelle had an emotional breakdown and contemplated dropping out of the program. Her confession of this contemplation during cogen initiated a series of conversations that aimed to ease Michelle's negative emotions and convince her to stay in the program, as shown in the previous sections. During the process, we observed group participants using many extrinsic emotional regulation strategies trying to calm Michelle's emotions, such as attention deployment, cognitive change, and situation modification. As a result, these conversations in cogen shifted Michelle's emotions from feeling unconfident, anxious, and depressed, to feeling confident, empowered, and happy. In fact, these cogen dialogues not only lightened up Michelle's mood but also strengthened the whole group's solidarity, as articulated by Addison and Jasmine in their journal entries about cogen below.

> *This week, cogen was very relaxing. This week, Michelle felt uncomfortable about the place she was in, and she talked about thinking about how she isn't good enough, and we all spoke to her in our own words to make her feel like she isn't useless. She told us that we inspire her to be better and I really liked how everyone pitched in for a good positive thought. She was talking about quitting the program but we convinced her not to. Everyone gave her a positive vibe to feel better and we explained that everyone is different and we think she has a lot of potential. This week, cogen was a good way to open my eyes that there are a lot of people going through something and we learn to cope with different situations. She is a very strong girl and she is the highlight of the whole group.*
>
> (Addison, journal)

> *In my personal opinion, the most important and most interesting observation this week was how well we were able to cope with and understand each others' feelings. We all spoke about personal things and it helped Michelle to understand that it is okay to be different. . . . I like that others love to listen to my silly stories or vice versa because I am really starting to feel like a family at UTEP. It is a very comfortable zone to be in and I wouldn't trade it for the world.*
>
> (Jasmine, journal)

As reflected in Addison's and Jasmine's journals, they reported that "all" the participants spoke up freely in cogen and shared different opinions equally. Moreover, the participants were able to give Michelle "a positive vibe" to make her feel better emotionally. As a result, Jasmine even commented that the whole group started to "feel like a family!" These positive impacts were also verified in Michelle's journal, as shown below.

> *In this cogenerative dialogue, this week we had an emotional dialogue since all of us said what we actually feel about this program, and how some of us feel that we do not belong*

> *here. But obviously our scientist and the girls that always help us told us not to worry a lot about the voice that tells us that we are not in the level to work with a scientist, since everybody has that voice and a lot of people who think positively try to ignore that voice, so we must do the same, so that we don't get disturbed when we are in a scientist project or something important that we have to get done with the abilities that we all possess.*
>
> (Michelle, journal)

Michelle shared that she learned from her group members that it is okay to ignore one's self-critical voice and refocus on other important aspects of the science internship. As a result of cogen, Michelle was convinced to stay, was able to keep working in the program, and completed the program successfully. After completing the program, Michelle was interviewed and asked to reflect on her internship experience. She recalled wanting to drop out in the middle of the program and sharing her frustration in cogen. With new insights gained from her group in cogen, she realized that by participating in the internship she was trying something new for the first time. Thus, feeling challenged and foreign was inevitable for Michelle. With the explicit support and encouragement she received during cogen, she felt empowered to continue the program.

> *I wanted to drop out in the middle. I said in the cogen too that I wanted to quit. But after I went home, I was like, "There's nothing to worry about." And I don't know even why I was stressing out that day. Because, after that, the next day, it was fun. And I was like, "Ah, this is so easy and I understand it." So, I mean everybody has their moments when they are like stressed about some things. Especially when it is the first time you do something like this. Because it's my first time going outside my house and doing something new. So it was a little bit difficult, but at that time, yeah, it was a little bit like, "Oh, I wanna quit, but [laughter] it was good."*
>
> (Michelle, post-internship interview)

When asked about her thoughts on cogen, Michelle responded strongly that if there had been no cogen in the program, she thought that there would have been many tensions and many students would have quit the program, including herself.

> *There would be a lot of difference if we didn't have cogen. The tension. I say that the tension was the first thing, because if there was no cogen, I would say that at least four out of us, we would have quit. If we did not have cogen, I would be the one that was quitting, too [chuckles]. Cogen was something a part of the week that we would be like, "Oh, it's cogen time, yeah!" The food and the funny things and the characteristics and everything, it's gonna be like, we could finally talk what we wanted, wanted to be talking for a long time, you know? Especially when Dr. Macbeth asked us what we are feeling right now, and why, or what do we think [about] what we're doing, it's helping you in a way. So I think cogen is something really important. . . . I think the purpose of cogen was to lighten the mood and, like, everybody to be more fun with each other. And I think we accomplished that in a really good way.*
>
> (Michelle, post-internship interview)

Michelle described cogen as a powerful tool to "lighten the mood" and said that the group could use this place to "finally talk what we wanted." In particular, cogen helped to strengthen the social bonding with the scientist, Dr. Macbeth, who would take time to listen to the high school students' voices in cogen.

7. Discussion

Cogen promotes an equitable and respectful conversation to address concerns and issues, with the goal of improving teaching and learning as a team. As illustrated in the analysis, one of the students, Michelle, suffered from low self-esteem after participating in the internship for a few weeks. Thus, she started to develop thoughts of dropping out of the program. Before quitting, she decided to share her feelings in cogen, which significantly changed her mind. As a result of the cogen discussion, she decided to stay and eventually

completed the program. Based on the data, I observed that cogen may have played many important roles in helping to regulate and transform Michelle's negative emotions.

First, cogen may provide a safe space to reveal emotions. Emotion suppression is a common strategy people use to hide their emotions, especially when revealing their emotions might cause embarrassment. However, emotion suppression may lead to negative consequences, such as health issues or memory loss [38,39]. In the science internship, students might suppress their emotions due to the challenges of conducting open-inquiry projects or working with scientists. They might develop negative emotions, such as frustration, depression, or self-doubt. It was observed that cogen provided a place for students to reveal their emotions. Take Michelle as an example. She had developed low self-esteem in the first few weeks of her internship, but she did not tell anyone and kept the resulting negative emotions to herself. Eventually, she contemplated quitting the program and decided to share this thought with her group members in cogen. Sharing her dropout plan in cogen was not unusual because the purpose of cogen was to share concerns about the internship. Participants expected to share concerns in cogen in order to brainstorm solutions as a team. Michelle's revealing her dropout plan in cogen showed that she deemed cogen as a safe place to share her concerns, even a personal concern. Cogen aims to provide a safe space for participants to engage in dialogues freely, equitably, and respectfully. Creating such a space in which all participants feel safe is not an easy task because it requires continuous trust developed among participants over time. In the Work with A Scientist Program, the cogen mediator, three cogen rules, and cogen heuristics all played important roles in creating a safe space for participants. If we can successfully create more safe spaces, like cogen, for students or employees, we may help participants dare to reveal their emotions and avoid the negative consequences of emotion suppression.

Second, cogen may provide a supportive space to share emotion regulation strategies. Poor emotion regulation and poor social communication may lead to self-injury and stereotyped behaviors [40]. Thus, to maintain one's well-being, emotion regulation is an important skill for people to learn. When people regulate their emotions, they normally enact certain strategies without explicitly labeling these strategies or being fully conscious of them. In fact, not all people are comfortable talking about their emotions. In some traditional cultures, expressing emotion is even a forbidden behavior, let alone sharing emotion regulation strategies with others. However, as illustrated in this paper, to address Michelle's emotional breakdown, many group members shared different types of emotion regulation strategies with her (e.g., attentional deployment, cognitive change, situation modification). They explained these emotion regulation strategies by sharing stories from their own lives. Michelle was able to relate to these stories and interpret her situation in a new light. That is, in the safe place of cogen, the participants were all comfortable in expressing their emotions and discussing their emotion regulation strategies. This is likely due to the fact that cogen promotes the value of listening to different voices and perspectives. Thus, participants feel free to share their different opinions without hesitation, even regarding the topic of emotion.

Third, cogen may provide a constructive space to transform negative emotion. In addition to equity, respect, and diversity, cogen also aims to bring constructive insights to improve participants' collective practices. Thus, brainstorming wise solutions and workable action plans to address issues identified by participants is an important characteristic of cogen. In this study, for example, participants were expected to come up with constructive ideas to improve the internship collectively. Whenever a participant identified an issue, the other participants would take it seriously and brainstorm possible solutions together. In Michelle's case, many emotion regulation strategies were suggested, including the possibility of Michelle using attentional deployment by refocusing on different dimensions of the internship (e.g., having fun in science), Michelle's possible cognitive change of valuing good qualities in herself (e.g., inspiring others), and even a possible situation modification by the whole group (e.g., adopting a nontraditional grouping). These emotion regulation strategies shared in cogen eventually transformed Michelle's negative emotions into posi-

tive emotions. Throughout the internship, different problems were discussed and solved in each cogen session. That is, cogen can serve as a fire extinguisher, putting out a spark each time and avoiding these sparks becoming a serious fire, just as Michelle's emotional breakdown was transformed through cogen and Michelle's dropout was avoided.

An important implication of this case study is to show how cogen may serve as a tool to sustain both individual and organizational health. As illustrated in Michelle's case, cogen provided her with a safe space to express negative emotions. In fact, when people express negative emotions, they are likely to later adopt a relational adjustment for the better, achieve higher treatment compliance, and demonstrate healthy reactions to peer rejection [41] because expressing negative emotions allows people to convey their needs to significant others and elicit help from others. For example, research shows that by communicating disappointment, people may establish mutually beneficial relationships [42]. Moreover, positive emotions can be maintained if stakeholders are empowered and socially supported in an organization [43]. Thus, for any organization, like the internship program in this study, cogen holds great potential for addressing small issues one at a time and helping sustain the health of individuals and the organization over the long run.

In terms of theoretical contribution, this case study builds on the emotion regulation framework [31] by illustrating the unique functions of cogen for *response-focused situation modification* and *meta-dialogues on emotion* (see Figure 2). In the original emotion regulation framework, situation selection, situation modification, attentional deployment, and cognitive change are four *antecedent-focused* regulation strategies. That is, people often draw on these four strategies *before* an emotion-stimulating situation. However, in Michelle's case, we did not observe any situation modification strategy used by Michelle to regulate her emotions. This is likely due to the fact that Michelle could not find a modification idea by herself, or she simply did not feel that she had the power to modify the internship situation before she revealed her negative emotions. Since the internship was a collective group practice, Michelle might have felt powerless to initiate any change by herself, just like any other student. However, during cogen, other group members suggested ways for collective situation modification (e.g., "our group may do something nontraditional"). This finding shows that cogen has great potential in empowering students to change the current situation collectively. That is, although Michelle could not initiate an *antecedent-focused* situation modification beforehand, she and her peers could initiate a *response-focused* situation modification afterwards. Another unique function of cogen in this study were the meta-dialogues on emotion. In the original emotion regulation framework, the only strategy for response-focused regulation is *response modulation*. In Michelle's case, I observed that Michelle was trying to suppress her emotions (crying) at different moments during cogen to modulate her emotional response. However, I also observed that other cogen participants actually had rich meta-dialogues on emotion e.g., "crying is good for the soul"). These meta-dialogues recognized the nature and existence of emotions. Instead of suppressing her emotions, Michelle's peers actually suggested that Michelle cry out loud and discussed the benefits of crying (e.g., release of stress). These meta-dialogues may open up new possibilities for response modulation and bring new insights to people's response modulation strategies (e.g., being mindful of what benefits crying might bring).

8. Conclusions

This ethnographic case study demonstrates how cogen was used by scientists and high school students to address a high school student's emotional breakdown during a science internship. This intrinsic case study demonstrates how cogen may provide a safe space for participants to reveal negative emotions, share emotion regulation strategies, and transform negative emotions collectively as a team. The emancipatory and democratic nature of cogen has great potential to empower students to share their opinions equitably, even in an emotional breakdown situation. This case study may serve as a springboard for future research on examining the impacts of cogen on individual health and organizational health.

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