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Teacher Empathy and Science Education: A Collective Case Study

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To initiate dialogue on empathy in science classroom, its role in science teaching, and to encourage science teacher education researchers and faculty to consider the role of empathy in science teaching, we conducted an instrumental collective case study with five science education graduate students at a Research-I university in the US. Data were collected through face-to-face semi-structured interviews. Within-case and across-case analyses were performed to interpret the data from the individual interviews and compare them with one and another. Our findings collectively speak to our participants' perspectives of empathy in science teaching. Finally, we discuss implications for teacher education and professional development and the need for learning sciences and science education research to systematically examine teacher empathy and student learning.

Keywords: empathy, teaching, science education, case study, graduate students

INTRODUCTION

Learning sciences research and science education reform movements highlight the importance of social interaction in learning science (Bransford, Brown, & Cocking, 2000; Palincsar, 1998). Successful scientists in the 21st century often are those who can work synergistically with others from different areas of expertise in group or large-scale projects. Thus, group work, peer collaboration, and interactions with others are some valued practices over individual activities for science education students as they learn about science (e.g., Harskamp & Ding, 2006; Micari & Light, 2009; Ritchie & Tobin, 2001). Learning about science is no more considered as an individualistic activity; indeed, many researchers agree that the effective science learning activities are the ones in which students work in collaboration and complete activities in groups and/or interactions with others (Lave & Wenger, 1991; Wenger, 1998). Different from the logical positivist view of science, in today's science education classrooms,

students learn about science through collaborating and interacting with their peers and teachers.

In a climate that social interaction plays a significant role in one's learning, the learner's emotions become very important. If the learners are not feeling safe, welcomed, or comfortable in the learning context, they will not fully engage in learning activities (Demetriou, Wilson, & Winterbottom, 2009). For example, research indicates that students' comfort or liking of school predicted cooperative classroom participation and independent or self-directed classroom participation in the subsequent school semester (Ladd, Buhs, & Seid, 2000).

Even though there is a growing body of research on the importance of social and emotional processes in learning and achievement (Cooper, 2010; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Liew, 2012), relatively limited research has specifically focused on the socio-emotional climate of science classrooms and science education. Because teachers have traditionally approached science education from a logical positivist perspective, science teachers may inadvertently believe that emotions and feelings play a secondary, or even play no major role, in science learning. Importantly, the teacher plays a significant role in creating the learning environment and cultivating the classroom climate for student learning; including being responsive to students' needs and concerns (Cooper,

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State of the literature

- Limited research exists on teacher empathy in science education.
- Science education tends to focus on content learning without utilizing students' emotions to optimize learning.
- The socio-emotional climate of science classrooms is an emerging area of research.

Contribution of this paper to the literature

- Explored the prospective science teacher educators' perspectives of empathy in science teaching.
- Proposed a new agenda of research for science education.
- Brought attention to the role of empathy in science classrooms to promote student-centered instruction.

2010). To effectively recognize, care about, and then respond to students' needs and concerns, teachers must exhibit empathy (Demetriou et al., 2009).

The present study initiates a discussion on the role of empathy in science teaching and presents findings of qualitative data derived from interviews with five graduate students who are prospective science teacher educators.

Theoretical Framework

Although definitions differ somewhat across theorists and researchers, empathy is "an affective response that stems from the apprehension or comprehension of another's emotional state or condition" (Eisenberg & Liew, 2009, p. 316; Eisenberg & Strayer, 1987). Thus, empathy involves being able to take another's perspective or feeling compassion towards another (Davis, 1983). Empathy has also been related to moral development and attitude (Hoffman, 2001). Despite varying definitions, empathy has been studied by researchers in various contexts and researchers agree that empathy can be developed right from childhood (Selman, 1975). Teacher empathy has been defined as "the ability to express concern and take the perspective of a student, and it involves cognitive and affective domains of empathy" (Tettegah & Anderson, 2007, p. 50). Although research supports the view that supportive learning environments (including empathic and supportive teacher practices) are conducive to student learning and achievement (Birch & Ladd, 1997; Liew, Chen, & Hughes, 2010; Pianta & Stuhlman, 2004), teacher empathy is often overlooked in teaching, most notably in higher education (Tettegah & Anderson, 2007). Furthermore, teacher empathy may

be especially neglected in science education possibly because science is traditionally associated with logical thinking or reasoning that is unbiased by affect or emotion. Yet, Teich (1992) highlighted that empathy was crucial for establishing teacher-student rapport and relationship. Additionally, Gilly (1980) said that the "relationship between teachers' empathy and their teaching ability is linked to the classical notion that a teacher cannot properly instruct pupils without knowing them well" (as cited in Brunel, Walker, and Schleifer, 1989, p. 228). Thus, teacher empathy is a required teaching skill that promotes a positive learning environment for all students. Moreover, researchers agree that teachers can be trained to be more empathetic (Lam, Kolomitz, & Alamparambil, 2011).

On one hand researchers agree on a teachers' role in improving student learning (Conboy & Fonseca, 2009), on the other hand to date, there has been limited systematic research on the role of teacher empathy in science education (Barr, 2011) especially in teaching context. Teacher empathy has been examined in contexts such as bullying (Bauman & Del Rio, 2006), predicting student enrollment in science subjects (Zeyer, 2010), and even attitude towards environmental education (Kilinc, Boyes, & Stanisstreet, 2011). Further, researchers agree that motivation and emotion are involved in learning and achievement (Elliot, 1999; Tella, 2007; Zeyer, 2010). However, the role of teacher empathy in science education is a relatively new and unexplored area (Barr, 2011). In teacher education programs, science educators are typically taught to acquire scientific content knowledge, pedagogical knowledge, and pedagogical content knowledge (Shulman, 1987). Similarly, science teaching also focuses on content learning rather than its application (Costu, 2008). For teaching of any subject, educators need pedagogical knowledge which includes, but is not limited to, designing student-centered learning environments, preparing and communicating the learning objectives and goals, and assessing students' knowledge acquisition through summative and formative assessments. Future science educators in teacher education programs often complete multiple courses on content knowledge and the pedagogical knowledge. Pedagogical content knowledge, that does not necessarily receive similar attention with content knowledge and pedagogical knowledge, goes beyond the knowledge of the subject matter to the dimension of the subject matter for teaching (Shulman, 1987). In science education teaching context, pedagogical content knowledge can include learning about multiple representations of the scientific assertions, the most powerful analogies to help explain the abstract science concepts and models, and the most effective use of the illustrations, examples, and demonstrations (Shulman, 1987). A person with pedagogical content knowledge

knows how to make the learning of complex science concepts easy or difficult for the particular age group. In other words, pedagogical content knowledge requires knowledge in both content domain and in students' background and preconceptions. Pedagogical content knowledge helps a science teacher to consider her students' alternative conceptions and to overcome students' misunderstandings. Neither the pedagogical content knowledge dimension nor the scientific knowledge dimension, however deals with the socio-emotional aspects of learning or creating a supportive and warm classroom climate. Likewise, although science teachers are instructed on pedagogical knowledge that focus on learning theories, science teaching strategies, and assessment methods and techniques (all of which are necessary for effective teaching), they lack formal preparation and training in the social and emotional aspects of teaching and learning which may be equally important in students' science learning experiences, subject matter performance, attitudes and beliefs towards science related topics and even their likelihood to select science as a future career. We want to open the dialogue to consider and include the role of teacher's empathy in science classes because it may facilitate student engagement in science learning activities, their success in learning the subject matter, and even choosing science as their future career (Barr, 2011). To understand how teachers view the role of empathy in science education, we purposefully decided to interview science education graduate students because they have the most recent first-hand experience in the courses and programs offered in science education departments. Because the majority of graduate students in science education programs have either had previous teaching experiences or will become science teacher educators, their perspectives of the role of teacher empathy in science class will contribute meaningfully to the learning sciences and science education research literature, and may have important implications for teaching and learning.

Study Methods

The present study is an instrumental collective case (Stake, 2005) with five science education graduate students as cases. Our unit of analyses was a science education graduate student's perspectives of empathy in science class and the role of teacher's empathy in student learning. We designed a semi-structured interview protocol (Creswell, 2007) in order to explore our participants' perspectives of empathy and its role in science teaching. The protocol included twelve questions, yet, based on the conversations with the individual participants, we asked emerging questions and omitted few of the questions in the protocol. Appendix presents the twelve questions originally listed

in the protocol. Most of the interview conversations aroused around the contexts of the items listed in the appendix.

Participants and Their Selection

We selected our participants using purposeful sampling strategy coupled with convenience sampling strategy (Creswell, 2007). The five participants were chosen because they were (a) graduate students in a science education program at a Research-I Institution in U.S., (b) they were willing to participate and available to talk to us, and (c) it was convenient for us to talk with them.

Our participants were Kevin, Jennie, Sarah, Megan, and Alyssa (all pseudonyms). Kevin was an M.S. student and Jennie, Sarah, Megan, and Alyssa were Ph.D. students pursuing graduate degrees in science education program at the time we collected data. Kevin, Jennie, Alyssa, and Sarah were native English speakers and Megan was an international student. Kevin was the youngest among the five participants. Jennie was the oldest. Sarah, Megan, and Alyssa were in early 30s. Kevin had about two years of teaching experience whereas Jennie had more than 20 years of teaching experience. Kevin had a B.S. degree in physics and he was studying to receive an M.S. degree in science education. Kevin had completed majority of his M.S. courses in the science education program. Jennie had a B.S. degree in biology. Jennie was studying for her Ph.D. degree in science education. She had taken more than half of her required Ph.D. courses at the time we collected the study data. Sarah had an M.S. degree in chemistry. Her research involved undergraduate chemical education on the nature of scientific models. She taught 6th grade science, earth science, chemistry, integrated physics, and chemistry, and advanced physical science over two years at a local Catholic school in Southern U.S. Sarah was also a teaching assistant in chemistry for a year and a half at a Research-I Institution in Southern U.S. At the time of the interview she was in her last semester of course work while working towards Ph.D. in science education. Alyssa had three years of teaching experience in invertebrate zoology and insect physiology both as a graduate and undergraduate teaching assistant. Besides she was a substitute teacher for two years at Southern U.S. school districts. Alyssa also taught a graduate level inquiry class. At the time of the interview, Alyssa had completed all her Ph.D. courses and was working on her Ph.D. dissertation. Megan, an international visiting scholar, had completed all her coursework and was working towards her Ph.D. in biology education. Megan's undergraduate degree was in biology. Subsequently, she taught science in middle and high school for four years besides doing private tutoring for a year in her country.

She then completed masters in science education before enrolling for her doctoral degree.

Data Collection

We invited the five graduate students to participate in the study voluntarily. We had secured approval from the Institutional Review Board (IRB) office at the participating university to conduct our study. We explained to our participants the study purpose and their rights as participant before requesting their consent. All five graduate students agreed to participate and provided consent. The first author met with the participants one-on-one in their offices on campus. Each interview lasted around 45 minutes. The conversations were recorded using a digital recorder. The recordings were transcribed verbatim within five to ten days of data collection.

Analysis

Within-case analyses were carried out to separately examine each case in details. We performed cross-case analysis to compare and contrast the similarities and the differences between the cases. We do not claim that our findings can be generalized over a group of population with the similar characteristics, but hope to provide insightful data for similar cases, that are, science education graduate students in science education departments. We analyzed the interview transcriptions using the constant comparative method (Glaser, 1978), which helped us identify the common themes, organize them in categories, and delimit the data. We read the transcribed verbatim (Oliver, 2005) a couple of times as we identified the common themes. We employed open coding, axial coding, and selective coding in our analysis. Open coding phase was the first time we read the transcriptions. At this phase, we generated codes for each incident our participants conveyed. We either used in vivo codes (exact words interviewees spoke) or sociologically derived codes (codes that the researchers created) to describe the incidents. In our second time reading the transcriptions, we created main categories and merged the codes with one another to organize them under the main categories. This phase was when the axial coding occurred. In our third time reading the transcriptions, we employed selective coding. Incidents and codes that did not belong to any meaningful categories were deleted. Codes that were similar to one another with slight differences were grouped in an overarching category. Our final reading of the transcriptions was selective in nature in contrast to the open-endedness of our first reading. The main categories representing the codes and their incidents represent the main themes of our findings. In the

findings section, we report these themes along with some illustrative experts from the conversations.

FINDINGS

Within-Case Analysis

Case 1- Kevin

Kevin defined empathy as understanding other people's feeling at a particular time and context. According to Kevin, other people's feelings are not fixed or rigid, but changes over time. Therefore one's empathy towards another individual is also not fixed or rigid, but emerges from the context and changes over time. In his definition, Kevin provided a doctor and patient analogy to illustrate his understanding of empathy. When asked to define empathy Kevin said:

...empathy could be explained by taking an example of doctors. The analogy is to have sympathy and feel bad about the patients but they should understand their feelings and I think that this is an important part for me, that is how we define empathy, the teacher should understand what the students are going through and may make adjustments accordingly.

Kevin maintained that a teacher with no empathy skill cannot teach successfully. Kevin believed that the role of a teacher encompasses caring about the students and closely monitoring their learning process. Without empathy, caring for someone is almost impossible, which in turn delimits one's ability to keep track of students' learning. Kevin said:

If a teacher does not have empathy skills, to me that means that they do not care about the students at all. And if they do not care, what is their goal? If they are trying to get their students learn, shouldn't they care about what the students are doing? How they are learning? Their progress.

When we asked Kevin whether connecting emotionally with the students is the same as being empathetic, he replied:

That is a difficult question for me because in some respects it is the teacher's responsibility to maximize students' learning to make every effort but at some level it is also a student's responsibility to learn and work and if the teacher takes empathy too far and takes too much of responsibility therefore it could weigh down a lot of successful teachers because if the students are not performing well as they should and, it might not be a teacher's responsibility but I think there is a fine line there. Should a teacher feel bad that the students are performing poorly? Absolutely, I do. When my students perform poorly when I did student teaching, I did feel bad and wanted to do everything I could to get them there and I encouraged students to provide extra opportunity to make the efforts.

Among the advantages of having empathy Kevin listed are: understanding the nature of students' problems and difficulties and providing feedback accordingly. Kevin said:

[Empathy] always pushes you to try a little harder because you are understanding the nature of [students'] problem, what their difficulties are. And if you do really care about the students, I think that you try a little harder rather than just getting through the material so I think the disadvantages though would be if you care too much, you may become either very depressed or pulled down because you cannot have hundred percent success or you cannot change the world.

When we asked about the ideal situation to express empathy, Kevin responded that one-on-one situation is the most ideal. He said:

I think that it is most useful when you are in one-on-one situation. I do not think that it means as much or comes across as a correct way if you say it in front of the whole class. I think it is more important on one-on-one basis because then you can address the issues and let those students know what to address.

Case 2- Jennie

When asked about the importance of expressing empathy, Jennie said that:

It is important but within limits. I think that if you are too empathic then you go too far to the other side. Because at some point you might feel sorry for the kids that their situation is so bad that at some point they have to be held accountable for what's going on.

When asked about the advantages of empathy, Jennie responded:

[Empathy] helps in every form with them. When they think that you care about them they are going to respond better in the classroom. You will have less classroom management issues if they think that you care and you listen to them and feel what they are feeling.

Jennie maintained that knowing the limit to express empathy is tricky. She said:

It is different for every kid, some kids can manipulate you and can take advantage; oh, she likes me; she feels sorry for me; I will give her some excuse trying not to do my homework. So you kind of get the feel of the kid and make sure they are not manipulating you or playing on your feelings. But at the same time you do not want to be hard so that the kids know that you care about them.

To demonstrate empathy Jennie tries to be authentic and does not put on a façade. Jennie expressed this as:

I think it also relates to being authentic with the kids; not putting on a facade, like I am a tough guy, or anything like that, then I always try to be myself. Basically listen to the kids.

On the issue of creating a boundary, Jennie mentioned that it is hard to find where the fine line is

but you need to use your judgment and see all aspects before acting just based on your emotions.

Yes, I had a student I coached. She was complaining about certain issues at home. At first I was panicked and almost ready to call the protective services. Then I had a conference with her mother and found out that there are certain issues with a boy and this and that. She [the student]) was portraying that her parents were mean to her. At one point I was on her side. Later I realized that she might be number one attention seeking from me and may be sort of manipulating to her side.

Jennie explained that connecting emotionally is helpful in feeling empathetic towards a person. If you know more about a person, you feel more empathetic. When asked about the importance of emotions in empathy, Jennie said:

Definitely. Although you feel more empathetic towards someone you know but if you see a homeless person on the street you say look at that. I feel more about the people whom I know or family members but even those who I see in the world I feel, oh look at that person! You see commercials on TV like that.

Jennie further mentioned that it is equally important to be empathetic within reasonable limits as sometimes the students may take undue advantage of the teacher.

Case 3- Sarah

Sarah defined empathy as an ability to understand someone else's feeling. She said: "Empathy is someone's ability to understand someone else's feeling. And like put themselves in someone else's shoes and really try and see something from their perspective and what kinds of feelings and emotions would come from them."

According to Sarah, one should have experienced a similar situation to be empathetic to someone else. She told us: "I think it is hard to be empathetic if you have not experienced a similar situation."

Sarah pointed out that it is imperative to be honest with the students and consistent with your expectations so that your students will understand you when you say something. This requires the teacher to be patient. Sarah said:

I think patience is [very important]. If your students know you are honest and truthful and what your expectations are and you are clearly communicating and doing the same way all the time then they are going to understand when you say something and what it means.

Sarah cautioned about the fine line between being empathetic with the students and where to limit your conversation and being responsible with the level of your empathy. Empathy does not mean to be close friends with the students. Sarah expressed this as:

There is a difference between being empathetic and getting to know your students and being friends with them. I think that if you are not careful, not only are you going to cross

the line where they can take advantage of you as a teacher but you are also going to cross the line. For example, we joke around like hey Ms. ABC, can we take ride back home or can I go grab your car and take a ride. I think no, that is not going to happen, I am your teacher and I do care about you but I am not going to become a part of your life outside of this environment. I want to know about [your life] and I want to hear about [how you feel] because it is important for me to know what's going on with your life but I do not need to be a part of it. I think that there is the fine line which sometimes some teachers unfortunately have a hard time knowing where to stop having the conversation.

Case 4- Alyssa

Alyssa defined empathy in simple words: “*Empathy is the ability to feel what others are feeling.*”

Alyssa pointed out that knowing your students as individuals is critical for their learning. The teacher should be watching over not only her students' cognitive development but also their in-class behavior. As appropriate, an action should be taken.

I think it is important to understand where your students are, not only for the subject material but also who they are as individuals. When you know your students well enough, you can tell about their feelings. For example, you might be lecturing too much and your students get disconnected so it is time to back off a little bit and understand your students' cognitive dissonance.

Alyssa further commented on the essence of knowing your students for an ideal instruction:

Knowing your students' background and where they are coming from give you information about how to adjust your class and your teaching because what might work in one classroom situation might not work in other classrooms. So to know who your students are is a boon to your teaching.

When asked to elaborate on her experience with the use of empathy, Alyssa mentioned:

I typically do not have difficulties with it. Like I can tell, I can read faces I look at the body language and can tell what they are saying, what they are not saying.

Alyssa highlighted that an empathic teacher can make use of the students' facial expressions and their body language to understand about the feelings of the students during the instruction. According to Alyssa people often do not fake their facial expressions and body languages that any information generated through this will be genuine and can very well be used to inform the class teaching context and the teacher can make modifications in the lesson plans.

Alyssa maintained that recent reform movements and pedagogical orientations are more student-centered and they require more student-to-teacher interaction and understanding. Particularly when we consider the How People Learn Framework (Bransford, Brown, &

Cocking, 2000), the role of empathy in learning centered pedagogies become apparent. Alyssa said:

Understanding and expressing empathy can be two different things. We are moving away from a very traditional and teacher directed, teacher guided, teacher focused learning environment that we see in traditional classrooms and you know the huge lecture halls. So moving away from there because how can you really interact and be empathic and understand the students if you are just up there jabbering and you have your own agenda and everyone is just focused on you. We are moving towards to a much student-centered environment, such as the one recommended by the HPL framework where you think about your learners and you focus on the student and you put the student at the center. So keeping in mind your students at all times in addition to the content, yourself, and the community. But once you think about student centeredness, I think it can really help with empathy and understanding where your students are, what the content and how you interact with them and how you scaffold the class, how you orchestrate the class and everything else.

On how a teacher can take steps to be more empathic towards the students Alyssa mentioned:

Well open your eyes and pay attention. Really, really have to pay attention to who they are. Don't have the class focus on you, focus on the students.

Alyssa agreed that culture does play a role in empathy. Sharing a similar background helps express empathy according to Alyssa. Alyssa said:

It might be more difficult but I think you can. There are some things are very similar like smiling as an expression of happiness, expression of nicety or happiness or whatever but like humor varies from culture to culture and the understanding that something might be funny to you but might not necessarily be funny to another so you have to be considerate to the group of students that you are working and so paying attention getting to know people and asking questions things like that can help and we are a global community so I think it is important especially in research one institutions where you have people from all over the world. When I learn that we have new graduate students, I enjoy the happy chit chat conversations.

Alyssa advised being attentive as being empathic. She suggested teachers should especially refrain being empathic about two topics: politics and religion. Alyssa said:

Well you always have to be careful to not cross lines. When you are getting to know somebody, you do not touch on hot issues such as politics religion and a couple others and that is just something you do not go asking. This is American professional culture but there is also a way you can talk about how you feel about this material and what is the coolest thing that you learned do you have any questions. These are the things that you can ask them in getting to know them.

Case 5: Megan

When asked about what is empathy Megan responded:

Empathy is being in other person's shoes. Looking from other's perspectives. Trying to understand what other person thinks about something.

When probed about the necessity to experience the same or similar situation to express empathy Megan opined:

If you do something at a job, at a position, on any role, I think that you can understand the other person easily. Also this type of conversation depends on your background if you have read something about those things, this roles of works or jobs, whatever you can understand people if you want.

According to Megan, if you hadn't had the same experience, you would have read about the experience or the people who experienced it and still have developed empathy towards those individuals.

When asked about the challenges experienced in expressing empathy, Megan said,

You should be open-minded. Your philosophy should not be conservative. As a teacher you have to be open to all people. You have to like and understand all people."

Megan commented that knowing your students' social background is more primary than teaching them the science concepts right away. She said:

First of all when I was a teacher, I tried to understand my students' social backgrounds because it is important to understand their social backgrounds. Some students do not think that they need to learn some concepts about science; it actually is a luxury for them.

Megan highlighted an instance when expressing empathy was useful for her students to learn science concepts:

One of my students was not interested in biology and not doing good. A year later he became successful and began to receive high grades in biology. Then he studied biology more than any other subject. If the students like you as a teacher, they achieve more than they would imagine. So it is important how empathetic you are and your behavior towards the students since they may define your students' academic success.

On the strategies to express empathy with students Megan replied:

I was trying to be one of them. First of all, I did this so they understood me and they shared with me their problems: psychological and academic problems. I talked to their families and I met with them out of school time so we were like friends. But this is not just one single rule—being friends--, you also need to be successful academically

and know your teaching content. If you do not have enough knowledge academically they do not learn.

When asked about the importance of connecting with the students on a personal level to express empathy, Megan mentioned:

I got in touch with their families, I contacted them and tried to learn their family problems and shared their student problems and family and I advised something to the family.

Cross-Case Analysis

The participants narrated their experiences to elaborate their positions on the role of empathy in science classrooms. Their explanations of the role of empathy differed to some extent. Megan, Alyssa, and Sarah concurred; empathy helps in understanding other's views, emotions, and situations. They also emphasized on putting ourselves in others' shoes to understand them better. Describing empathy in science teaching Kevin mentioned, teaching with empathy does not require extensive emotional involvement rather it requires an ability to visualize students' roles and emotions. Alyssa also shared the same view and mentioned, *"I think it is important to understand where your students are; not only the subject material, but also who they [students] are as individuals."* Megan added, it is vital to understand students at both academic and psychological level and she therefore utilizes her experience as a student to design a science class instruction.

According to Jennie, the importance of expressing empathy in class cannot be neglected. She explained,

I think that empathy is having certain feelings towards the students. Being able to read body language and that sort of things take good observations skills and may be then some training and understanding and reading about... I mean you know if kid's arms are crossed they are closed off to you. So it is not the time to really push them, you got to know kids that will escalate quickly as they are gonna blow up and you do not want to push them because then your class is gone.

In agreement with Jennie, Alyssa also underlined the importance of connecting with students. She elicited the differences between the traditional teaching approach and learner centered approach,

Understanding and expressing empathy can be two different things. It is moving away from very traditional teacher directed, teacher focused learning environment that we see in traditional classrooms and you know the huge lecture halls. So moving away from there because how can you really interact and understand the students if you are just up there jabbering and you are there and everything is focused on you.

Jennie, Megan, and Alyssa agreed that it is easier to express empathy if we previously experienced similar situation. Jennie also highlighted we feel more empathic towards people who we are familiar with or have known more. She agreed with Kevin on teacher's role in improving students' performance by being empathic.

Jennie also stressed on students taking undue advantage of the teacher. She mentioned, if a teacher is too emotional with students, students might strive gaining sympathy from the teacher for undue reasons. To prevent this Alyssa highlighted, "*you have to look for trends in your students; if you know your students you can know if they are using you or feeding you a load of crap, a load of lies.*"

Jennie and Sarah shared similar views for demonstrating empathy in teaching. Jennie mentioned,

I think it also relates to being authentic with the kids not putting on a facade like I am a tough guy or anything like that so I always try to be myself. Basically listen to the kids.

Whereas Sarah mentioned the following essential skills to be empathic:

I think patience is huge, honesty, and consistency. If your student knows you are honest and truthful and what your expectations are and you are clearly communicating and doing the same way all the time then they are going to understand when you say something and what it means.

Jennie also stressed, an empathic teacher is concerned genuinely about students' progress. Although our participants agreed with the role of empathy in teaching, they differed on their views to express it. We discuss our participants' differing opinions in the following section.

When asked about connecting with students on a personal level, Megan mentioned: "*I got in touch with their families, I contacted them and tried to learn their family problems and shared their student problems and family and I advised something to the family.*"

Kevin shared a different view and stressed on expressing empathy on an individual basis "*it is best to express empathy in 'one-on-one' situation because it helps address the issue in a more practical way.*" Additionally, Sarah opined about demonstrating empathy in classrooms, "*I think acknowledging success or achievements are something that can be done in the classroom setting.*"

Participants differed about maintaining a fine balance between the empathy necessary for teaching effectively. They noted that overuse of empathy may result in students taking undue advantage. Jennie mentioned the importance of expressing empathy within limits. Sarah cautioned about the fine line between expressing empathy and how to understand the limits: "*There is a difference between being empathic and getting to know your students and being friends with them.*"

Alyssa advised to express caution while using empathy but shared a different view on maintaining the fine balance,

Well you always have to be careful to not cross lines. You do not touch some issues such as politics, religion, and a couple others and that is just something you do not go asking. But there is also a way you can talk about how you feel about this culture and what is the coolest thing that you learned and do you have any questions. These are the questions, that the relationship with the material that I do not think necessarily line with the privacy.

Kevin connected empathy with improving students' performance, however, he believed, since highly empathic teachers "care too much" they may "become either very depressed or pulled down." Kevin however expressed the opinion that an empathic teacher may still be an effective teacher,

Well I do not want to make too strong of a connection between the nice teachers being also very empathetic, I wonder how much of it had to do with empathy skills just kind of personality of the teacher I would say that they are connected but to say that the teacher who has good empathy skills gets walked over by the students, I think is a false statement for example a teacher I know in particular was a very smart teacher has lot of care for the students and was also a really nice person so I think empathy skills do play a crucial role.

Kevin related empathy with caring and gave examples to elaborate the differences between expressing empathy in different scenarios besides stressing the practical applications of empathy. Whereas Megan said, an empathic teacher should try to understand students' social backgrounds. On the use of empathy skills in science teaching Megan opined: "*First of all when I was a teacher I tried to understand my students' social backgrounds because it is important to understand their social backgrounds.*"

Participants explained their strategies to connect with students. Although our participants shared a common notion of how empathy can be effectively utilized in teaching to enhance student learning, they varied in their teaching styles and use of empathy. Participants also expressed their belief in connecting with students, understanding them better, and creating a supportive class environment to foster learning.

CONCLUSION

Our participants reported that empathy plays a role in students' learning. They noted empathy expressed in a typical classroom is complicated because it may include many dimensions. Although, empathy helps in connecting with the students, they believed it was equally important to know the limits and ideal situations to express empathy. It is important for teachers to be

supportive while setting appropriate boundaries for themselves and their students in order to effectively promote autonomous learning by meeting both the social-emotional and academic or learning goals of students (Liew et al., 2010; Demetriou et al., 2009). Furthermore, teachers need to self-care by being aware of and regulating their own emotions through setting personal and professional boundaries in order to avoid teacher stress and burnout (Kyriacou, 1987). Our participants had different teaching experiences that might have contributed to the differences in their views. We call for further studies on the ways that teachers could use empathy in science education to optimize student engagement and learning while maintaining appropriate professional and interpersonal boundaries. There may be other characteristics that are associated with people's views of empathy and its role in teaching. Teachers' sex, age, experience, and even the topic of instruction may be factors that influence both the way and the degree to which teachers express empathy in class. These professional development issues need to be considered for pre- and in-service teachers in science education, as well as in other disciplines. Furthermore, future studies should include the views and voices of students on their teacher's empathy and its role in their learning and achievement.

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APPENDIX: Semi-Structured Interview Protocol

Main Research Question: What are the prospective science teacher educators' perspectives of empathy in science classroom and its role in teaching and learning?

Questions (*Below questions guided the conversations. As appropriate, emerging questions were asked and some of the below questions were not posed*).

1. Please describe empathy in your own words.
2. How do you feel if you find someone in distress?
3. What do you think about the statement that a teacher should be empathic towards their students?
4. When is the ideal situation to express empathy in class?
5. How can empathy be expressed in a science classroom/ How can a science teacher be empathetic towards the students?
6. What do you do to judge your students' feelings?
7. How do you feel when your students succeed? How do you feel when they fail?
8. How do you relate to the difficulties your students face by?
9. What do you do if you have a disagreement with a student of yours on an issue?
10. How do you approach when you want to correct one of your students' mistakes?
11. Have you ever been in a situation when you felt helpless, hopeless, or frustrated in your classroom? How did you deal with the situation?
12. Have you ever come across a situation where being empathic was counterproductive? How would you deal with such a situation?