"This is the Funniest Lesson": The Production of Positive Emotions During Role-Play in the Middle Years Science Classroom

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Abstract This study builds on our previous work where specific science activities, such as demonstrations and laboratory activities, evoked students' positive emotional responses and focused students' attention on the science content they were learning. In this study we were interested in students' discrete emotions in a Year 8 science class expressed during a role-play activity in a biology unit on skin burns, called 'Singed'. Data from two focus groups of students from the class are presented. Drawing on multiple data sources, including classroom video recordings, observations of classroom transactions, thinking prompts, field notes and emotion diaries completed at the end of each lesson, we developed insights into individual student emotions. Using a theoretical perspective drawn from theories of emotions founded in sociology, we identified that students expressed the emotions of happiness, joy, and enthusiasm during the role-play. These positive experiences aligned with a high interest score reported by students when the class results were averaged. Importantly, the thinking prompts which were questionnaires completed before and after the role-play, showed evidence of students' learning and understanding of the science concepts related to skin burns. This study suggests that role-play can be used successfully as a teaching strategy in the middle years.

Keywords Role-play · Discrete emotions · Interest · Middle school science · Emotion diary

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P. J White et al. (eds.), *Science and Drama: Contemporary and Creative Approaches to Teaching and Learning*, https://doi.org/10.1007/978-3-030-84401-1_11

Introduction

There is a growing concern internationally and in Australia about the disengagement and decline of interest and motivation of science students in the middle years (i.e. from age 11 onwards) (Anderhag et al., 2016; Jenkins & Nelson, 2005; Osborne & Collins, 2001; Potvin & Hasni, 2014; Potvin et al. 2020). This is an important issue for science educators, as disengaged middle years students will be less likely to enrol in senior science subjects (Kennedy et al., 2014; Osborne et al., 2003) and consequently, less likely to develop informed science perspectives, become scientists, or science-trained professionals (Tytler, 2007). Of further concern, is the PISA (Program for International Student Assessment) 2018 survey indicating that the performance of Australian students in mathematics and science has been steadily declining between 2003 and 2012 (Thomson et al., 2019). Furthermore, according to Sue Thomson, the PISA national project manager for Australia, this finding is of "a concern … (as) we're not giving them [students] the same level of skills as they are in other countries and [it is] a 'wake-up call'" (Duffy & Wylie, 2019, para. 5). The PISA study also indicated that when compared to the average student across OECD counties, Australian students felt more afraid of failing science (Thomson et al., 2019).

To increase engagement and enjoyment in science in the middle years, there is a need to implement effective pedagogical approaches and simultaneously to understand the role of emotions expressed by students during those approaches. Sinatra et al. (2014) noted that "in order to broaden participation in science, we must capitalise on student emotions that are adaptive for science learning and those that promote sustained interest and pursuit of science careers" (p. 415). Students can be engaged in emotionally engaging, drama-based pedagogies (i.e. role-play), that are fun and stimulating, but further research is needed to understand better if these lessons contribute to a student's positive perception of science.

Since the relationships between drama-based pedagogies (DBP), science and student emotions are not fully understood, this study will examine the interplay between the 'organ donation' role-play and students' discrete emotions and self-reported interest. One broad research question that guided the research design was: Does the pedagogical strategy of role-play make a difference to students' emotional experience of science? As the study progressed, two more focused questions emerged:

1. What were the positive emotions experienced by the students during the role-play activity?
2. What evidence is there of students' understanding of science terms/concepts?

In order to understand better the interplay between role-play and emotions, in the sections that follow, we explore students' emotions expressed during the science activity and we provide theoretical perspectives on emotions research.

Emotions Research

Previously, science education research has mostly focused on the effect of logical reasoning and cognition in learning science. However, over the past 15–20 years, research on emotions in education has emerged and highlighted the importance of understanding emotions experienced by students, and the significance of emotions on learning outcomes (Ritchie & Tobin, 2018; Sinatra et al., 2014). Immordino-Yang and Demasio (2007) have noted that "when we educators fail to appreciate the importance of students' emotions, we fail to appreciate a critical force in students' learning" (p. 9).

Our previous research has shown that middle school students experience both positive and negative emotions when learning science (King et al., 2015, 2017). Research on positive emotions has contributed considerably to understanding the nuances of positive emotional arousal in science classrooms. For example, positive activating emotions, such as enjoyment are associated with positive outcomes (Pekrun, 2006). Research has shown that positive affect increases engagement because positive emotions, such as happiness and joy help to "broaden one's thought action repertoire and build resources" (Fredrickson, 2001, p. 221). One study by Tomas and Ritchie (2012) has shown that students experienced pride, strength, determination, interest and alertness during the BioStory project (a science project with a moral and ethical dilemma) and those emotions were associated with enhanced feelings of self-efficacy. Bellocchi and Ritchie (2015) found links between pride and triumph within classroom interactions and instructional tasks during learning episodes on the topic of energy. This study builds on our earlier research (King et al., 2015) by investigating if a role-play activity has an effect on middle years students' discrete emotions and interest when acting out a scenario related to the socio-scientific issue of organ donation.

Pedagogical Approaches Research: Why Use Role-Play in Science?

Other research has focussed on novel pedagogical approaches used in science classrooms to engage students and generate interest in the problem presented, for example, using video games such as *MinecraftEdu* (Pusey & Pusey, 2015), using gamification (Fleischmann & Ariel, 2016), or using historical vignettes (Bellocchi, 2004) in the science classroom. This research has shown that through novelty and fun, those approaches can generate interest, enhance teaching and learning of science concepts and help students to develop a deeper understanding of the related science concepts and increase their motivation and engagement in science.

Research has also shown that using dramatic pedagogies, such as role-play can be utilised in classrooms as a different pedagogical approach (Dorion, 2009; McSharry & Jones, 2000; Ødegaard, 2003). Role-play is a drama-based pedagogy (DBP)

focused on an embedded process-oriented approach to learning (Lee et al., 2015). The potential benefits of role-play for learning and teaching have long been recognised. It is a fun, engaging and stimulating activity that can motivate students to learn. During role-play, the learners who are participating are required to immerse themselves in a social scenario and take on a role in which they pretend to be someone or something other than themselves (Killen, 2013). Through role-play students are developing their creativity and imagination, which assists in the development of scientific thinking and conceptual understanding and makes learning in science more attractive, especially to students who have been disengaged with science (Heyward, 2010; Killen, 2013). Role-play can be used in teaching of emotionally or behaviourally difficult to handle real-life topics, such as sex and drugs education, child-protection (McSharry & Jones, 2000), or to teach students about moral or ethical issues arising from the curriculum (Colby, 1987), such as climate change, nuclear technology, or organ transplantation. However, there is little research on role-play in school classrooms and the emotions expressed by students as they enact scenarios related to socio-scientific issues. Serious science topics can use role-play to elicit a variety of emotions in students. Positive emotions expressed during the role-play of serious topics may enable students to participate more fully in learning rather than withdraw due to the confronting nature of the topic.

Theoretical Perspectives

This study was informed by theoretical perspectives drawn from theories of emotions founded in sociology (Turner, 2007, 2009). Turner's (2009) sociological theory of emotions is founded on the premise that the dynamics of specific emotions and the social organisation that causes the arousal of discrete emotions are important in theorising about human emotions. He explains that emotions are produced in "socio-cultural conditions and once aroused [will] have effects on these conditions" (p. 342). In a review of twenty scholarly readings, Turner suggests that there are four primary emotions: anger, fear, sadness, and happiness. Emotions are also valanced, i.e. they can be categorised as positive and negative (Stets, 2010). In humans, emotions can be aroused in varying levels of intensity from low, medium through to high-intensity states. Happiness/joy and enthusiasm would be valanced positive and embarrassment would be negative (Turner, 2007). Turner argues that the sociocultural environment impacts on students' expression of emotions, which affects the dynamics of face-to-face encounters and the larger social structures in which they occur. Turner asserts that understanding the sociocultural origin of discrete emotions may afford knowledge about how these emotions affect the micro- (e.g. in face-to-face interactions), meso- (e.g. classroom procedures), and macro- (e.g. school policy) levels of social reality.

Methods for Identifying Emotions in Grade 8 Science

This study is informed by Stake's (2005) interpretive perspective of case studies in conjunction with understandings of ethnography (Creswell, 2012). We have attended 26 lessons over a 9-week period. The lessons were approximately 50 min long. There were 27 students in the class. The unit called 'Singed' required students to learn about skin transplants after they complete a story where a boy is burnt when a jet ski explodes. Drawing on the analysis of multiple data sources, including classroom video recordings, observations of the classroom, field notes, emotion diaries completed at the end of each lesson, thinking prompts and the analysis of facial expressions, insights into individual student's emotions are reported. The analytical techniques used are described in more detail below (i.e. meso-level and micro-level analysis).

Meso-Level Analyses: Emotion Diary (EmoDiary)

Based on the work of Zembylas (2008) and Ritchie (Ritchie et al., 2016) we included 10 discrete emotions on the emotion diary (EmoDiary). Those emotions were agreed by a panel of researchers as the most salient emotions for the middle years' students. They included happiness/joy, sadness/disappointment, anger/irritation, anxiety, disgust, pride, wonder, enthusiasm, frustration, and embarrassment. To prevent students' confusion of less familiar labels, an emoticon for each label was added. At the bottom of the EmoDiary was a scale where students rated their interest level in each lesson on a scale from 1 (very bored) to 10 (very interested). A mean score of interest for each lesson was calculated by averaging students' responses on the interest scale.

Students were asked to complete an EmoDiary at the end of each lesson, indicating any emotion that was strong enough for them to notice and to indicate the intensity of the particular emotion (low, medium, high). During the period of the data collection we accessed over 500 8th grade students' diaries.

An EmoDiary is a self-reporting instrument that requires student cooperation for completion. We met the students during the first lesson at the beginning of the 'Singed' unit to introduce the research and explain the EmoDiary and how students should identify their emotions. The students were given a practice EmoDiary, and following a whole class discussion we were confident that students understood how to recognise emotions and to fill in the diary. The EmoDiaries were analysed by counting each of the emotions reported by students, lesson by lesson. These were graphed and trends were found which can be seen in Appendix 1. Students' comments on the EmoDiaries were analysed thematically.

Meso-level Analyses: Thinking Prompts

The Thinking Prompts were a paper-based questionnaire that examined students' progressive understanding of science concepts which were administered to students on four different occasions in the following lessons: week 1/lesson 4; week 3/lesson 4; week 4/lesson 4; week 8/lesson 3. This enabled us to examine changes in students' answers over the duration of the unit.

In the Thinking Prompts, students were asked eight questions which related to unit content. For example:

1. Have you heard of first, second and third degree burns before?
2. What evidence is used to determine the type of skin burn?
3. What are the differences between them?
4. Have you heard of organ harvesting?

Student responses to the questionnaire were analysed qualitatively in order to gauge students' conceptual understanding that could be attributed to their participation in various lessons using a wide variety of pedagogical approaches, including role-play throughout the duration of the unit.

Micro-level Analyses: Facial Expression

Analysis of the video recordings have been used to complement our data drawn from the EmoDiaries and Thinking Prompts. The videos were analysed for expression of students' emotions. The manual procedure for interpreting students' facial expressions developed by Ekman and Friesen's (2003) Facial Action Coding System (FACS) have been applied. This analysis of in-the-moment students' emotional facial expressions was used to reinforce or triangulate the discrete emotions identified from the multiple methods utilised in this study.

Study Context: The School, The Biology Unit, The Two Case Studies

This study was conducted in a Year 8 science classroom in a large co-educational urban school in South East Queensland. The science class consisted of 13 boys and 14 girls, typically aged between 12 and 13 years. The context for this science unit was burns. The unit explored concepts related to burns such as the structure of cells and function, skin structure, skin grafts, organ harvesting and organ donations affording opportunities for connections with the real-world. Lessons included a variety of activities such as computer-based lessons where students researched organ harvesting, teacher-led lessons, lessons with a guest speaker, debates, video

lessons, decision making activities, poster activities, reporting, role-play activities and laboratory activities. During the unit, an innovative story-writing approach about socio-scientific issues, namely BioStories was used (e.g. Ritchie et al., 2011).

In this study, the researchers were interested in the emotional engagement of the year 8 students during the role-play activity that occurred in the unit during week 6, lesson 2. During the role-play activity the students were asked to form groups (4–6 students) and to firstly, write a script and secondly, act out a short drama depicting the ethical dilemma about organ donations through role-play. The task required students to reproduce the events that could occur when a decision was needed to be made about the use of organs from a brain damaged relative who was in hospital. Students were given four defined role-play characters that included:

1. The intensive care doctor;
2. A parent of the young person who is brain damaged from, either (a) the collapse of a rugby scrum or (b) a fall off a horse whilst show jumping;
3. A brother or sister;
4. The hospital transplant specialist coordinator.

The research presented here focuses on two focus groups where students chose their own groups for this activity. The first group consisted of high achieving students who worked very hard to achieve good results in science. Table 1 shows the names of those students and the character roles that students were acting during the role-play.

The second group were academically lower achievers than Focus Group 1, but demonstrated high levels of engagement with the activity. Names of those students and their character roles are presented in Table 2.

We decided to focus on these two groups, as they present the range of emotional experiences expressed during the activity. In addition to the fine-grained analysis

Table 1 Focus group 1

Student's name (Pseudonym)	Role-play character
Rosie	Intensive care doctor
Cassie	Hospital transplant specialist coordinator
Tessa	Sister
Alicia	Mum

Table 2 Focus group 2

Student's name (Pseudonym)	Role-play character
Alex	Intensive care doctor
Nola	Hospital transplant specialist coordinator
Carol & Vanessa	Twin sisters
Cathy	Mum
Sophie	Brain damaged person

of the two case studies, we graphed the results of discrete emotions as recorded by each student in the class across 10 of the 26 lessons. We chose to focus on those 10 lessons only, because those lessons were at the end of the unit and they were representative of the range of the emotions and interest recorded by the students. Furthermore, we graphed the average interest scores as recorded by each student for each lesson on a Likert scale at the end of the EmoDiary. The peaks and troughs of the average interest score for the entire class are in Appendix 1. Whilst a full analysis of this graph is beyond the scope of this chapter, the analysis provided an indicative view of the variation in emotions and interest ratings across 10 (out of 26) lessons of observations. Lesson 2 in week 6 stood out in the analysis of the interest graph for showing the highest average interest recorded by students (8.67/10). This high average interest score, coupled with the many positive emotions recorded by students correlated with a lesson on role-play and required further investigation to understand better students' emotions and the activities that may have led to a positive experience. In the following section we present two cases to show how the emotions were aroused in the class during the role-play activity. We also argue that through the Thinking Prompts students have shown an improved understanding of the science of skin burns developed throughout the whole unit.

Results

Assertion 1. Positive emotions of happiness/joy and enthusiasm were expressed during the planning and re-enactment stages of the role-play activities.

A summary of students' mean interest levels across the 10 lessons in the unit were calculated by averaging students' responses to the interest scale (see Appendix 1). Overall, students' mean interest scores varied between 6.88 (lesson 6.1) and 8.67 (lesson 6.2). The mean score for the entire unit (26 lessons) was 7.30, suggesting that the students were generally interested during the science lessons. The 'organ donation' role-play activity scored the highest average rating of 8.67, compared with lessons such as lecture-style lessons with PowerPoint slides (6.88) and the computer room research task (7.09). In the role-play lesson students in both focus groups expressed a high level of interest and also reported experiencing the discrete emotions of happiness/joy and enthusiasm. The following analysis shows how the students from both focus groups were expressing heightened emotions during the planning stage of the role-play.

Focus Group 1 (FG1)

This focus group consisted of 4 students, namely Rosie, Cassie, Tessa, and Alicia (see Table 1). The lesson started with the students inside the classroom. Five minutes into this lesson, students were told to go outside and practice their role-play. The

following excerpt occurred 14 min and 36 s during the practice role-play session outside the classroom (see Excerpt 1). Both Cassie and Tessa were seated on the table, while Alicia was taking notes and writing the script. They were discussing organ transplant as they wrote the script and discussed death and what happens to the body. In turn 1 Alicia was asking Cassie (who was playing the hospital transplant specialist role) what she should say in the role-play when thinking about donating her organs when she dies. "What do you want done with your body when you die?" In turn 2 Cassie agrees that this is the correct way to state the question in the script rather than "what do they do with your body when you die?" This toing and froing to determine the correct script was typical of the way the students engaged with each other. In turn 3 while leaning on the table and covering her hand with her left arm, Alicia (who is playing the role of mum) says "And at that part I'll bury my head into my eyes" and started to laugh. Although the script they were creating was relatively sad (referring to Alicia's death and the removal of her body), there was much laughter. Alicia's laugher appeared contagious as other girls started to laugh in synchrony with her, showing a shared positive mood and collective effervescence (Fig. 1) (Tobin et al., 2013). However, afterwards, as Tessa sought to control her laughter, she commented that "This is awful" (turn 4) referring to the more sober topic of a discussion of a body after death. In the following turn Cassie said in a quiet voice that "This is a very interesting science lesson" (turn 5), and Rosie agreed. The excerpt below revealed a moment where Cassie states that she is finding this lesson interesting. As Cassie was a high achieving, conscientious and quiet student, her statement was noteworthy for us.

Using Turner's (2009) sociological lens that emphasises the interplay between the dynamics of specific emotions and the sociocultural conditions during the group

Excerpt 1 Focus group one planning their role-play: an 'Interesting lesson'

Turn	Speaker	Role	Conversation
1	Alicia	Mum	Yeah. What do they do with your body when you die? No, that's what you would say; What do you want done with your body when you die?
2	Cassie	Transplant specialist	Yes
3	Alicia	Mum	And at that part I'll bury my head into my eyes *(covering her head with the left arm)* into your eyes *(all laughing)* (Fig. 1)
4	Tessa	Sister	This is awful
5	Cassie	Transplant specialist	This is a very interesting science lesson
6	Rosie	Intensive care doctor	Good. Aj?
7	Alicia	Mum	Don't let me write anymore
8	Tessa	Sister	Are we done?
9	Rosie	Intensive care doctor	Is that done?
10	Alicia	Mum	No, and then you should be like, mummy I think we should do this *(all laughing).* Yeh, I like that

Fig. 1 Girls are happy

work that contributed to the expression of these emotions, we have identified students' positive emotions during the role-play activity. Through the analysis of the EmoDiary completed by the FG1 students, it was evident that FG1 students experienced high intensity emotions of happiness/joy and enthusiasm as reported in the diary (see Table 3) during this event outlined in Excerpt 1. For example, Cassie commented that she was "Very happy today that I couldn't stop laughing while presenting the play. It was so funny that it was hard to keep a straight face", and that she was "very enthusiastic throughout [the] lesson to participate in [the] group activity and perform it, even [if] we couldn't stop laughing".

Focus Group 2 (FG2)

There were six students in the Focus Group 2 (FG2) (see Table 2). Similarly, as for FG1, the FG2 students expressed excitement and enthusiasm when they were planning the role-play. In a 4-min segment of the lesson, the teacher had to tell them four times to be quiet because their voices and laughter were becoming too loud. Eventually, the teacher asked them to move to another location where their voices would not travel to other classes. On one occasion the teacher said: "I love you being excited, but you've got to respect other people". After moving to the other location, behind the classroom, FG2 students continued with their role-play practice. The girls agreed that Sophie will play the brain damaged person after the fall off a horse. The following conversation (Excerpt 2) occurred 10 min and 36 s into their practice session when students were discussing if they should revive a dead person played by Sophie.

Despite Sophie expressing that she did not like the idea of the two boys performing CPR on her (turns 2–10), she showed happiness through her exclamation in turn 13 with the statement that "This is the funniest lesson ever" (turn 13 & Fig. 2). At this moment her facial expressions showed the emotion of happiness, as defined by Ekman and Friesen (2003), as her cheeks were raised, the corners of her lips were drawn back with mouth parted and teeth exposed. In the following turn, Vanessa (sister) agreed with Sophie and said, "It is!". Both students also indicated in their EmoDiary,

Excerpt 2 Sophie is happy

Turn	Speaker	Role	Conversation
1	Nola	Transplant specialist	Yeah but they will never recover but some other people might die because you did not donate their organs
2	Alex	Intensive care doctor	Unless you guys want to try CPR
3	Sophie	Brain damaged person	Don't you dare!
4	Vanessa	Sister	Yes?
5	Sophie	Brain damaged person	Ew. No. Gross
6	Nola	Transplant specialist	Maybe Sean?
7	Carol	Sister	Ew. Even more gross
8	Vanessa	Sister	Or Tim Fanshawey?
9	Nola	Transplant specialist	Fanshawey?
10	Vanessa	Sister	Fanshawe!
11	Nola	Transplant specialist	Okay. Then after you say yes. After you sign the papers and say yes
12	Cathy	Mum	I'm not signing anything
13	Sophie	Brain damaged person	This is the funniest lesson ever (Fig. 2)
14	Vanessa	Sister	It is!

Fig. 2 Sophie is happy: "This is the funniest lesson ever"

a high level of happiness/joy and enthusiasm and commented that "Today was fun, funny". Nola who was playing the character of a specialist doctor experienced a high level of pride as reported on her EmoDiary and commented that it was the "Best play ever by us" (Table 3).

From the field notes made by the researcher (author 1) it also was evident that FG 2 students and especially, Vanessa, Sophie and Nola have experienced positive emotions, as they were laughing a lot, smiling and being emotionally involved in their role-play practice session. Further evidence of students' happiness in FG1 and FG2 can be seen in the recorded emotions and comments written on their EmoDiaries that day (Table 3). The analysis shows that students in both focus groups expressed the positive emotion of happiness/joy and enthusiasm in the role-play lesson and that

Table 3 Reported emotions by students from both Focus Groups (FG1 and FG2)

Student	Discrete emotion	Intensity of emotion (Low/Med/High)	Comments on EmoDiary to question: *In your own words, what you were doing, and what happened, when you experienced the emotion?*
Focus group 1			
Cassie	Happiness/Joy	High	Very happy today that I couldn't stop laughing while presenting the play. It was so funny that it was hard to keep a straight face
	Enthusiasm	High	Very enthusiastic throughout lesson to participate in group activity and perform it, even we couldn't stop laughing
Alicia	Happiness/Joy	High	Drama activity *(with drawing of a heart)*
	Enthusiasm	High	To drama-up science
Tessa	Happiness/Joy	High	Play/Acting
	Enthusiasm	High	Drama/skit
Rosie	Happiness/Joy	High	Role playing
Focus group 2			
Sophie	Happiness/Joy	High	Today was fun, funny
	Enthusiasm	High	
Alex	Happiness/Joy	High	REALLY FUN hahaha
	Enthusiasm	High	Coz it was fun doing the play thing
Nola	Happiness/Joy	High	Role play
	Pride	High	Best play ever by us
Cathy	Happiness/Joy	High	We did plays today!
Vanessa	Happiness/Joy	High	Role-play
	Enthusiasm	High	Role-play!
Carol	Happiness/Joy	High	Role-Play!

they rated the lesson as highly interesting. An overall interest level for both groups was 9.6/10.

In contrast, despite having a safe and supportive environment provided by the teacher and other students, three students from both focus groups experienced different intensity levels of embarrassment during the re-enactment and performance in front of the class. Alicia and Tessa were from the high achieving FG1 and both experienced embarrassment, indicating on their EmoDiaries that the intensity of it was high and commented that they were embarrassed because of "the awkward performance" and "when presenting". Nola, a student from FG2 indicated that she experienced a low level of embarrassment, with a comment in her emotion diary of

"Role play" next to this emoticon. It is important to note that only one more student from the entire cohort of 27 students indicated experiencing a low level of embarrassment. Overall, 4 students from the whole class of 27 students felt embarrassed when acting out in front of the class reminding us that uncomfortable feelings can be experienced when students are asked to perform in front of their peers. While role-play is a strategy that was experienced predominantly positively by most students in the class, we suggest that teachers incorporate strategies for encouraging students to participate who may be hesitant or embarrassed.

Assertion 2. Students showed an understanding of science concepts related to skin burns.

The Thinking Prompts, a paper-based questionnaire that examined students' progression of learning science concepts (e.g. skin anatomy and physiology, types of burns, skin grafts, organ harvesting) were administered to students on four different occasions, as explained earlier. Table 4 describes the progressive improvement of two students' understanding related to the topic of burns. Two students' responses (Cassie and Sophie) before and after the role-play are included.

Analysis of the Thinking Prompts revealed evidence of students' improved understanding of the biology concepts related to skin burns after the role-play (e.g. in

Table 4 Representative responses of the thinking prompts by Cassie and Sophie

Thinking prompts	
Before role-play (W3/L4)	After role-play (W8/L3)
(a) Cassie (from Focus Group 1)	
Q1. Have you heard of first, second and third degree burns before? What are the differences between them?	
Not sure, know that first, second and third degree comes in a particular order	First degree burns involve the injury to the **epidermis*** layer
	Second degree burns involve the **dermis l**ayer (part of)
	Third degree burns involve the whole entire epidermis layer and can extend through to the **subcutaneous** layer if severe
Q2. What evidence is used to determine the type of skin burn?	
(No entry)	Blisters, severe pain + red skin for 2nd degree (also swelling)
	Redness and local pain is felt in 1st degree
	No pain felt in injury + Depth of injury for 3rd degree (loss of pain sensitivity)
Q3. Have you heard of skin grafts before? What do you think it is?	
No. I don't know, maybe something to do with skin issues?	Yes. They are **donated** skin that is used on patients if their skin can't produce skin for the burn/wound to heal
Q4. Have you heard of organ harvesting? What is it?	
No. Harvesting the organs! (I think)	Yes. Practice of removing usable organs from somebody dead in order to be **transplanted** into somebody else

(continued)

Table 4 (continued)

Thinking prompts	
Before role-play (W3/L4)	After role-play (W8/L3)
(b) Sophie (from Focus Group 2)	
Q1. Have you heard of first, second and third degree burns before? What are the differences between them?	
Yes, a first degree burn is a minor. A second degree kills the skin but should heal. Third degree burns kill the nerve endings and leave scars	Well, first degree only burns the **epidermis,** the second degree burns through the epidermis and into the **dermis** and a third degree burn, burns through all the layers, including the **subcutaneous***
Q2. What evidence is used to determine the type of skin burn?	
I don't know???	How deep the burn is, the percentage of skin that has been burnt and the amount of **scaring**
Q3. Have you heard of skin grafts before? What do you think it is?	
Yeah. I don't know, I have just heard of it	Yeah! *(with drawing of a smiley face).* When skin is taken from the **donor site** & placed on the **recipient site**
Q4. Have you heard of organ harvesting? What is it?	
Yes. When someone dies, if they have good organs, they can be given to people who need them	Yeah! *(with drawing of a smiley face).* **Harvesting** deceased people's organs and giving them to people in need

Note* Words marked in **bold represent new biology science concepts

question one, both students have used a new biology term accurately for the skin layers, such as dermis, epidermis and subcutaneous layers). Interestingly, for all of the students in the two focus groups, the analysis showed that 8 out of the 10 students showed an improved understanding of the concepts of skin burns through the Thinking Prompts responses, in a similar way to Sophie and Cassie. However, we cannot say definitively that the role-play contributed to students' improved responses on the Thinking Prompts, but that role-play was one strategy used to encourage an understanding of the science concepts associated with organ transplant. Two other students were absent from the class when the Thinking Prompts survey was administered after the role-play.

Summary

In this multiple-case study we report on the interplay between role-play and student emotions. The findings in this study highlight the importance of group interactions and cooperative design during the preparation of the role-play to enable students to 'act out' the ethical dilemma of organ donation. The study has found that role-play evoked students' strong positive emotions (high intensity expressions of happiness/joy and enthusiasm) when students enacted character roles during the role-play. These positive experiences aligned with a high interest score when class results were averaged.

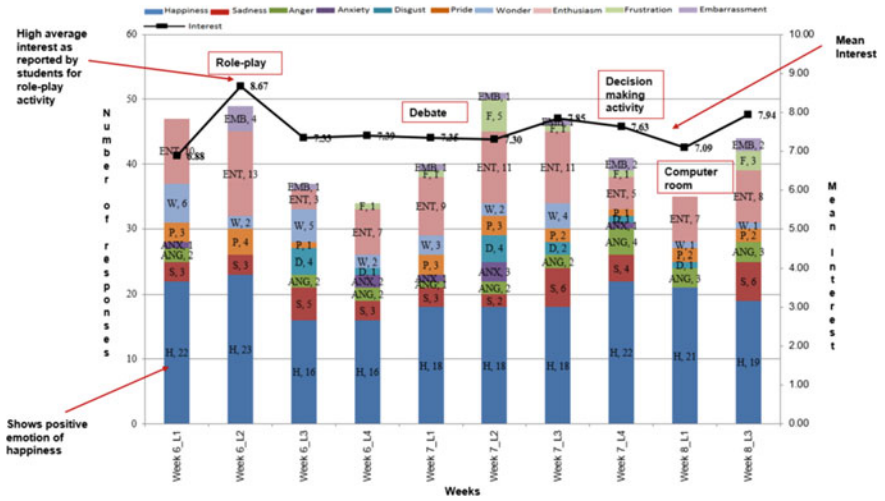
Importantly, the Thinking Prompts which were written before and after the role-play, showed evidence of improved students' learning and understanding of the science concepts related to skin burns (Table 4). However, it should be noted that apart from using the role-play during the unit, the teacher utilised various other pedagogical strategies, such as debates, hands-on activities, poster activities and decision-making activities.

As the research has shown, in the science classroom, the role-play is still underused and not a regular part of teachers' repertoire, often because role-play is used more frequently in creative arts-based lessons and there is a lack of examples and research showing how it can be used in the science classroom. Some teachers also fear that they are losing control in the classroom when teaching in an active way. However, this chapter indicates that the meaningful incorporation of drama-based pedagogy (i.e. role-play) with science in a year 8 class increased students' positive discrete emotions and interest while contributing to students' learning of science concepts.

We argue that role-play, as an emotionally engaging activity, should be used in the classroom to complement other pedagogical approaches in order to enhance students' engagement and interest, and that it can potentially contribute to a student's positive association with science. To make effective use of role-play in science education teachers need to be cognisant of how the role-play will support students' learning and development of conceptual science understanding and which strategies to use for encouraging students to participate who may be embarrassed. If done correctly, role-play can be enjoyable and rewarding emotional classroom experiences for the students and teachers and offers significant potential to contribute to a student's positive association with science. Such positive experiences may lead to students recalling science favourably which may have a longer lasting impact; influencing students to choose to continue studying science beyond post-compulsory schooling or for a continued personal interest in science. However, we do not advocate that all science lessons should be a highly intense emotional experiences for students, but such lessons occasionally, can contribute to positive outcomes for students.

Through a better understanding of the type of science activities that evoke positive emotions in students, and how this contributes to students' interest and enjoyment of science, we can determine the activities that are more likely to emotionally engage middle school students. Such research will be of value to current science teachers and pre-service science teachers for planning activities that afford opportunities for positive experiences for students.

Appendix 1: Graph of Mean Interest Rating and Emotions as Recorded by Students for Weeks 6–8



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