

## Teaching cells using drama : Reflections on practice

### Abstract

Drama is used in science education as a method to enhance various abilities. A common reason for using drama is to stimulate conceptual understanding. This study reports on a project focusing on learning about cells, in which 50 student teachers participated in a teacher directed drama and some of them moved on to create their own dramas about processes in cells. Responses on of how the student teachers experienced the dramas were collected through a questionnaire, and written reflections. Data were analysed both descriptively and by using a modified version of the tool Content Representations (CoRe), which is related to the theoretical framework of Pedagogical Content Knowledge (PCK). The results show that almost all of the student teachers were positive to the use of drama in science education and the majority wanted more instruction on drama methods in their teacher education. The results support earlier studies reporting on reasons for using drama in science education and in addition, some new aspects were added to the practice of drama in science education.

### Introduction

Drama is used in science education as a method to enhance conceptual understanding, knowledge about the nature of science or the focus on dimensions of science in society (Ødegaard, 2003). Furthermore, drama has also been used in science education to stimulate the development of inquiry-skills (McGregor & Precious, 2010), as well as to assess how children progress in their knowledge and thinking about science (McGregor, 2012). However, even though there have been reports of the positive effects of using drama as an instructional strategy in science education, it seems that it is not widely used (Ødegaard, 2003; Alrutz, 2004).

In earlier studies, both pre-service and in-service teachers have mentioned that they need to develop their knowledge about different instructional strategies to support students' learning (e.g. Alake-Tuenter et al., 2012; Käpylä et al., 2009; Nilsson, 2009, 2014). From a Swedish perspective, the use of drama is commonly not included in science teacher education courses. Hence, there is a need to provide teachers and student teachers with training in how to use drama in science education, as well as discussions on purpose and when it could be rewarding to use drama as an instructional strategy.

This study investigates how student teachers reflect on the use of drama as a tool to enhance conceptual understanding about cells in the terms of knowledge about different kinds of cells and major cell-processes.

Furthermore, the study investigates how both primary and secondary student teachers reflect on the use of drama in science education regarding their future teaching practice and the science teacher education programme. The research questions are:

*How do student teachers reflect on drama as a strategy to stimulate conceptual understanding about cells and cell processes?*

*How do student teachers reflect on the use of drama in future education?*

## Method

### Research context

The study was conducted during two science teacher courses at a university in mid-west Sweden. The courses did not have any drama included in the curriculum, but had a focus on science education. One of the courses was for student teachers in primary school and the other for future teachers at secondary school level. Hence, the aims of learning about cells were not the same for the two groups of students.

### Data collection and analysis

In the primary teacher science course, 40 students volunteered to participate in the study. In the secondary teacher science course, 10 students consented to participation.

Responses from the participants on how they experienced the dramas were collected through a questionnaire (the primary student teachers) and written reflections (the secondary student teachers). The questionnaire was distributed at the end of a course in science, about three months after a session when drama was used to teach about cells. The secondary student teachers reported their reflections at the end of a course that lasted for two months.

Data from the questionnaire were analysed descriptively. The reports from the secondary student teachers were analysed with a modified version of the tool, Content Representations (CoRe), which is related to the theoretical framework of Pedagogical Content Knowledge (PCK).

CoRe was developed by Loughran, Mulhall and Berry (2004), who believed that it is important that teachers can articulate their practice in relation to knowledge and theories. The tool presents a way in which issues of specific science content, as well as strategies on how to teach this content, can be captured. The tool has earlier been used by Walan, Nilsson and McEwen (2016) to analyse primary school teachers' reflections when they used an inquiry- and context-based teaching model as part of their instructional strategies. In the modified version of CoRe, drama is added as the instructional strategy chosen, hence the teachers cannot choose any strategy, as in the original version. An overview of the participants and the methods used in this study is presented in Table 1.

**Table. 1.** Overview of participants, form of drama used and methods for data collection and analysis.

<b>Group of student teachers</b>	Primary school (40 student teachers)	Secondary school (10 student teachers)
<b>Drama approach</b>	Teacher directed	Teacher and Student directed
<b>Purpose of drama</b>	General view of cells and cell processes.	Conceptual learning about cells and cell processes (more in depth) and idea of instructional strategy
<b>Data collection</b>	Questionnaire	Student reports
<b>Data analysis</b>	Descriptive	Qualitative based on CoRe

## Results

The results of the research questions are presented from both the primary and secondary students teachers' perspectives based on the different data collections and analysis.

### Student teachers' reflections on drama as a strategy for conceptual understanding about cells and cells processes.

The primary student teachers all responded that they remembered the drama about cells, even though three months had passed since the session. They remembered different aspects of the content of the drama and mentioned fragments of the drama, such as the organelles in cells and their function, and the artefacts used in the drama (such as the specially designed t-shirts for each of the organelles). Some students also reported that they got the whole picture and understood how cells are organised and function. Some of the responses included several aspects. One student could for instance respond that she/he particularly recalled artefacts and the organelles. An overview of the responses of what the primary student teachers remembered from the drama about cells is found in Table 2.

**Table 2.** Responses to what students remembered from a drama about cells.

<b>What students remembered</b>	<b>Artefacts</b>	<b>Fragementes</b>	<b>The whole picture</b>	<b>The organelles</b>	<b>The functions of the organelles</b>
<b>Number of responses</b>	11	10	23	3	9

In a specific item in the questionnaire the primary student teachers were asked if they had learnt what is characteristic of cells and their main processes and whether the student teachers had grasped the differences between plant cells and animal cells. The results are presented in Table 3.

**Table 3.** What primary student teachers claimed that they had learnt about cells after the use of a drama.

<b>Item/Respons</b>	<b>Yes</b>	<b>No</b>	<b>Partly/maybe</b>
3A (what a cell is)	36	2	2

3B (what cells are doing)	38		1
3C (differences animal and plant cells)	31	4	5

Here are some examples of open comments made by the primary student teachers on the use of drama to stimulate learning about cells and cell processes:

*It is engaging and concrete and visualises the processes, makes it easier to learn.*

*It makes it possible to get the whole picture of what is going on.*

*It is so much easier to remember.*

*It is good because you experience it through several senses, so it is easier to learn and remember compared to traditional lectures.*

The secondary student teachers' reflections on drama as a strategy for conceptual understanding about cells and cells processes is presented based on some of the items from the modified CoRe (Table 4). The student teachers' individual reflections are presented in short and grouped in the different themes they chose to dramatise.

**Table 4.** Items from the modified CoRe related to the research question about drama and conceptual understanding about cells and cell processes with the student teachers' responses in summary.

Item	Protein synthesis	Meiosis	Animal cell	Translation	Cancer cells
<b>The Big ideas</b>	<p>The whole picture of the process.</p> <p>How the nucleotides are paired.</p> <p>The difference between transcription and translation.</p> <p>What is a codon?</p> <p>The function of ribosomes.</p>	The process of meiosis.	The "anatomy" of animal cells, and the function of different organelles.	<p>The process of translation.</p> <p>The role of mRNA, tRNA and rRNA.</p>	<p>What is cancer?</p> <p>How can it be treated?</p> <p>Emotions related to cancer.</p>
<b>Expected difficulties for the students</b>	To grasp the whole process.	To know the difference between	Students may mix different organelles	So many steps and concepts involved for	Cell division

	The difference between transcription and translation.	mitosis and meiosis.	and their function.	students to grasp.  The language is new to the students.	
<b>Teachers' own SMK</b>	The drama required SMK.	The drama required SMK.	It helps me as a teacher to get the whole picture. Something to relate to.	A support for me in my learning. Made it possible to see the whole picture.	I needed to check that I had understood things correctly when I wrote the script for the drama. Required SMK.

The summarised results of the student teachers' reflections on drama as a strategy for conceptual understanding about cells and cells processes show that both the primary and the secondary student teachers groups were on the whole positive. Most of the student teachers found that the use of drama helped them in their own conceptual learning not only in terms of getting the whole picture, but also in learning details and comparing differences between cells and cell processes, such as mitosis and meiosis. The secondary student teachers also reported what they believed was important for students to know (big ideas) and what they expected to be difficult for students to understand.

### Student teachers' reflections on the use of drama in future education.

This research question investigated how the student teachers reflected on the use of drama in future education both in terms of their own needs for more education, learning how to use drama in the teaching of science, but also in their ideas of using drama in their own future teaching.

The results of the primary student teachers reflections on the use of drama in future science education showed that almost all of them want to use drama in their future teaching of science. Furthermore, most of the primary student teachers responded that they wanted to have more drama in their science education course at the university (Table 5).

**Table 5.** Primary school student teachers' responses to future use of drama in their science teaching and needs of training to develop more confidence in using drama.

Item/Respos	Yes	No	Maybe	I don't know
<b>Drama in future teaching of science</b>	37			2
<b>Need of more drama in science course</b>	28	5	2	4

Here are some examples of open comments made by the primary student teachers on the future use of drama in their science teaching and needs of training to develop more confidence in using drama:

*More drama in chemistry; it is such a difficult subject to understand.*

*More drama in physics, especially about pressure.*

*I would like to have drama about atoms and molecules.*

*I get the idea now, so not necessary with more drama in this course.*

The results of the secondary student teachers reflections on the use of drama in future science education are based on five items from the modified CoRe. The student teachers reflected on the positive aspects of using drama, the challenges, drama in science education in general, in their future teaching and their perceived needs of more instruction in how to use drama in science education. Once again the reflections are presented in short and grouped into the different themes that were dramatised (Table 5). All of the student teachers had positive arguments for using drama in science education. Some of them argued that it is positive that students can be engaged and involved and stimulated to learn. One group of students highlighted social aspects, development of creativity, and language skills.

The student teachers also found some challenges in using drama, such as being a time consuming activity, the requirements of space, the risk of misconceptions, etcetera. Most of the student teachers thought that the use of drama as an assessment tool would be quite difficult. Overall the student teachers were positive to the use of drama in science education in general, but there were arguments presented emphasising that it is important that the use of drama should be serious and not just for having fun. One student teacher, who had worked with the cancer cell drama, thought that sometimes the use of drama could make things more complicated. Nine of the student teachers thought that the support of a drama teacher could help them develop their use of drama even more. However, one of the student teachers who developed a drama about translation was clear about not needing any more training in how to use drama in science education.

**Table 5.** Items from the modified CoRe related to the research question about drama in future science education with the student teachers' responses in summary.

Item	Protein synthesis	Meiosis	Animal cell	Translation	Cancer cells
Positive with drama?	It can be the best way for	Students can become more involved than	It can support students'	Students can become	Can support learning

	some people to learn.	<p>with traditional teaching.</p> <p>It is fun.</p> <p>It is positive from social aspects.</p> <p>It stimulates creativity. It can support learning of science language.</p>	learning since they can be involved and experience through their own senses and bodies.	parts of the process, and it will help them in their learning.	for many students.
Challenges using drama?	Time consuming.	<p>A risk of misconceptions.</p> <p>Risk of students just playing around and not being serious.</p> <p>Practical issues, getting space in classrooms.</p> <p>Teachers need to be aware of critical social aspects among the students.</p>	Risk of misconceptions if the teacher is not clear about the use of metaphors, for instance.	A risk is that you can make processes too simple.	<p>To really involve all students.</p> <p>It takes time to prepare.</p> <p>A risk that students only learn their role and do not get the whole picture.</p>
Drama as assessment	Difficult to assess students'	Possible, since those creating the drama	Difficult to assess students	Difficult to measure	Possible.

	knowledge of science individually in a drama.	need to understand it.	individually using drama.	if students really understand. Prefer traditional tests.	Maybe a problem for students who are shy.
Drama and science in general	Positive. Seems to stimulate learning from a sociocultural aspect.	Positive. Great with combination theory and practice.	Positive. Can be used as a summary before a test, for instance.	Important to use drama in a serious manner, not just for fun.	Learning with the body. Positive.  Some things could be more complicated to show using drama.
Drama in future teaching	Positive to using it.	Positive.	Positive, but time consuming.	Positive.	Positive. It is good with variation in teaching.
Need for training, using drama in science teaching	Need more training in this to feel comfortable.	Was not that difficult. Perhaps could be more developed with support from drama teacher.  Need for knowledge about different	Maybe a drama teacher could show the best ways to use drama.	No.	A drama teacher could probably find parts in the drama that could be presented more clearly.



		drama techniques.			
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In summary, the results of the primary and secondary student teachers' reflections on the use of drama in future education show that they were on the whole positive to the use of drama in their future teaching of using. The majority of the student teachers argued that they thought that more drama in their education at the university could be useful and they wanted more instruction on drama methods in their teacher education.

## Discussion

As already argued earlier studies of aspects of drama in science education have reported positive outcomes, yet drama is not often used (e.g. Ødegaard, 2003). Abrahams and Braund (2012) argued that designing effective science lessons using drama requires expertise across two very different subject areas; consequently, many science teachers find it difficult to incorporate this instructional strategy into their teaching. Earlier studies have also reported on the needs of science teachers to develop instructional strategies (e.g. Alake-Tuenter et al., 2012; Käpylä et al., 2009; Nilsson, 2009, 2014). In this study some outcomes of using two different forms of drama in science teacher education courses were investigated. The drama strategies used were a teacher directed drama and, for the secondary student teachers, participation in a task based on student directed dramas. The study focused on how the two groups of student teachers reflected on the use of drama to stimulate conceptual understanding about cells and cell processes, but also about reflections on the use of drama in science education in the future.

The positive outcomes of using drama to stimulate conceptual learning reported in earlier studies (e.g. Ødegaard, 2003) were confirmed in this study. However, there were also some new aspects found in the data. One of the student teachers in this study discussed how drama could be used to handle emotions connected to the teaching of science, in this case, teaching about cancer cells. There are examples when drama has been used to handle emotions, for instance, when dealing with conflicts (Malm & Löfgren, 2007) or other kinds of emotions such as anger, embarrassment, suspicion, surprise or concepts such as friendship, fear, creativity or ignorance (Farmer, 2011). However, to my knowledge, using drama in science education has not been presented explicitly in relation to handling emotions.

Student teachers in this study confirmed earlier reported challenges of using drama in science education such as something being time consuming, or the lack of space (e.g. Alruz, 2004; Darlington, 2010; Dorion, 2009).

Furthermore, the student teachers were both positive and critical in their reflections on the use of drama in science teaching relating to social aspects. The positive reflections indicated that drama could provide students with a social context and develop their language. Drama approaches in classrooms usually require social interactions and collaboration between participants (e.g. Dorion, 2009). Furthermore, social constructivist models of teaching emphasise the need for collaboration and dialogue (Kim, 2001). The main critical aspect of using drama in science teaching was related to social aspects as the need to really include all students if drama was used was stressed. There were some opinions that the teacher needs

to be aware of the social climate in the class, e.g. bullying, which could be problematic in a drama situation. These thoughts can be related to teachers' need to have general pedagogical knowledge and management of the classroom (Shulman, 1986, 1987). However, this risk has probably not been mentioned previously in research about drama in science education. This does not mean that the risk exists, but that it has not been highlighted as a constraint to using drama in science education.

Despite the critical reflections on the use of drama in their future teaching of science, the student teachers were positive and most of them responded that they would use drama as an instructional strategy in their future education of students. The student teachers gained many insights about the use of drama in science education after only one session and task. Still, more development is needed. Abrahams and Braund (2012) discussed that it could be a problem for science teachers to use drama since this is a field that science teachers are usually not familiar with. Hence, it was of interest to find out how the student teachers reflected upon the competence that drama teachers have and if they would appreciate more training or support by a drama teacher. Most of the student teachers believed that it would be positive and that they could develop their competence and skills in how to use drama in science education. However, one of the student teachers argued that science is the main subject and not too much focus should be placed on drama.

Teachers have their own ideas of the kinds of instructional strategies they prefer. Some teachers are positive to the use of a variation of strategies and some want to stick to traditional ways of teaching. Still, in this study, student teachers in science were provided with the opportunity to use drama, and the majority found it positive.

Future studies could explore even more and other outcomes, or effects of integrating drama in science teacher courses. In this study the secondary student teachers were presented both to teacher directed and student directed forms of drama. However, any comparisons of how the student teachers reflected on the different forms were not investigated because of time constraints. This is another possible future study. It could also be of interest to investigate whether these student teachers actually will use drama in their future teaching when they have graduated and started their teaching career.

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## Appendix

### Items used in the questionnaire delivered to primary student teachers.

1. Do you remember the drama we did about cells at the beginning of the course?
2. What do you remember from the drama? Please write everything you remember.
3. Did you learn a. what a cell is?  
b. what cells are doing?  
c. the differences between animal cells and plant cells?
4. Have you experienced other drama sessions connected to science in your teacher training? If so, what?
5. Would you like to have more drama in your teacher training? If so, why?
6. Do you think you will use drama in your future teaching of science? If so, why?
7. Do you wish that we had included more drama in this science course? If so, what kind of science should the drama be connected to?

### Original CoRe as presented by Loughran et al., (2004).

Each item is connected to Big ideas (what students are supposed to learn, in particular).

1. What do you intend students to learn about this idea?
2. Why is it important for students to know this?
3. What else you know about this idea (that you do not intend students to know yet?)
4. Difficulties/limitations connected with teaching this idea.
5. Knowledge about students' thinking, which influences your teaching of this idea.
6. Other factors that influence your teaching of this idea.
7. Teaching procedures (and particular reasons for using these to engage with this idea).
8. Specific ways of ascertaining students' understanding or confusion around this idea (include likely range of responses).

### Items in the modified Core used for ananlysis of secondary student teacher reports.

1. What do you expect students to learn about this specific knowledge? (Big ideas).
2. Why is this important for students to learn? (Why learn this.)

3. What is your knowledge of students' conceptions/misconceptions of the subject and how do these influence your teaching? (Expected difficulties for the students).
4. What about your own knowledge within this field? (Teachers' SMK).
5. How do you think drama can support this kind of learning?  
(Positive with drama in this case?)
6. What difficulties could occur in connection with the teaching of this content, i.e. what problems could arise in the educational situation?  
(Challenge with drama in this case?)
7. How do you think drama can be used to assess students' learning about this specific knowledge? (Drama as assessment).
8. How do you reflect on the use of drama in science education in general? What can be positive and what can be a challenge? (Drama and science in general)
9. How do you reflect on drama as an instructional tool in your future teaching? (Drama in future teaching?)
10. How do you reflect on the use of drama, in terms of not having previous education in how to use this strategy? Did you feel a need to have support from a drama teacher? Please motivate your answer. (Need for education using drama?)