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Biotechnology learnings using 'Claymation' and 'Slowmation'.

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This 'Claymation' and 'Slowmation' project incorporated content as well as skill development. The participants – 4 pre-service teachers and 4 secondary school students explored chromosome mapping and DNA replication. Through research, the writing, revising and editing of storyboards, two short videos were produced. Two of the pre-service teachers had prior experience with Claymation, however none of the participants had prior knowledge of chromosome mapping or DNA replication. This paper describes the learnings of the participants in terms of their self generated questions, the need for attention to detail, and argumentation / negotiation skills.

Introduction

This paper describes a small study investigating "learning *with* technology" (Jones, 2005, p.1). Jones distinguishes between learning *with* and learning *from* technology, in that learning *from* technology involves passive learning from a web page, a video or an audio recording. Learning *with* technology is "when the learners are actively engaged in a learning problem while using technology to solve that problem" (Jones, 2005, p.1). Instead of watching a video, the learner creates a video.

The purpose of this paper, then, is to explore the "learning *with* technology" by secondary school students and pre-service teachers when the technology is 'Claymation'.

Claymation in education

'Claymation' involves the use of clay to create characters, scenery and props. These are then used to create a video in a stop motion format using a digital camera. Minute changes to the characters and props between each photograph create the appearance of movement on the screen. Most people are familiar with movie studio examples of Claymation like *Gumby* and *Chicken Run*.

Hoban and Ferry (2006) conducted an extensive review of literature pertaining to "claymation, clay animation, stop motion animation and stop frame animation" (p. 2.), only to find a paucity of research publication. Most articles pertain to describing the procedures for making claymation and adverts in magazines. Five articles were found relating to the use of: 1) claymation in pre-service teacher education, 2) promoting literacy skills, 3) promoting collaboration, 4) need for adult assistance, and 5) the need for extended periods of time to produce a video. Hoban and Ferry (2006) found claymation has potential (theoretically) as a teaching approach, but is too tedious and time consuming to be widely used. Hoban (2005) and Hoban and Ferry (2006) describe 'Slowmation' as a viable alternative.

'Slowmation' is a simplified version of claymation that uses many of the same learning processes – "researching information, planning and writing a story, storyboarding, designing models, taking digital photographs, using visual literacies, using technology, evaluating and , most importantly, working collaboratively as a team" (Hoban, 2005, p. 27). Key differences between 'claymation' and 'slowmation' are summarised in Hoban (2005), and so will not be described here at length. One fundamental difference of relevance to this paper is that of the plane of construction and movement. In claymation, the models are constructed in the vertical plane so they are free standing. In 'slowmation', the models are constructed in the horizontal plane so they can be moved manually on a piece of card on the floor. Hoban's study outlines the seven step procedure for making a slowmation movie: 1) Plan, research, teach, 2) Jigsaw, 3) Storyboarding and story writing, 4) Making and photographing, 5) Download and import, 6) Enhance and Edit, and 7) Show.

Thus, the small numbers of papers published are procedural in nature. Very few, if any investigate "the value of the teaching approach for student learning" (Hoban & Ferry, 2006, p.2), but instead many explore the pedagogical approach for teaching science concepts in higher education classes. This paper describes the value of the approach for learning of both secondary school students and pre-service teachers.

Participants and methodology

Four pre-service teachers and four secondary school students participated in a one day workshop during a school vacation period. The group was split into two groups, each with two secondary school students, and two pre-service students as shown in Table 1. Pseudonyms are used.

Table 1. Characteristics of participants.

Group & Topic	Name	Student Status	Science Interest & Ability
A: Chromosome Mapping	Mike	Pre-service Primary Education	Highly interested, high ability
	Sarah	Pre-service Secondary – ICT, Mathematics	Low interest, moderate ability
	Trudy	Yr 11	Low interest, high ability
	Laura	Yr 11	High interest, moderate ability
B: DNA Replication	Wendy	Pre-service Primary Education	Moderate interest, moderate ability
	Tony	Pre-service Secondary – Biology, Geography	High interest, moderate ability
	Ellen	Yr 11	High interest, high ability
	Angie	Yr 10	High interest, high ability

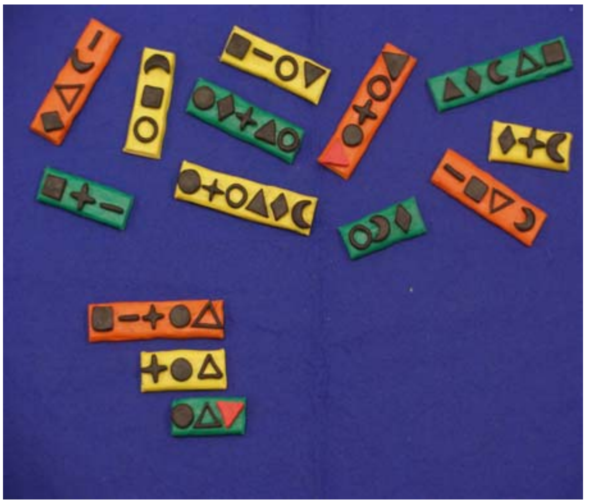
The information in the "Science Interest and Ability" column was based on the number of science subjects being undertaken as part of their current studies and the self reported results of these subjects. Wendy and Mike were allocated the roles of Group Leaders as they had both completed a clay animation unit as part of their studies. The remaining participants were asked to self allocate to a group but requested that each group have only two pre-service teachers.

Once groups had formed, each was given the following four topics as suggestions for their claymation or slowmation video: 1) gene splicing, 2) DNA replication, 3) electrophoresis, and 4) chromosome mapping. The participants were shown a short segment of a *Wallace and Gromit* video as an example of a claymation movie. With the assistance of the Team Leaders, Mike and Wendy, the groups spent 1 hour familiarising themselves with the materials and processes. The aim of this process was to enable those with no claymation experiences to have some knowledge, though limited, whilst they researched their topics and planned their video. The groups had unlimited time and resources (internet, text books, university library etc) to inform the selection of a topic and then information on the topic. Group A selected chromosome mapping, and Group B DNA replication. None of the participants had previously studied their topic. Both groups could have selected the same topic. Both groups then proceeded to research their topic, and create their video.

Findings

The findings are presented for each group separately.

Group A. Group A decided to make a video about chromosome mapping (mapping is the construction of a series of chromosome descriptions that show *the position and spacing* of unique, identifiable biochemical landmarks, that occur on the DNA of chromosomes). After locating a definition of chromosome mapping it was quickly agreed that it would be "a cool video, 'cause you could incorporate it into a unit on codes, and spies and stuff" (Mike).



Self generated questions (SG = Self Generated)

SG 1 How much rubbish do you think is on a chromosome? [laura]
SG 2 We are using shapes to show different bits on the chromosomes. What do you recon the real bits look like? [Mike]
SG 3 Hey Gilian, where could we get some real DNA to look at? [Gillian: We could extract it from some fruit easily enough – but after we have done the video's] SG 4 Then could we look at it under a microscope to see how it really looks on a chromosome? [Sarah]
SG 5 If DNA is like white snot, why are we using different colours? [Laura]
SG 5 How can we show when an overlapping sequence does not quite overlap? Or when it does fully overlap? [Sarah]

The above self generated questions indicate that the participants were intellectually engaged with the science topic at hand. Many self generated questions were concerned with the real life physical appearance. The participants were concerned that their video representation was similar to the actual chromosome appearance. Appearance, or visual image, seemed more important than the processes involved in terms of self generated questions.

The need for attention to detail (AD = Attention to Detail)

AD 1 Is there a size ratio thing between say the length and width of a chromosome? And thickness? [Sarah] [also SG]
AD 2 You mean the chemical landmarks not bits. It is important to use the correct names or we will get confused. Keep it accurate. [Mike] [in response to SG 3]
AD 3 Those shapes have to be all the same size. Symmetry or similarity or something I think it is called. Otherwise our video will look like it skips or jumps. [Laura]
AD 4 When we get the pieces moving in to show alignment, we need to make sure the overlapping sequences are accurate.[Trudy]

The need for detail, as linked to appearance, was important but so was a need to be attentive to terminology. The creation of a slowmation video is very kinaesthetic. There also appears to be a hidden visual learning component. The participants needed to get the appearance right according to their common understanding of the topic. Alignment, scale size and similarity were issues they openly discussed – more so than the scientific processes involved in chromosome mapping. Terminology was an important concern as it generated discussion on the need for correct terms instead of lay terms. In addition to this, there was a very productive discussion relating to the incorrect usage, and subsequent narrow definitions of a term.

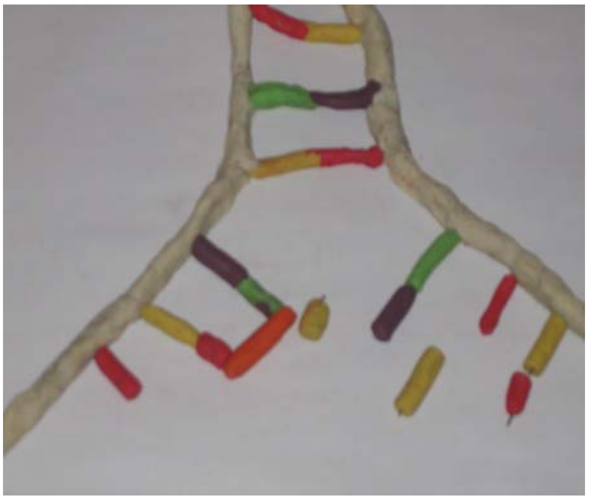
Argumentation (A = Argumentation)

A 1 No not symmetry. That is a maths topic not science. It means if you cut it in half each half matches the other. [Sarah] [in response to AD 3]
A 2 A maths topic? No, not *just* a maths topic. It is everywhere, so there will be a symmetry in a chromosome. But you are using a wrong word. You don't want symmetry in the shape sizes. You mean size. [Mike] [in relation to AD 3 and A 1] .
A 2 Yea that's what I said, size. [Laura]

A 3 But you said more – the symmetry bit. Symmetry is different. It is not relevant to what we are doing. You need to say the word that means "all the same size, shape, dimensions" sort of thing. Congruence? Maybe? There is another word though. [Mike]
A 4 Congruence triangles. I remember them. We have triangles and they SIMILAR. SIMILAR is the word. We need similarity in our shapes. [Laura]

What initially appeared to be a simple error in the use of the word 'symmetry', quickly became an exploration of symmetry, resulting in the self generation, through argument, of meanings for symmetry, size, and congruence.

Group B. Group B decided to make a video about DNA replication (DNA replication is the process of copying a double-stranded DNA molecule to form two double-stranded molecules). It took approximately half an hour for this group to reject the electrophoresis and gene splicing topics because of a lack of consensus on the particular phase of electrophoresis to present, and what gene to splice: "No, I am not doing anything with bacteria, yuck!" (Ellen). It was decided that as "DNA is everywhere, so it is OK to do then?" (Tony).



Self generated questions (SG = Self Generated)
SG 1 So how does it know GC always go together? Or is it that AT always go together? I mean is there a hidden thing that says both pairs know? Or does just one pair know, and the other has no choice? You know like a default system [Ellen]
SG 2 These nucleotides, where do they come from? [Wendy] They must just sort of appear from nowhere once it breaks. [Angie]
SG 3 Use the terminology – remember what Gillian said? You mean when it unravels. Anyway, I read there was an enzyme involved at the helicase. But where the enzyme comes from I don't know. Would a chemical reaction make an enzyme? [Ellen]
SG 4 Osaka filament? Ummm they must have discovered it in Osaka do you think? [Angie] No, it is the Okazaki filament. Okazaki not Osaka.Was Okazaki Japanese? I doubt it as this DNA stuff, like all the big research on the double helix, comes from America doesn't it. So Okazaki must be a technique. No it cannot be a technique if it is a filament can it? I am confused. Does it matter where the word comes from? [Tony]

The self generated questions for Group B seem directed at the processes and composition of the DNA. Again terminology is important to the participants. Ellen tries to get Angie to use the correct terms, and Angie and Tony seek the origin if key terms.

The need for attention to detail (AD = Attention to Detail)
AD 1 Hey, should the lagging strand should not be the same dimensions as the leading strand. [Tony]
AD 2 Maybe not the same length dimension, but the bases in the pairs have to be or it would be lopsided and unwind unevenly [Wendy]
AD 3 Oh no! we didn't check the direction of the spiral. It goes clockwise .. or anticlockwise when it spirals. We just unravelled it. It could be wrong! [Ellen].

There was a need for the participants to consider physical changes and processed. Whilst there was no correct nor incorrect method production of the DNA replication video, there is an assumption that the science could be wrong making the video wrong.

Conclusions

It is interesting that there is a shift away from the visual appearance (Group A) to the processes and functions of the topic (Group B) when considering self generated questions. It is possible that the complexity of the topic influences the nature of the questions. If the topic requires a greater representation effort (such as the fiddly detail in the representation of chromosome mapping) than a more simpler topic (such as DNA replication), then cognitive load focuses on the representation, rather than scientific processes. Attention to detail is important in terms of proportionality as well as processes. Argumentation does not always occur.

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