

UiO : InterMedia
University of Oslo

Students' conceptual practices in science education
Productive disciplinary interactions in a participation trajectory



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Relevance for the TEL 2011

- Basic socio-cultural study: Mediation
- Intermediate concepts for analysis:
 - Free and forced moves
 - Productive disciplinary interactions
 - Participation trajectory
- Example of a design experiment
- Example of an interaction analysis
- Example of how to build up an article

Aim

- Is to understand students' conceptual practices in science education as a cultural phenomenon
- This entails following a group of students while they solve a particular scientific problem from A to Z, and investigating how different cultural means are made relevant through their interactions in varying ways over time.
 - knowledge domain
 - combination of tools
 - interpersonal relations

Research question 1

- How do the students' and their teacher's interactions unfold according to the specific characteristics of the computer-based 3D model of the insulin gene and the website designed to support this?
- Free and forced moves: bridging, transcription and filling (Pickering 1995)

Research question 2

- How does a group of secondary school students, plus their teacher, socially interact while solving a problem related to a computer based 3D model of the insulin gene?
- Interpersonal relations:
 - problematizing,
 - authorizing,
 - accountability

Research question 3

- How does the students' course evolve in a useful manner for the students and their teacher during their problem solving?
- Participation trajectory

Design experiment

- the research project attempted to engineer *innovative* educational environments and conduct studies of these innovations (e.g., Brown, 1992).
 - computer-based 3D model of the insulin gene
 - website especially designed to support the 3D model
 - lower secondary school in Norway
 - a group of four 9th grade students' and of their teacher as they solve a particular problem from A to Z .

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A meeting with the DNA-molecule

Third Mission: Sequencing the DNA-molecule

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DNA-sequencing is a very complicated process. Since the HGP-project started in 1987 the methods have steadily been improved, and today the machines are doing most of the work. The methods are actually so fast now that we will finish the sequencing many years before planned.

You are going to use the old-fashioned method for sequencing; namely by pen and paper. When you are sequencing the gene, start at the bottom and “read” the stairs from the bottom and upwards along one side.

Mission: Sequence the DNA-molecule. Which of the three sequences A, B, and C is the right one?

Sequence A:

ATG TTT GTG AAC CAA CAC CTG TGC GGC TCA CAC CTG GTG GAA GCT CTC TAC CTA GTG
TGC GGG GAA CGA GGC TTC TTC TAC ACA CCC AAG ACC GGC ATT GTG GAA CAA TGC TGT
ACC AGC ATC TGC TCC CTC TAC CAG CTG GAG AAC TAC TGC AAC

Sequence B:

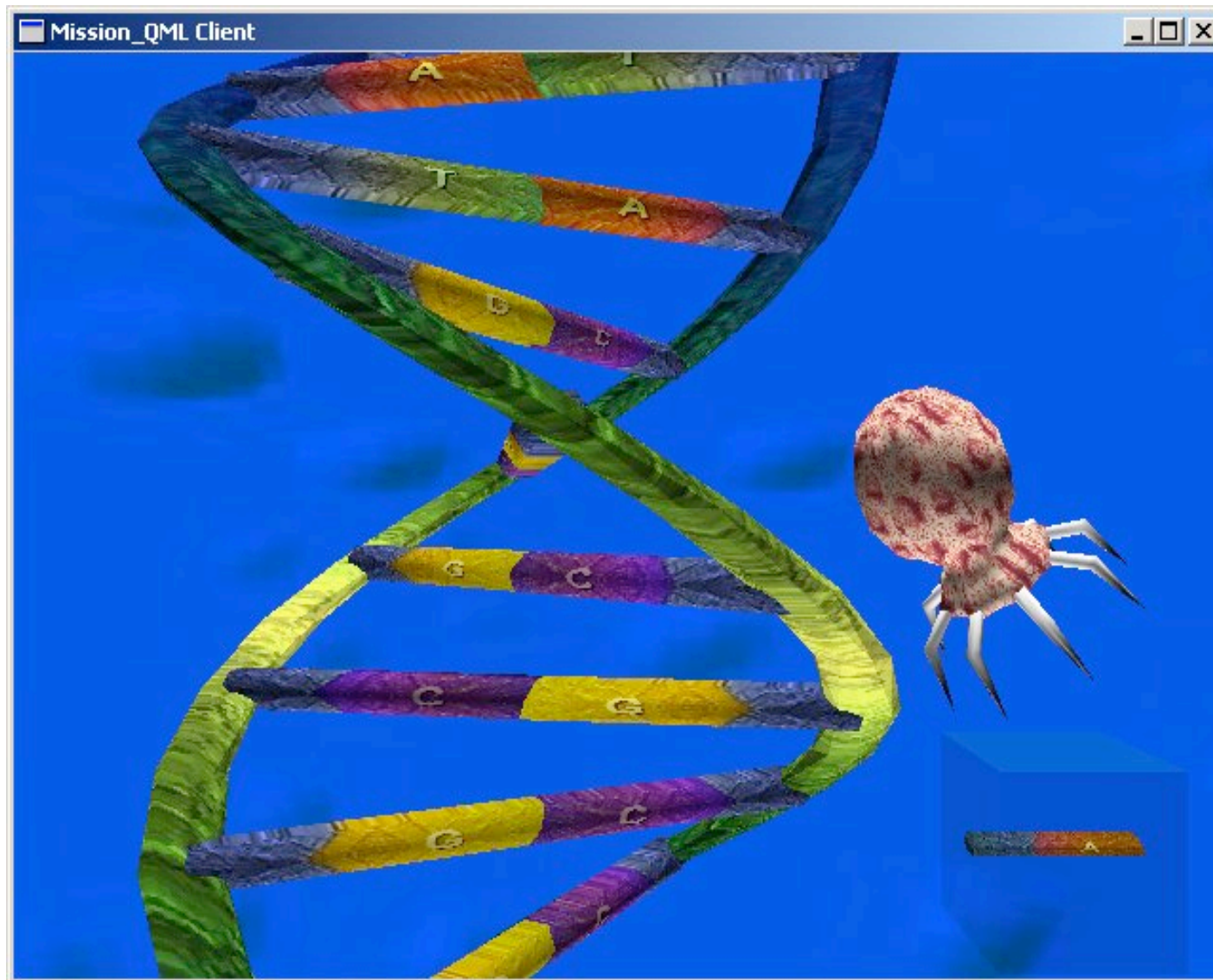
ATG TTT GTG AAC CAA CAC CTG TGC GGC TCA CAC CTG GTG GAA GCT CTC TAC CTA GTG
TGC GGG GAA CGA GGC TTC TTC TAC ACA CCC AAG ACC GGC ATT GTG GAA CGT ACC AGC
ATC TGC TCC CTC TAC CAG CTG GAG ACT GCA AAC TAC TGC AAC

Sequence C:

ATG TTT GTG AAC CAA CAC CTG TGC GGC TCA CAC CTG GTG GAA GCT CTC TAC CTA GTG
TGC GGG GAA CGA GGC TTC TTC TAC ACA CGC AAG ACC GGC ATT GTG GAA CAA TGC TGT
ACC AGC ATC TGC TCC CTC TAC CAG CTG GAG AAC TAC TGC AAC

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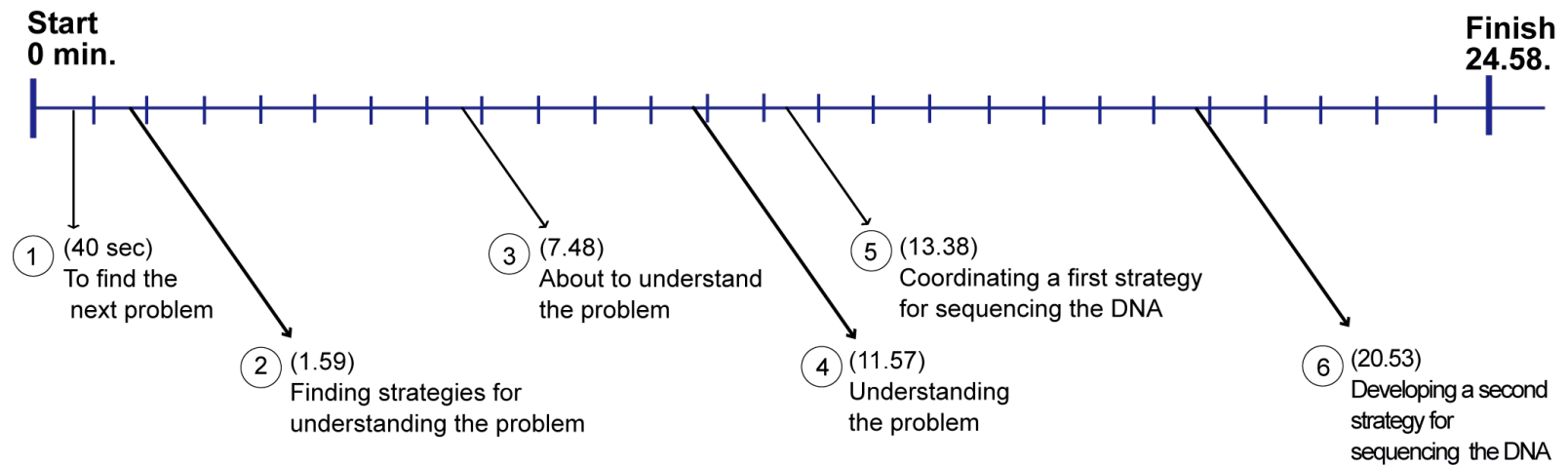
The task

- Sequence
 - Need to understand what DNA sequencing implies (website)
 - How it is possible to perform sequencing in a computer based 3D model of the the insulin gene
 - Read on the correct side of the insulin gene
 - Handle the rotation in the computer based 3D model of the insulin gene (arbitrary but here necessary because of the sequence on the website)
 - Find out which of the three sequences matches the computer-based representations (A)

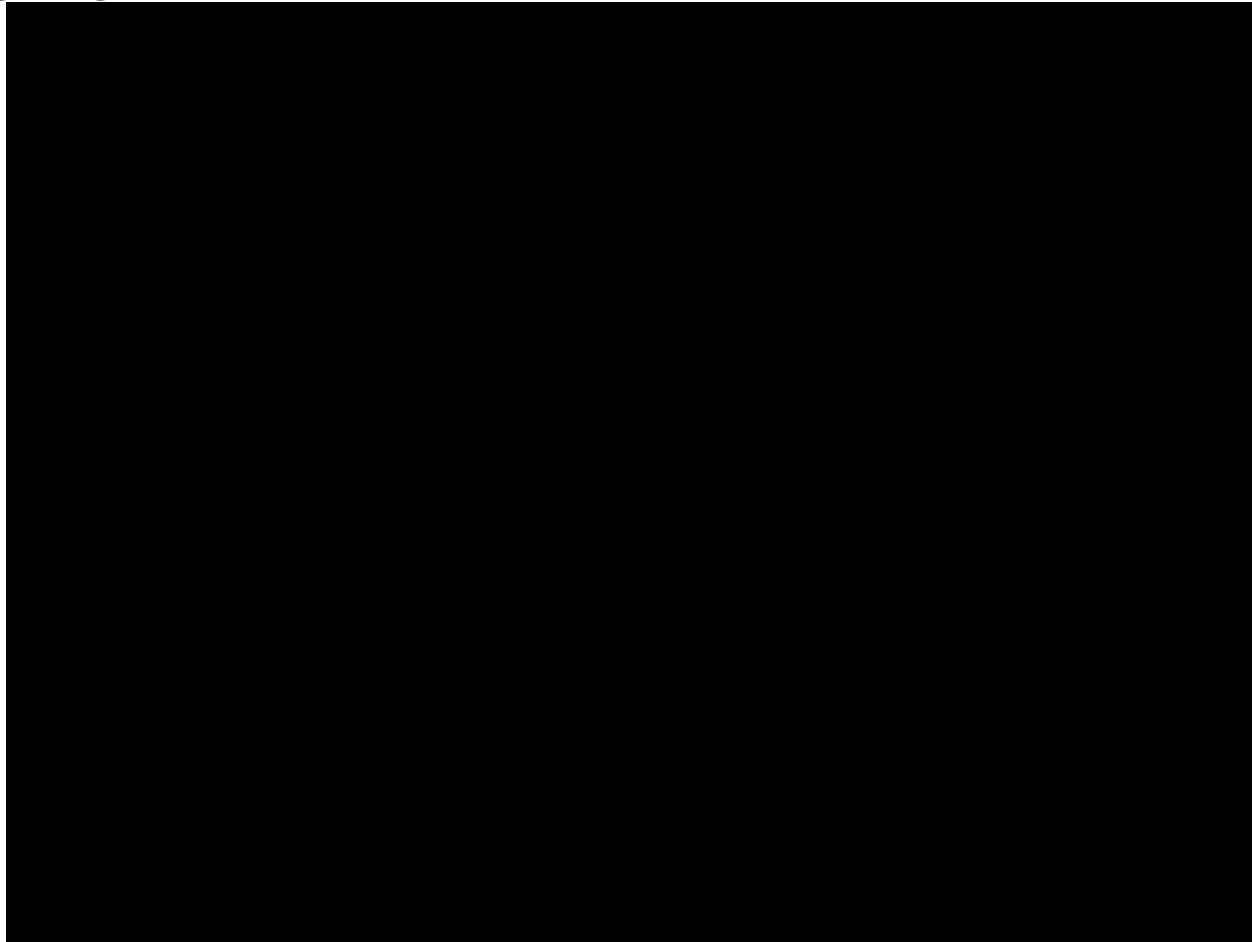
Interaction analysis

- Video data – interactions in the 3D model of the insulin gene – Primary data
- Post-test semi-structured interviews - used to support these findings and to provide additional evidence when needed
- 6 excerpts, *change* in the trajectory, each having a label
- Talk and action as point of departure and how this evolve moment-by-moment

Location of excerpts within the participation trajectory



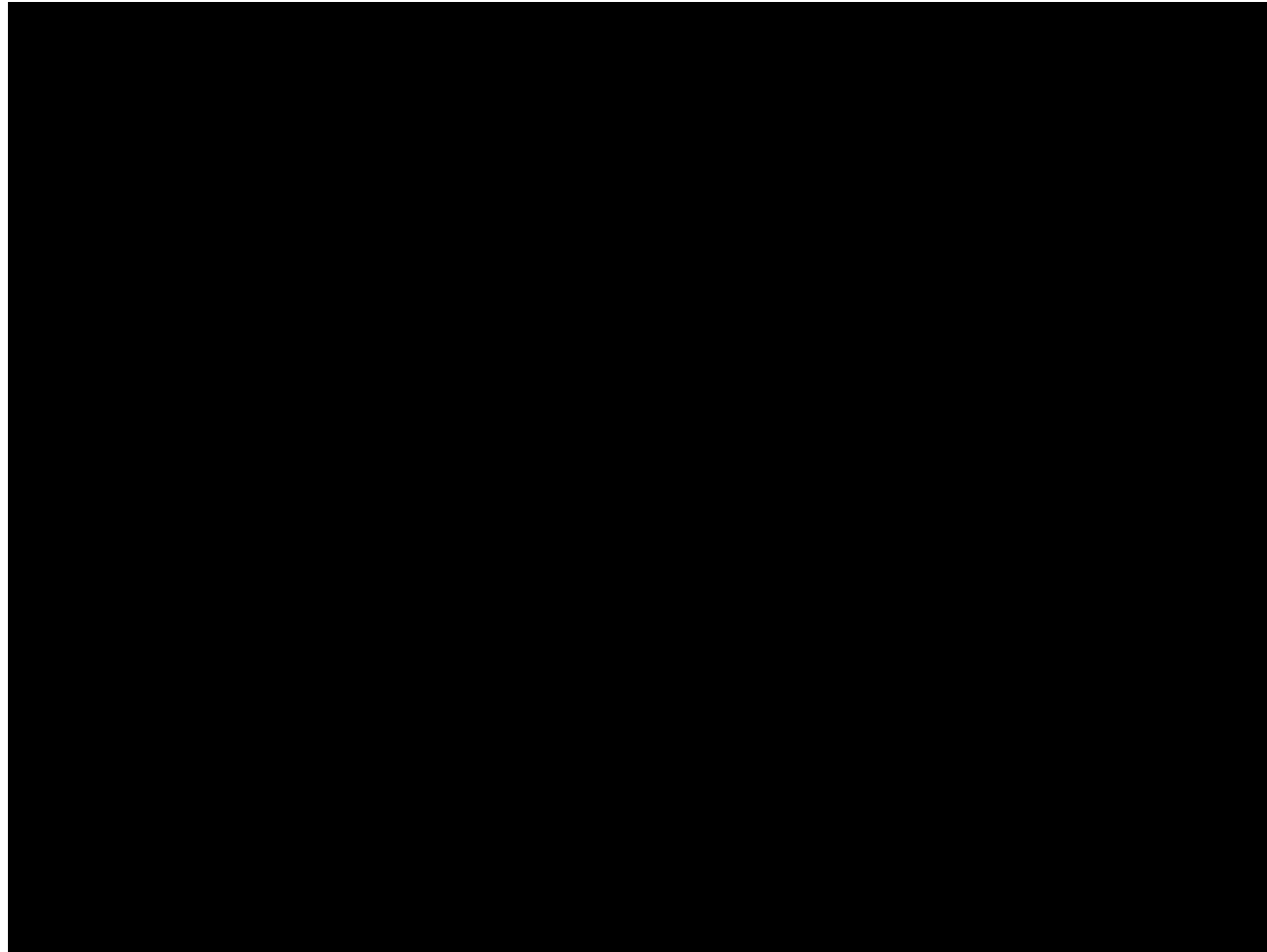
Excerpt 5: Coordinating a first strategy for sequencing the insulin gene



Excerpt 5: Coordinating a first strategy for sequencing the insulin gene

42. Pat: ... GCT. *Pat has started to sequence the computer-based 3D model of the insulin gene (see Figure 3).*
43. Cornelia: What are you doing, Pat?
44. Pat: I am walking up the stairs of the ladder and reading it.
45. Fredric: Yes, write it down then. *Fredric is referring to what they have been told on the website, using pen and paper (see Figure 2).*
46. Pat: GG.
47. Pat: Yes, okay. Then I have to begin ...
48. Cornelia: P, P, Pat. Tell, tell me what I shall write – then I can write.
49. Pat: Okay, then I'll start again.
50. Cornelia: Yes.
51. Pat: Shall, shall I look at both or just one ...
52. Fredric: Only on one side.
53. Pat: Okay.
54. Pat: TA ... *Moves herself and reads from below and straight upwards one side of the insulin gene. Cornelia is writing down what she reads. Fredric and Mark are not involved. Teacher stays in the background.*

Excerpt 6: Developing a second strategy for sequencing the insulin gene



Excerpt 6: *Developing a second strategy for sequencing the insulin gene*

55. Teacher: You start at the bottom, Fredric. *The teacher refers to the computer based 3D model of the insulin gene (see Figure 3).*
56. Fredric: Fine, I am at the bottom.
57. Pat: So then we can follow if it is right, ok?
58. Cornelia: Yes.
59. Pat: Start Fredric.
60. Cornelia: Are we starting at ATG or CAA?
61. Pat: ATG.
62. Fredric: Do I start at T or do I start at A?
63. Cornelia: You start ...
64. Pat: A.
65. Cornelia: Where are you then?
66. Pat: We are in that ...
67. Fredric: Where do we explain?
68. Fredric: There is the teacher (*he, he*).
69. Mark: Come on, tell me ...
70. Fredric: Okay.
71. Mark: Yes.
72. Fredric: AT. *Moves himself from side to side to handle the rotation in the computer based 3D model of the insulin gene. The others are back at the web confirming and correcting Fredric's reading. The teacher withdraws from the scene. Immediately after they finish reading, the group agrees that sequence A is correct.*

Summing up

- What is a model – how rich should it be?
 - Rotation + baseletters
- Intersection of mediational means not just object driven as other 3D studies.
- Interpersonal relations are not set during a participation trajectory

Summarizing the knowledge domain and the tools as mediating cultural means in the

