Design Experiments

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Task

In your project proposals you have written about different technologies that will be used in educational settings and for the purpose to support different skills or disciplinary knowledge.

Make an outline of a design experiment

a) Identify possible research questions

b) What kinds of preparations would you need to do (teachers, technology, organizational issues …)?

c) What could the learning trajectory look like (film, teacher presentations, assessment …)?

d) What types of methods would you employ to be able to answer your research questions (observations, interviews, student reports …)?

Krange, I. & Ludvigsen, S. 2009.

The historical and situated nature of design experiments – Implications for data analysis.

Journal of Computer Assisted Learning, 25, 268-279.

Aim

- Methodological contribution to the use of design experiments in educational settings
  - Implications of historical and situated interpretation to design experiments
  - Consequences for analysis of collected data
  - Suggestions to improve the designs of computer-based learning resources

Interpretations to design experiments

- A. Brown defines design experiments (1992, p. 141): “to engineer innovative educational environments and simultaneously conduct experimental studies of these innovations”
- Several independent aspects characterize classroom settings:
  - Teacher training
  - Curriculum selection
  - Testing

Interpretations to design experiments II

- Three special issues
  - Journal of learning sciences
  - Educational psychologist
  - Educational researcher
- Mainstream interpretation
  - Takes the individual as the unit of analysis when analyzing learning processes and outcome
  - We argue that this line of interpretation is similar to laboratory-oriented experiments – the context is taken into account without being included as part of the unit of analysis

Interpretations to design experiments III

- As Brown we include classroom ethos, curriculum and technology
- BUT while Brown conceptualizes contextual features in terms of external inputs to the interaction, we regard them as relevant when, and if, they become visible in the students’ and their teachers’ interactions. <u>In other words</u>: as intrinsic part of the interactions.
- Brown – individual as unit of analysis
- We – socio-cultural unit of analysis – mediated action

Interpretations to design experiments IV

- They “attempt to situate a research agenda in a classroom setting”
- We attempt to situate our studies of students’ learning into larger institutional settings
  - We go beyond the borders of the design experiment and include longer historical lines of which this is part.
  - The contextual aspects that are relevant are those that become relevant in the students’ interactions. That means interrelation between different mediational means, and how these change over time

Interpretations to design experiments V

- Sandoval & Bell, 2004, p 221: “Unfortunately, little is known about how to coordinate across these various levels [read contextual issues] or even how to specify the key variables interacting within and across levels”
- Collins et al, 2004, p 18: This approach of progressive refinement in design involves putting the first version of a design into the world to see how it works. Then, the design is constantly revised based on experience, until all bugs are worked out.”

Implications for doing interaction analysis

- Interactions are the primary source of data
- Different mediational means are relevant to the extent of their presence in the students' and their teacher's interaction.
  - Tools
  - Signs: micro-genetic and sosio-genetic
  - How these intersects

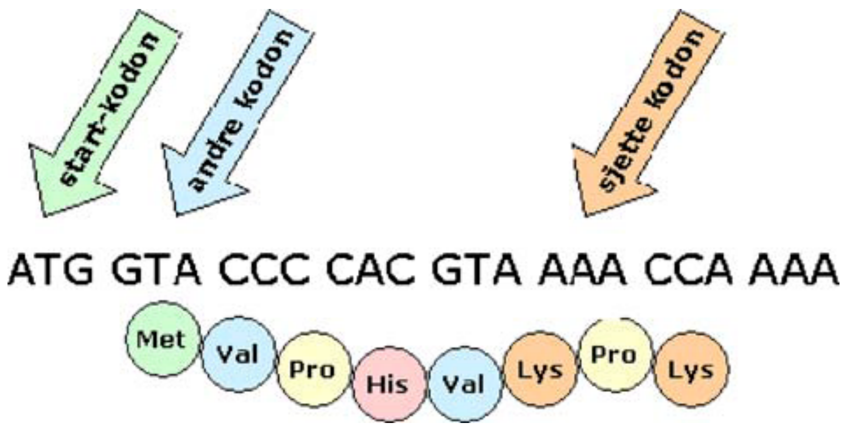
An empirical example

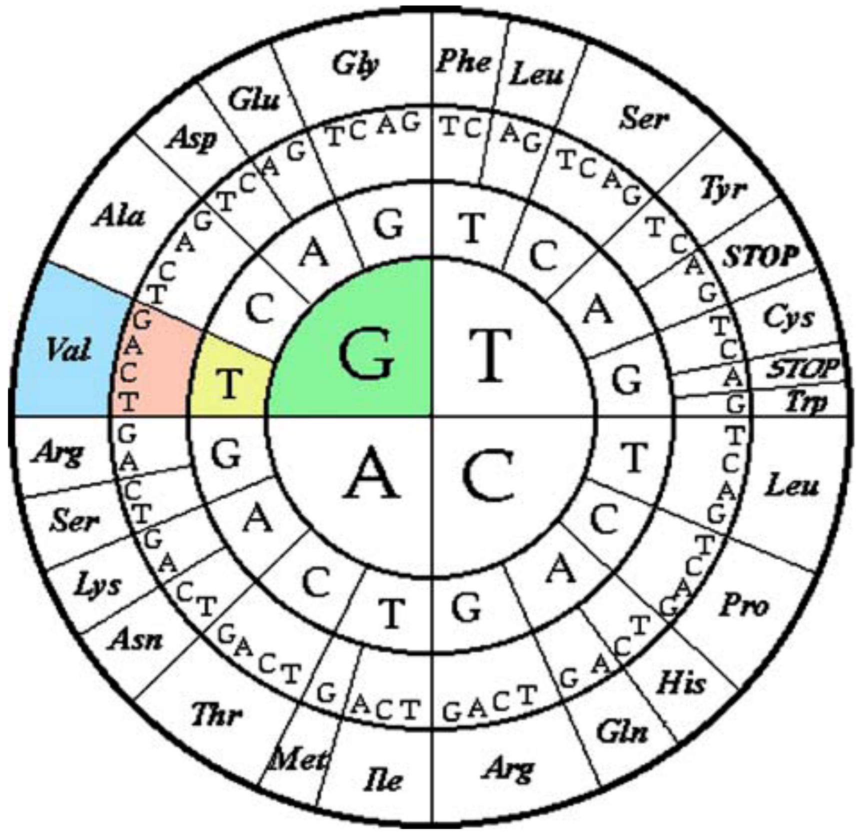
- Krange & Ludvigsen, 2008
- How a particular CSCL technology designed to support science education came into play during students’ and their teacher’s interactions within the institutional setting of a secondary school.
- Problems to construct conceptual understanding – how concepts are related to a larger conceptual system, or so-called “scientific concepts” (Vygotsky, 1986)
- Students’ concepts remained fragmented although they worked out all problems they were asked to solve

An empirical example II

- 4 week gene-technology project
- Groups of four 9th grade students
- Computer-based 3D models
- Distributed settings represented by avatars sharing the models and telecommunication system
- Website with educational inscriptions to scaffold progress and students problem solving + inscriptions related to the knowledge domain.

An empirical example III: To build an insulin protein





- Day 1: Sequences a DNA gene
- Day 2: building an insulin
  - How to use a codon table to read the DNA sequence of a gene
  - Find the corresponding amino acids and combine these into a protein
  - Use this knowledge to build a 3D model of the protein
  - This knowledge was available on the website

Empirical example IV

- The story - doctor suffering of hypoglyceamia
- Videorecordings of the students' and the teacher's problem solving and from a de-briefing setting
- 53 minutes, one student asks 12 times what they are doing means – this was never acknowledge neither by the students nor by the teacher before the problem was solved and they entered the de-briefing setting
- From procedural to conceptual understanding

Empirical example V: De-briefing session

Extract 1: Learning scientific concepts

1. Pat: So—then you can do the same, CCC. Then you have C C C. Pat uses the codontable (see Fig. 3) to examine the relation between the codons and the amino acids in Fig. 2.
2. Cornelia: Then it is Pro. Cornelia is using the codontable (see Fig. 3) to examine the translation of the next codon, C C C, in the DNA sequence into an amino acid, Pro, in Fig. 2.
3. Pat: Pro, yes. Then you can do it with C A C. Pat refers to the next codon, C A C, in the DNA sequence in Fig. 2.
4. Cornelia: C A C, then it is His. Now I have got it. Cornelia is using the codontable (see Fig. 3) to examine the translation of the next codon in the DNA sequence into an amino acid, His, in Fig. 3.
5. Pat: Yeah, you got it now?
6. Cornelia: Yes, but I don't understand what it is - what is it?
7. Pat: It is the genetic code. Pat refers to the heading of the website where the use of the codontable is explained (see Fig. 3).
8. Teacher: It is the code. If you are going to build something genetic, then it is the code, the instructions for how you should do it - what protein that should chain together. The teacher uses references from the website; instructions for how you should do it.
9. Mark: Then we...
10. Pat: Have we finished this task then?

Empirical example VI

- What do they prioritize when working with the problem?
  - To solve the task
  - To help the professor (story-line)
  - To develop scientific concepts

- Conclusion: when solving the problem the school as a curriculum deliverer hindered rather than stimulated the students’ knowledge constructions in science at least in relation to the meaning potential that was inscribed in the knowledge domain, and which could have unfolded in action.

Conclusions

- How far is it possible to design technologies, when cognitive and social aspects always will play a central role?
- To improve students’ knowledge constructions, it is not enough – nor is it in principle possible – to perfect the design of the technology
- There is also a need to improve institutional aspects on how schools support students’ learning when using technological tools where the teacher’s role is invaluable.