Imagination through Virtuality for in-depth Learning

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Abstract

Based on the fast growing technologies to allow students to explore and experience three-dimensional worlds, the question becomes relevant if and how technology offers essentially new dimensions to the learning process.

In a number of prototypes this presentation attempts to demonstrate how learners may undergo immersive experiences that complement the predominantly verbal expositions how complex realities like the many-facetted processes in living creatures work. Based upon the model of a mammal's heart, pre- and postsynaptic processing and finally the apprehension of cultural signs on migration, identity, culture and communication, this presentation aims at provoking the discussion in how far we may already rely on visual semiotics that may complement traditional learning material and further stimulate the further evolution into 'perceptual learning'. Based on recent experiments into the relation between cognitive style (holistic versus serialistic) and various memory capacities, the thesis is brought forward that we need to explore further the various concept-mapping techniques, both for the designer and the user of educational learning environments.

1. Introduction

It is not a recent phenomenon that during the further evolution of learning methods and further learning practices various streams meander and sometimes diverge to a large extent.

The first one is mainly keen on supporting students in the executive aspects of learning; its concern is the correct manifestation of skills and knowledge; Brusilovsky et al (1996).

The second one is primarily concerned about facilitating prerequisite steps in a learning process. Due to the nature of conceptual understanding I would like to stress the need for more adequate methods and tools that bridge the gap between intuitive notions and prior imaginations about the topic to be learned and the final well-integrated and particularly well-understood knowledge; Kommers, Grabinger & Dunlap (1996).

The third one is the paradigm that gives prior attention to the embedding of learning in the longer-term process of cognitive and professional development. Here we perceive often the complain that the long chains of training programs finally bring fragmented and isolated knowledge with a low transfer and a low contribution to the students' real life problem solving.

2. From Instruction to Extrusion

My speech will address ongoing research in the second stream. The approach is to avoid using the labels 'Constructionism' and 'Constructivism' as they have already dissipated a great deal of discussions with a high load on ideology. The thesis I will defend is that effective learning needs initially a student to mentally imagine the topic, concepts and its mechanisms. Most important in this respect is 'mentally' as it is not necessarily a visual, tactile or acoustic impression. Rather than 'construction' the student is exposed to rich, preferably immersive experiences that articulate the conceptual aspects of an underlying mechanism. This immersion 'extrudes' the student's prior imagination into the more adequate one, without not too much load on verbal and reasoning skills. Crucial is that the student goes beyond rephrasing the instructor's formulations about what should be learned. Problem-oriented learning has already quite a record in how to promote the student's apprehension of the topic to be learned. A crucial question to a first-year medical student would be: "what do you understand by curing a patient", or "What could be the underlying mechanism if a patients complains about a severe headache". These kinds of questions are not aimed at philosophizing; they should bring the student in the right position even before having met disciplines like anatomy, pathology, histology etc.

In our research together with the Faculty of Biology, State University in Groningen, The Netherlands, we have developed a rationale for introducing Virtual Reality in the courses on animal physiology.

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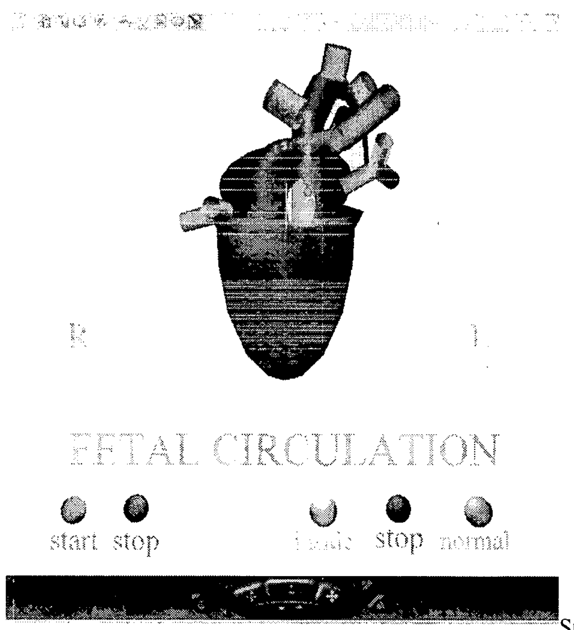
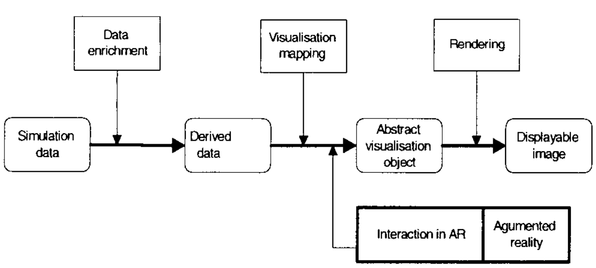
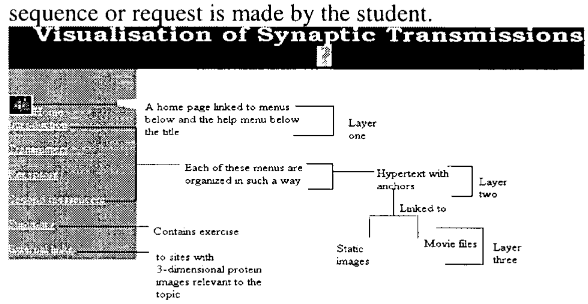


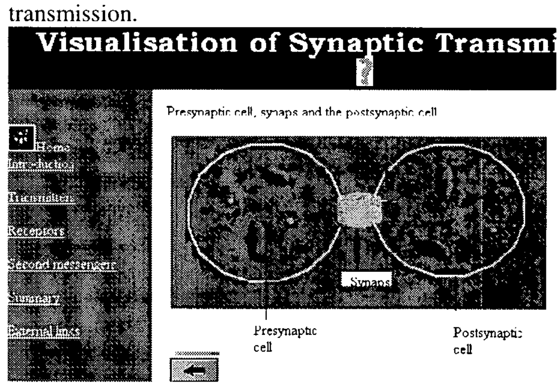
Students in the Faculty of educational Science and Technology worked out and experimented with cases like the 'closing of the foramen ovale during the birth of a mammal'. Together with Salah Al Thuwaini and Dr. Majed Alnaqeeb in the University of Kuwait we implement 'differential electrical and chemical processes in the synaptic gap' in VR, aiming at finding out the best visualizations for confronting students in the initial stages of learning. A secondary question became how to optimize existing VR models for being used by teachers in plenary presentations. The visualization pipelines as below is generally taken as the more generic flow from data unto flexible representations for the student. It opens the advantage of using dynamic representations based upon vectorized micro worlds that allow an external model to generate (render) a 3D display. Its approach goes beyond the VR metaphor, as it is not only a spatial argument that may change a certain view; it may be cognitive or epistemic arguments as well.



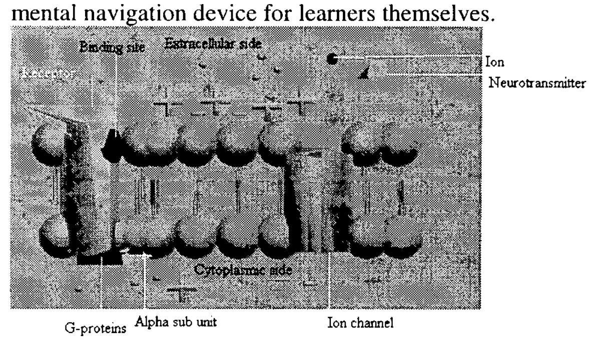
An even more drastic conclusion is that academic learning often means 'learning the unknown'; Studying by visualization soon brings both the teacher and the expert to try and shift the barrier from 'knowing that' towards 'knowing how' and 'knowing why'. One of the mechanisms to integrate explanatory information better is the linking of contextual information that will only pop-up if a certain sequence or request is made by the student.



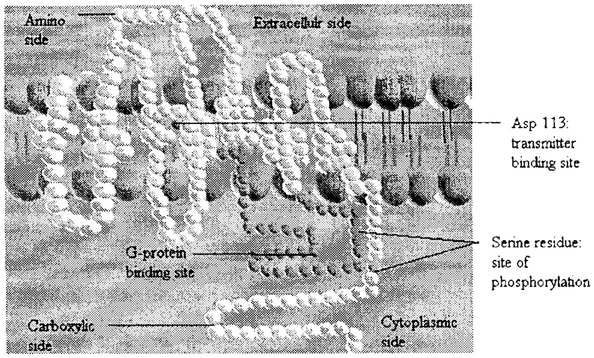
Tahir Billo (1998) designed the algorithm above for leading students to particular views on the synaptic transmission.



The adequate evolution from initial to the final learning resources with its links and transitions can only develop after in-depth reconstructions of the conceptual entailments in the domain. Appendix B shows the kind of analytic stages that took place in the conceptual design stage. Concept mapping seems not only to serve the design by experts; It becomes more and more accepted as mental navigation device for learners themselves.

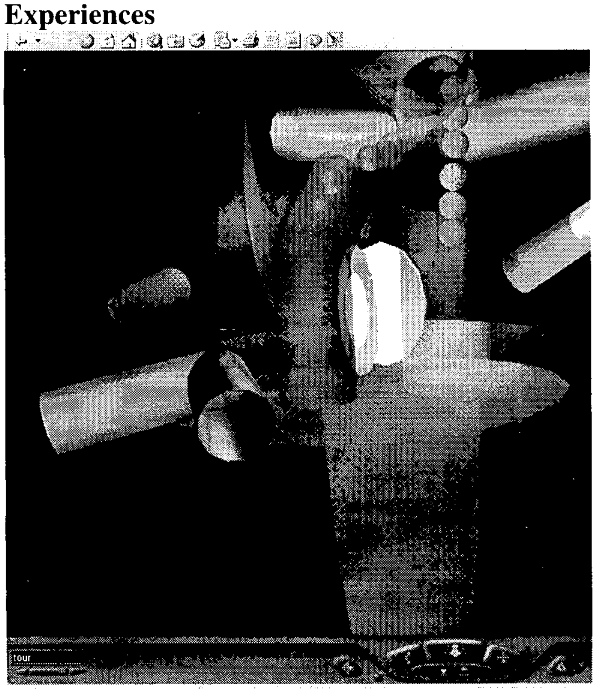


The visualization above is the result of activating an anchored link and will only appear if the student has called upon the attribute of "pre- and post synaptic cell". The second frame in an animation sequence articulates a central receptor molecule, taken as an example of receptor in slow (indirect) signal transmission.



The second Prototype above shows the beta -2 adrenergetic receptor and its membrane spanning features (static image). Each of the above prototypes has their own animated counterparts. With this second prototype a further extension is added to visualize the dynamics of reaction mechanisms in the animated scene. These two prototypes are combined and linked to their textual descriptions and form the final prototype. The applied rule is only to show the more mechanistic processes, once the student has demonstrated his/her interest for the next level of detail.

3. Immersive Complexity for Prerequisite Experiences

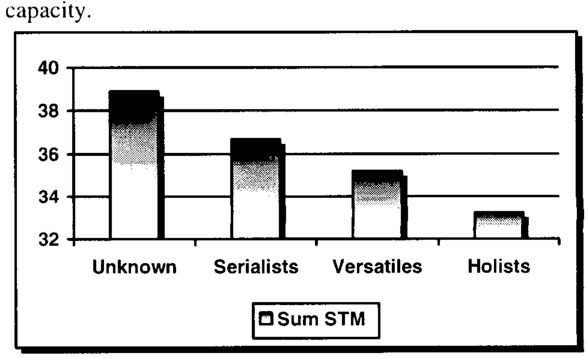


Sivia Dewyanti (1999) started her Master Thesis based on the question how VR models of the heart of a mammal should be built in order to promote a swift and still enduring understanding at the student. Experts in Biology teaching claimed that the 'foramen ovale' and its subsequent blood streams during and right after birth needs a complex imagination, that will only survive if its simultaneous performance can be seen.

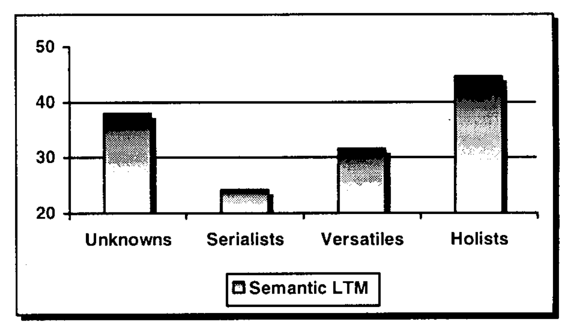
VR provokes us to express our momentary understanding of for instance the human heart in a dynamic 3D model, where flow and pressure are articulated and where transparency allows seeing processes in several layers at the same time. Our experiments intend to find adequate rules of thumb how to facilitate navigation and how to sequence the graphical articulations in order to promote the students' intuitive understanding of its functioning.

4. Cognitive Style and Learning Preference

The empirical evidence that learning in conceptual domains is highly sensitive to the balance between memorization and semantic elaborations was recently investigated. (Heling Huai, 2000). She found that students with a holistic learning style (based upon Pask's Smuggler Test) also have a significantly smaller short-term memory capacity.



But even more remarkable is the fact that the students with the serial style (highly capable to follow and remember sequentially fixed information) showed a considerable smaller learning effect in the long run.



Also they could not integrate their knowledge that good in an open design task; in this case the design of a new living creature that could survive in a specific environment. Extrapolating these findings into VR learning systems brings us to the recommendation to stimulate especially the more fluent students (with a good STM) to activate prior conceptions before being confronted with new topics. Holists will do this already by themselves, as they need it for the sake of compensating their weaker STM. Concept mapping proved to be a good candidate for stimulating students to imagine and negotiate about complex interdependencies between the key concepts in a domain

5. References

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