The Application of Complex Research Simulation Models in Education; a Generic Approach

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Computer models for complex systems such as the cardiac circulation, although designed to conduct scientific research, can theoretically be used for education. However, refinements and additional features introduced to enable highly complex simulations, make user-friendly teaching unfeasible. If still attempted, often ad hoc solutions are created. The final product does not entirely fulfils the intentions of the teacher, and sometimes the potential of the model and the skills of those involved are not fully utilized. At Maastricht University the Department of Biomedical Engineering is conducting research on the cardiac circulation using the computational model CircAdapt. In order to transfer this sophisticated research model of the human circulation into a user-friendly educational tool, an approach was chosen in which the various steps were explicitly defined. The definition of the simulation to be performed consists of five elements. (1) The description of the education concept, to be supported by this simulation, including learning objectives. (2) Input variables allowing the teacher to describe the problem. Variables that are used only internally to define (3) input and (4) output, and (5) the output variables that allows the teacher to visualize the results. The creation of a simulation package consists of a series of separate modules each identified by these five elements. It is not necessary for the builder of the teaching module to master all these five steps, the educational knowledge can be completely separated from the computational aspects if the model. This approach is unique in a sense that independent of the domain chosen, complex simulation models can be made accessible for teaching purposes. It can be utilized not only in physiological models in cardiology but also in other disciplines in medicine. By consequently using the same standard graphical user interface throughout the curriculum, the students get used and comfortable with computer simulation.