Supporting Undergraduate Bioscience Learners in Problem-Solving Process Skills Using a Technology-Enhanced Learning Environment

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Abstract: Problem-solving process skill is required to solve various open problems in genetics, and most often learners make the mechanical application of this skill without a comprehensive conceptual understanding. To address this difficulty, I am planning to develop a TEL environment which will be based on dynamic variable manipulation, system-generated appropriate and dynamic feedback, etc. for teaching this skill. Through a series of empirical studies, this research aims to design and evaluate the TEL environment.

Vision

Undergraduate bioscience and medical learners learn genetics since it is a compulsory foundational course in their curriculum. Learners are required to identify and justify the patterns of inheritance behind various biological phenomena. To identify these inheritance patterns, they have to solve problems which are either cause-effect problems (closed problems) or effect-cause problems (open problems) (Orcajo & Aznar 2005). Learners solve these problems by connecting theoretical knowledge with practical they do in the lab (Crews et al. 1997).

Experts solve these kinds of problems by performing a series of skills that can be grouped into problem representation, problem-solving and problem analysis (Orcajo & Aznar 2005). Problem representation requires them to qualitatively analyze the problem and propose a hypothesis. Problem-solving needs them to do steps like the design of a resolution strategy (analysis of problems in parts or resolution of a simpler case, study the problems using tables, graphs, percentages, etc.) and resolution (application of concrete cases with numerical data). Lastly, problem analysis includes steps to interpret the results according to hypothesis and theoretical framework used. These steps are often unclear to non-experts/learners as to why they are doing these steps.

However, learners' difficulty as reported in literature includes the mechanical application of common problem-solving process steps without a comprehensive conceptual understanding of these steps (Karagoz & Cakir 2011). So there is a need of teaching this skill explicitly to the learners. Therefore to provide an authentic learning environment for problem-solving process skill, I propose a Technology-Enhanced Learning (TEL) environment: Geneticus Investigatio (GI) as part of my doctoral research.

The proposed TEL environment will be based partly on the theory of anchored instruction (Crews et al. 1997). The learning environment will have a problem context similar to problems faced by researchers. Further learning material and activities in the environment will serve to "anchor" the subsequent learning which will also encourage exploration. I have used the TELoTS framework which gives step by step guidelines to identify, characterize steps and design learning activities for TEL environment (Murthy et al. 2016).

A classroom study with 22 undergraduate bioscience learners (convenience sampling) was conducted with this initial version of TEL environment to further inform the redesigning of the learning environment. Through this study difficulty faced by learners were triangulated from the individual interviews which were conducted with the learner and are being addressed in the second version of TEL. I am thinking to evaluate my TEL system from learning, engagement and interaction perspective and would like to discuss my research questions and respective data collection and analysis method for re-designing and evaluating my learning environment.

References

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