Universitetspedagogikk 2014-15: Kim Præbel, AMB/BFE

Review of Dreyfus H & Dreyfus S (1980) A five stage model of the mental activities involved in directed skill acquisition. Washington DC, Storming Media. 18 p.

In this review I will firstly provide a summary of the paper by Dreyfus & Dreyfus (1980) with particular attention to the learning process achieved at five stages in skill acquisition. I have chosen to focus on this aspect of the paper as the evidence presented for actual mental learning (brain-state) is rather vaguely presented. Secondly, I will exemplify and discuss the presented model for skill acquisition in relation to the academic hierarchy and skill advancement in genetics.

The authors start out presenting the problem dealt with in the paper i.e. that acquisition of skills (the learning process) is far more efficient in an instructor environment compared to the "trial and error" method. The aim of the paper is then defined to present a model that describes the learning process from the mental perspective. The study uses descriptive data obtained elsewhere. The method is discussed in relation to its validity compared to controlled laboratory experiments. Examples are given to support their choice of method, however only a few counter-arguments for the method are presented. The authors conclude that their method may illuminate that prior experience, in the form of recognition, is the key element in skill acquisition. Additionally, they argue that prior experience is a necessary to reach higher levels of skills. The paper then undertakes the presentation of the five stages in the skill acquisition process divided into stage 1. Novice; 2. Competence; 3. Proficiency; 4. Expertise; 5. Mastery. Stage 1 cover the beginner's skill acquisition process where the material should be broken down to "features" that the beginner may recognize without any prior experience of the particular skill (non-situational). The process also includes that "rules" will be given for how to handle the "features". To advance to the next stage the beginner needs to be guided through (either via instructor or self-observation) how to adjust the behavior in order to apply the rules within the process. At the stage 2, the beginner will advance the understanding of the topic (competence) by testing the acquired features in real "situations" either by own experience or by instructional guidance ("situational components"). The authors argue that since the student at this stage of knowledge understands the context of the topic the non-situational "features" now represents "aspects". Concordantly, the recognition of aspects may not be obtained by repetitions of features but only by real examples provided via "guidelines" given by an instructor. At the Stage 3 the performer is for the first time able to choose which of the acquired aspects that are needed for solving the situation. The student may also be able to differentiate situations addressing the same topic via memorized principles ("maxims"). The stage 4 performer no longer needs analytical principles ("rule", "guideline", "maxim") to address given a given situation. Hence the expert performer acts by intuition. When reaching stage 5 the performer is capable of exceeding the mental capacity of expertise in the temporal space. The authors argue, albeit rather vaguely in this text, that these moments of excess mental clarity occur because the performer no longer have to be mentally aware of the performance and the associated analytical principles.

These five stages in the skill acquisition process may be related to four levels of mental transformation; recollection, recognition, decision, and awareness (see Table 1 in Dreyfus & Dreyfus (1980)). The skill acquisition process, thus, is a function of mental organization which provides the basis for the instructor in a training situation to design the content at the mental level of the student.

The model of the skill acquisition process presented by Dreyfus & Dreyfus (1980) may very well apply to the academic hierarchy. Students represent stage 1 (novice) in their first years of studies, where they obtain the needed "features" for later advancement. These features may be tools (e.g. mathematics and statistics) to be used in more advanced courses (e.g. genetics). The students may reach stage 2 or 3 during their education, depending on intrinsic capabilities, teaching environment and extrinsic factors. It must be a goal that graduate students reach stage 3 within the topic of their master thesis. Stage 4 includes the permanent staff (associate professors and professors) and may also apply for PhDs and postdocs within their specific project. I assume that it is expected that all performers may reach stage 5 regardless of academic title as all performers, if well experienced in a given task, may reach the mental state of out of the box thinking or moment extreme perspectival clarity of the topic.

To exemplify D&Ds model I will use an example from genetics. In genetics, one of the most outstanding questions is how the alternative environmental forces of natural selection and random genetic drift (hereafter drift) shape phenotypic and genotypic variation. Since the geneticist do not know the parental background of individuals collected in natural systems one has to apply rather complex mathematical models to elucidate how the genes are inherited and hence to estimate the genetic basis for the phenotypic trait of interest. These mathematical models consist of three-dimensional vector based algorithms that are treated both via simulation and parameterized versions. The combinations of simulations and parameterized versions are then bootstrapped via Markov chain Monte Carlo (MCMC) bootstrapping to sample from the probability distribution (to obtain a p-value for whether natural selection or drift drives the phenotypic variation in a given environment). In other words, for a student to understand the actual problem, whether selection or drift drives the phenotypic variation in a given environment he/she would have to acquire the needed "features" (in this case basic mathematics) and obtain guidance ("rules") in how to handle the "features". In order to advance to the next stage of skill acquisition the student, thus, would have to understand the mathematics of vectors, why we simulate data, the theory of MCMC and general statistics, but not the connection between the these topics and the genetic problem. For the advancement in skill acquisition (to stage 2) the student should then be given datasets that in various ways combine the "features" to facilitate the transformation "features" into "aspects". For the further advancement the student should be introduced to the actual problem and given real pheno- and genotypic datasets to test the sets of "aspects" from alternative perspectives under instructional guidance. Only when the student are able to choose which aspects to apply when and at what stage of the analytical process the student should face the actual problem of e.g. the master thesis.