

Mathematical modelling demonstrates how students can get stuck in unproductive learning regimes

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Abstract: Self-regulated learning is the process by which effective learning happens: an iterative cycle of judging what has been learnt, followed by making decisions on what to invest effort in to learn further. When this process works well, learners can accurately assess their progress towards a desired outcome (e.g. mastering a skill, or passing a course), and make decisions about how to invest their limited time and resources to maximise learning. However, not all learners have the skills which underpin self-regulated learning, as learners may have poor judgement about how their learning is progressing. For example, they may believe that they understand the content and are progressing well, but they instead have a shallow understanding and are not meeting their learning goals. Learners' decision-making capabilities also vary in effectiveness. Some learners in tertiary education settings, for example, invest time in learning activities that develop procedural learning, or passive activities such as re-reading information or re-watching videos. These activities give the learner a sense of familiarity with the content without developing the conceptual learning required to master the topic and pass an exam. Furthermore, judgement and decision-making are connected: learners who choose ineffective (e.g., passive) learning strategies gain less information about their learning than those who invest time in more effective activities.

Here, we use a mathematical model, consisting of coupled ordinary differential equations, to explore interactions between the processes which underpin self-regulated learning. Our results provide evidence for two distinct self-reinforcing learning regimes: an unproductive regime in which poor judgement and poor decision-making undermine learning (and ultimately wellbeing), and a productive learning regime characterised by good judgement and decision-making. We predict that students with good judgement and poor decision-making (or vice versa) exist in unstable intermediate states. We also model interventions that can shift students from unproductive to productive regimes and discuss their implications for designing effective education.

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