Curiosity, Differentiated Instruction, and Assessment

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A Curious Course: Design Principles

- Free Choice
  - Students must have a choice of modules based on their interests
  - Students must be able to choose modules freely
- Learning Progress
  - Modules must allow students to demonstrate increasing competence
  - Assessment should maximise intrinsic rewards and minimise extrinsic
  - Students must be taught how to learn effectively
- Learning environments
  - Must be supportive of autonomy, competence and relatedness
  - Should be based around communities of staff & students

Models

- Self-Determination Theory (Richard Ryan and Edward Deci)
- Learning Progress Hypothesis (Pierre-Yves Oudeyer)

- Zone of Proximal Development (Lev Vygotsky)
- Self-Regulated Learning (Stephanie Toro)

Model 1: Self-Determination Theory (Richard Ryan and Edward Deci)

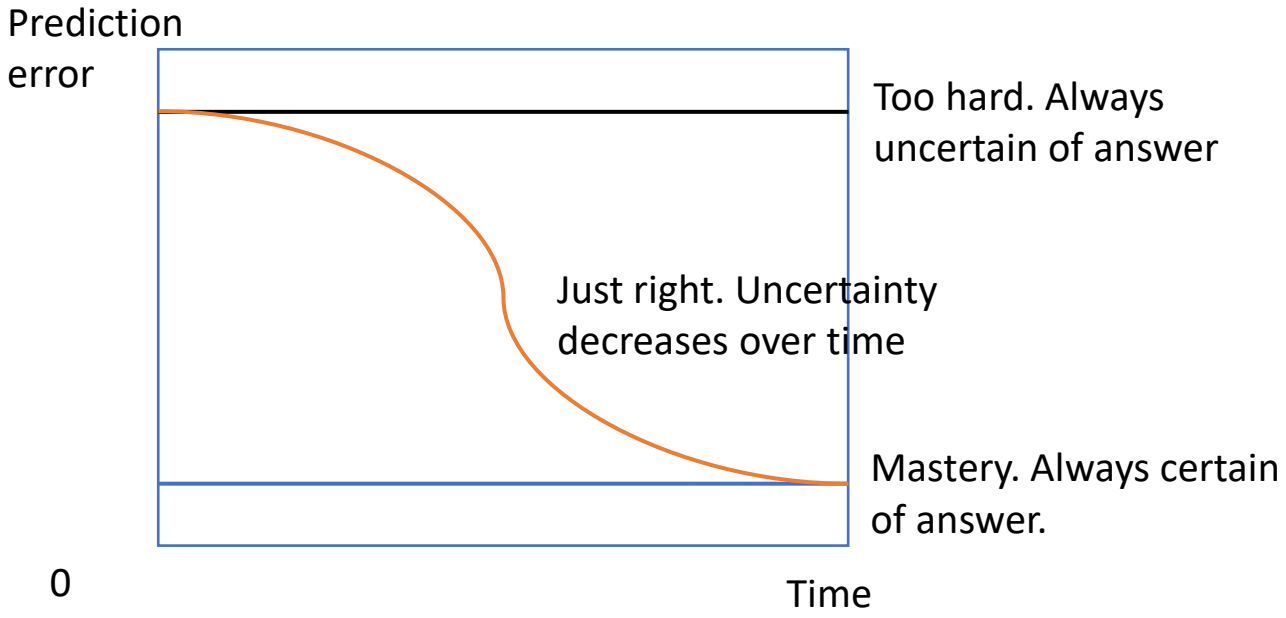
- intrinsic motivation
  - engaging in learning (assimilation, exploration, mastery) to satisfy a sense of personal enjoyment in the topic

- three fundamental and inter-related psychological needs
  - competence (tackling challenges at the appropriate level; constructive feedback/feedforward and associated assessment)
  - autonomy (“internally perceived locus of control”)
  - relatedness (social relations / communities of practice)

- extrinsic rewards may undermine meeting the three needs

Model 2: Learning Progress Hypothesis

(Pierre-Yves Oudeyer)



- Curiosity is a form of intrinsic motivation
  - inherent satisfaction from **novelty** and knowledge or competence gain
  - learning is dependent on **surprise** – "errors in prediction"
  - reduce subjective uncertainty by choosing activities that allow **learning progress** ("intermediate complexity")
  - learning progress increases curiosity – positive feedback

SDT and LP are overlapping models

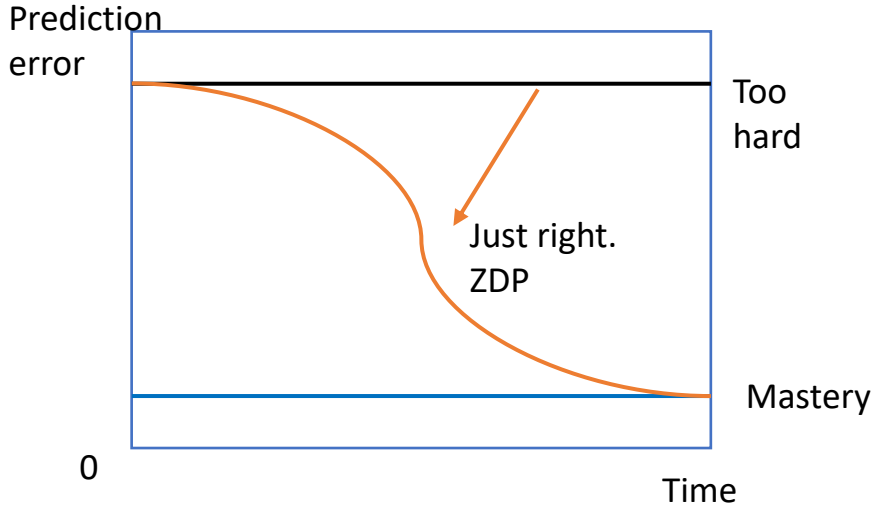
- Developing and nurturing curiosity as intrinsic motivation is a primary driver for student learning gain and well-being

- Offering courses that support students' autonomy, competence and relatedness results in knowledge or competence gain
  - curricula are emergent, dependent on a student's curiosity

- Extrinsic rewards can undermine effectiveness
  - "External perceived locus of control", e.g. compliance, punishments, instrumentalism ("I need this for my job")
  - "Relatedness" can help shift extrinsic (*controlled*) to intrinsic (*enjoyment*) motivation

Supporting Models

- Zone of Proximal Development (Vygotsky)
  - challenges that result in learning gain need to be scaffolded
- Self-Regulated Learning (Toro)
  - meta-cognitive skills: how to learn effectively, how to gauge own performance
- schema development



Steps in Module Development + Delivery

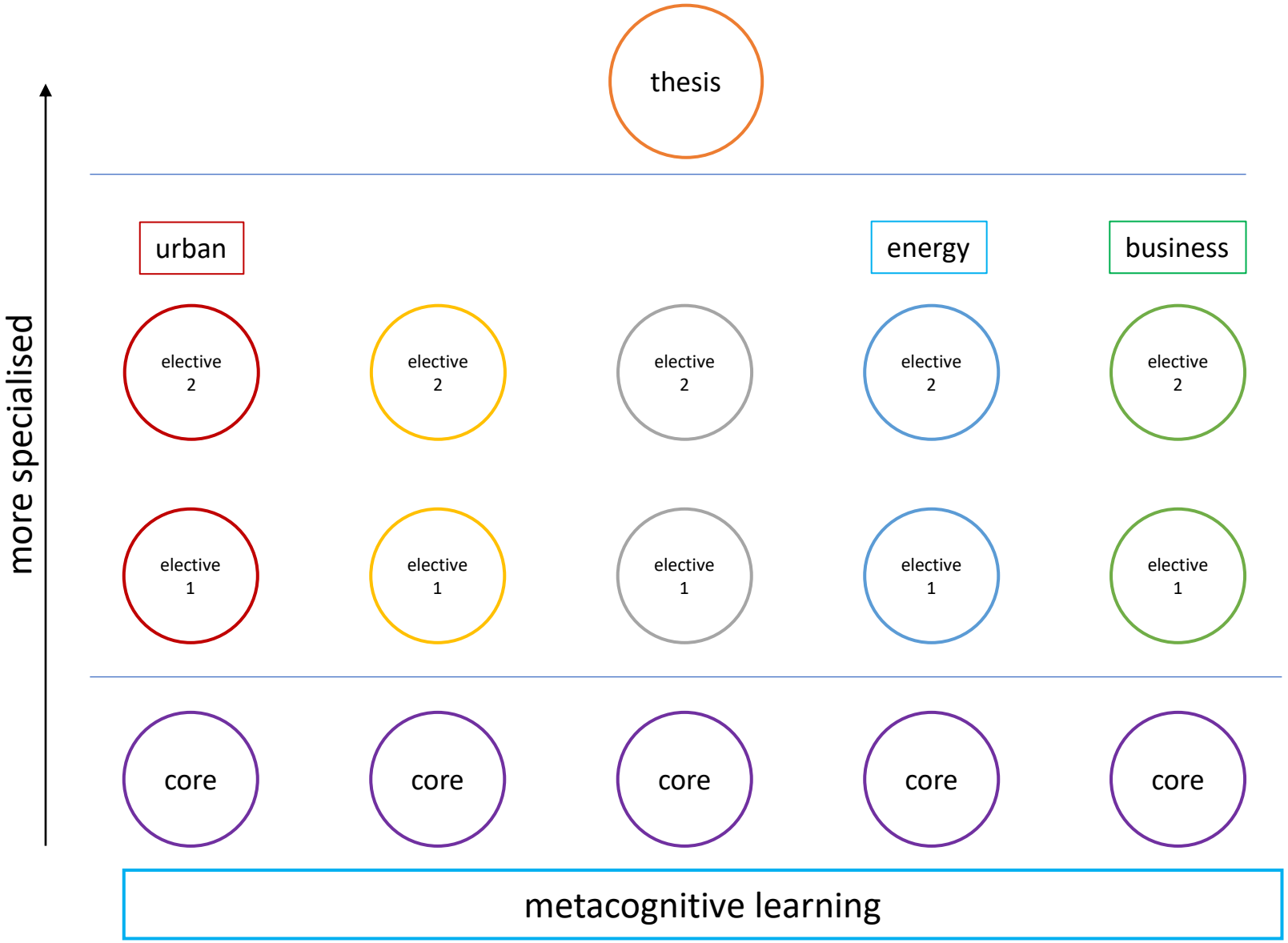
- Diagnose: is the module too hard, too easy or just about right?
  - Computerized Adaptive Testing
- Create communities of practice
- Set work that allows knowledge and competency gain
  - schema, methods, theory, applications
  - differentiated instruction – personalised learning based on competence (Tomlinson)
  - individual and group work
- Assess learning gain
  - self- and peer-assessment, reflective writing, formative feedback
  - summative assessment: application for unknown authentic problems
    - Bayesian Knowledge Tracing – probability of success in future applications based on previous learning?
- Minimise extrinsic rewards
  - e.g. summative learning gain assessment and projected competence vs degree categories

Speculative Redesign: MSc Environmental Technology

Current situation:

- 160 students recruited from any disciplinary background
- Interdisciplinary: 8 subjects taught
- Students have varying levels of competence at any one subject
- All students take the “core course” – 8 subjects
- Students specialise into one of 8 electives
- Summer thesis

MSc Environmental Technology



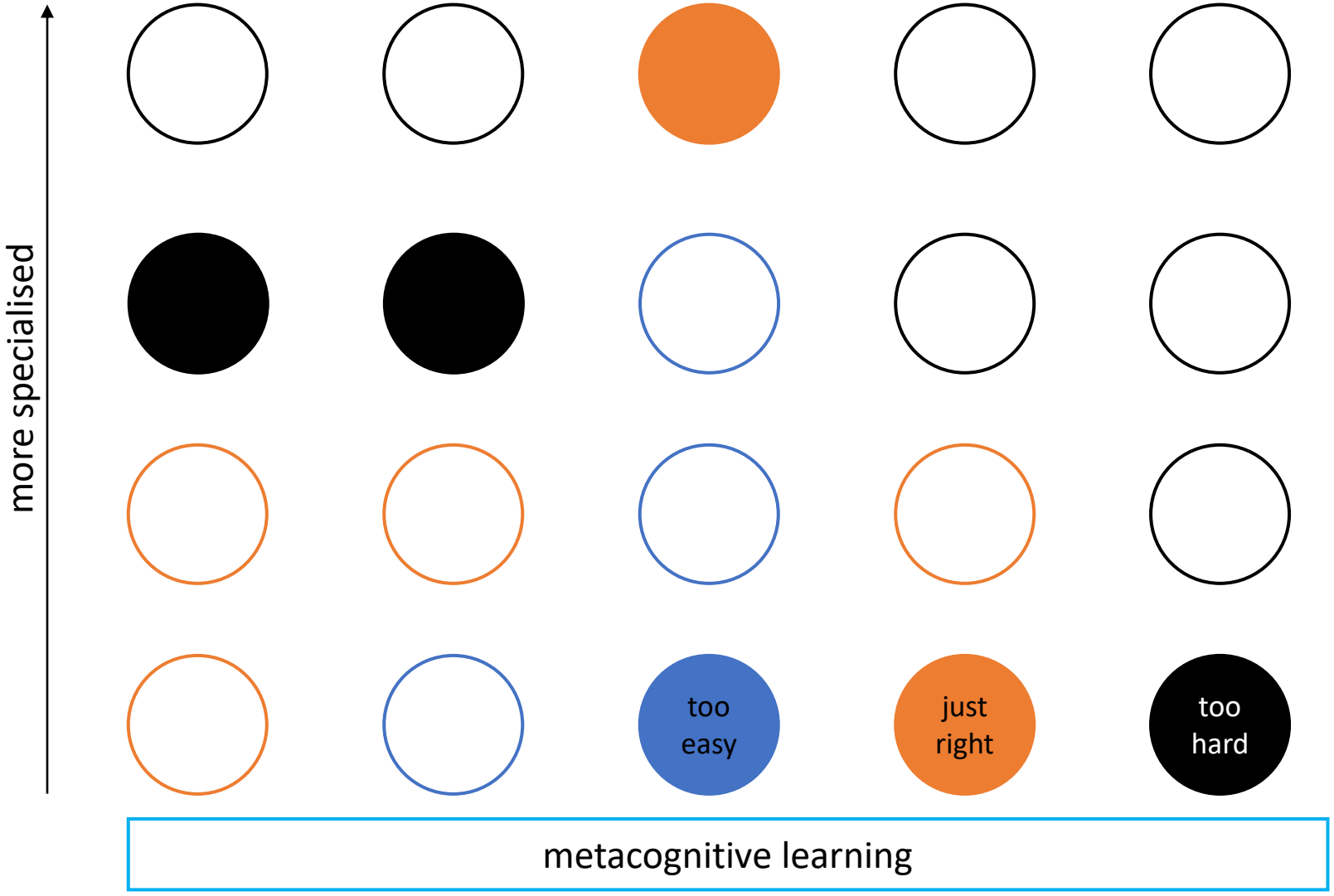
All 160 students take the core course in term 1.

Groups of ~20 students specialise in term two through electives.

All students undertake a research project over the summer.

Traditional Assessment

Step 1: Diagnosis

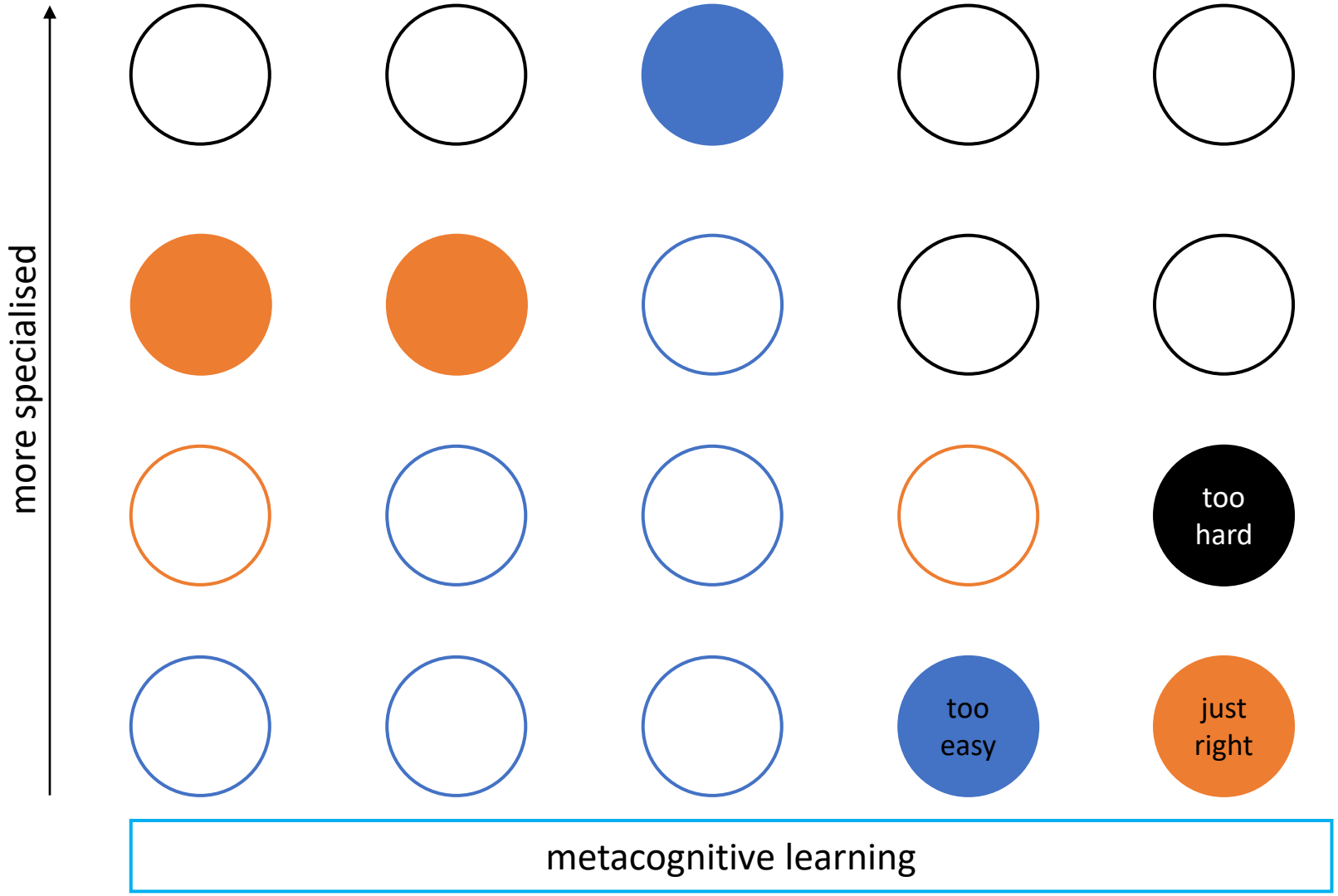


Students undergo tests that determine which modules they can choose give their current state of understanding.

Students choose from the orange modules only – these will result in learning progress.

Students take schema development courses to help them tackle the black modules.

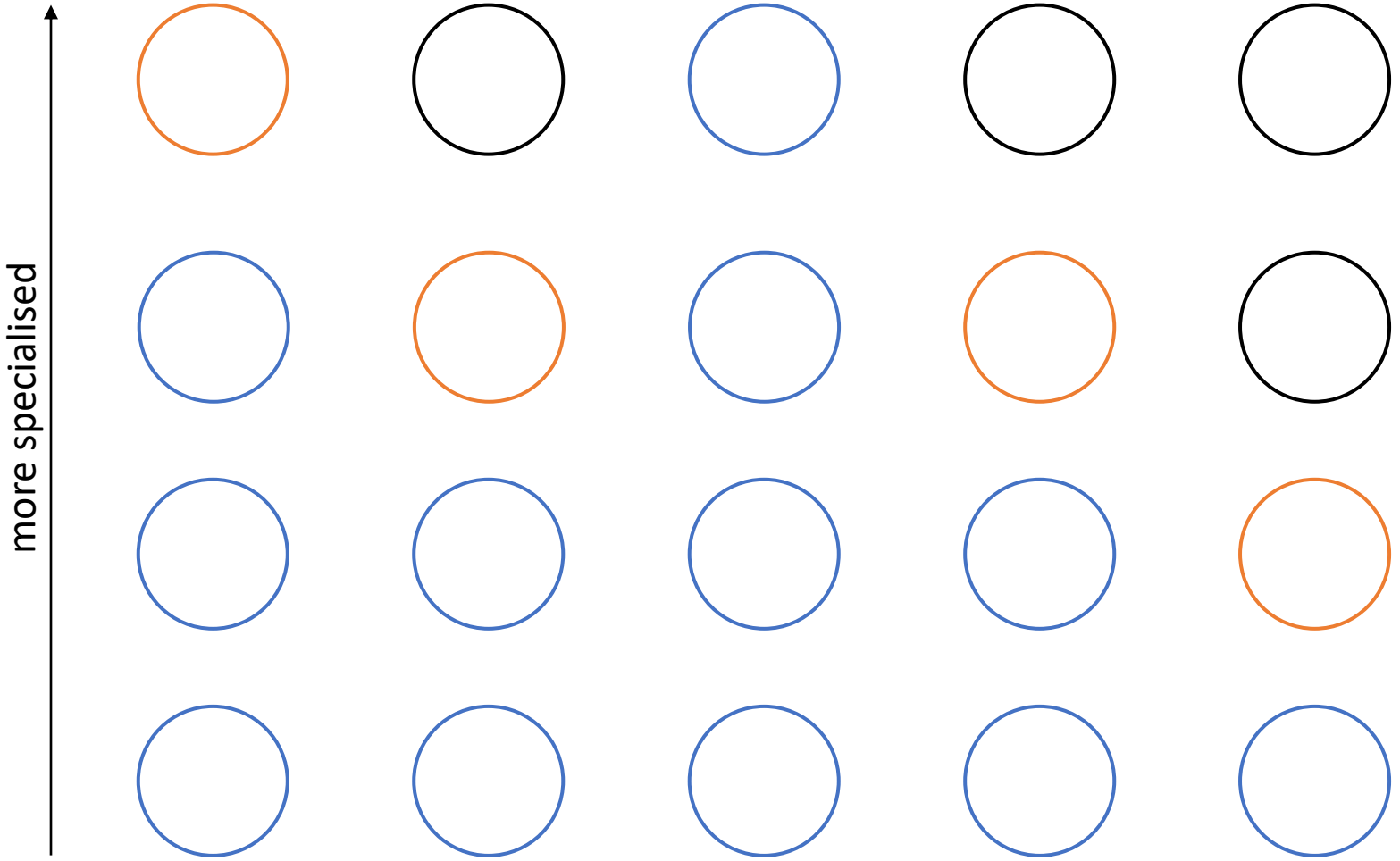
Step 2: Progression



Students learn and progress. Continuous testing indicates when they can move on to another module.

Schema development has opened up new modules for the students to take.

Step 2: Completion



Overall learning progress:

- the probability that a student will be able to tackle unseen problems in the future
- portfolio of outputs for summative assessment

Key References

- Ryan, R. M. and Deci, E. L. Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being. American Psychologist, 2000, 55(1), 68-87

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- Toro, S. Self-Regulated Learning Strategies for the Introductory Physics Course With Minimal Instructional Time Required. J. College Science Teaching, 2022, 51(5), 16-22