**The use of QuestionMark to deliver flexible “decision-driven” learning**

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**Decision making processes and learning**

- Decisions form a central part of conceptual learning and drive processes that stem from learned material.
- These span disciplines and inform on student understanding and appropriate application of knowledge.
- In life sciences, such decisions are central to executing experimental procedures accurately and appropriately.
- With this in mind, the current project aimed to build a simulation of a key experimental protocol driven by a student “decision engine”.

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**Bringing the process to life with QuestionMark**

- The decision points mapped in Figure 1 were transformed into “drag and drop” questions within QuestionMark.
- This provides:
  - visual impact
  - interactivity
  - enhanced experience of protocol/apparatus

**“Brings process to life”**

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**The Western blot: a decision-driven experimental protocol**

- The Western blot is one of the most commonly used experimental procedures in the life sciences.
- It studies protein in experimental samples, and is a fundamentally important technique.
- Actual practical classes are infeasible due to costs and time constraints.
- As a complex procedure, the Western blotting protocol involves many stages, and these can be mapped as decisions points.
- Each decision has a bearing on the final experimental result, and by presenting students with control of these decisions their learning can be applied, reinforced and assessed.
- Downstream of each decision there are unique consequences depending upon the precise decision made; these can be linked to each decision and presented as informative feedback.

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**Figure 1: The Western blotting procedure mapped as a series of decisions with consequences. The consequences of each decision create a series of loops and branches that realistically demonstrate how these steps will affect the outcome of the procedure (bubbl.us).**

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**Figure 2: Transformation of decision points into “drag and drop” questions within QuestionMark.**

- **A.** An original decision point within the flowchart (Figure 1).
- **B.** The decision point transformed into an interactive question.

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**Figure 3: Design and alignment of consequences, feedback and progress.**

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**Student feedback**

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**Outcome**

- The simulation was very well received by students and increased confidence with the protocol.
- Provides experience of the decision driven process in a safe environment and enhances understanding.
- Broadly applicable to any discipline with decision driven processes e.g. Law, Engineering, Business