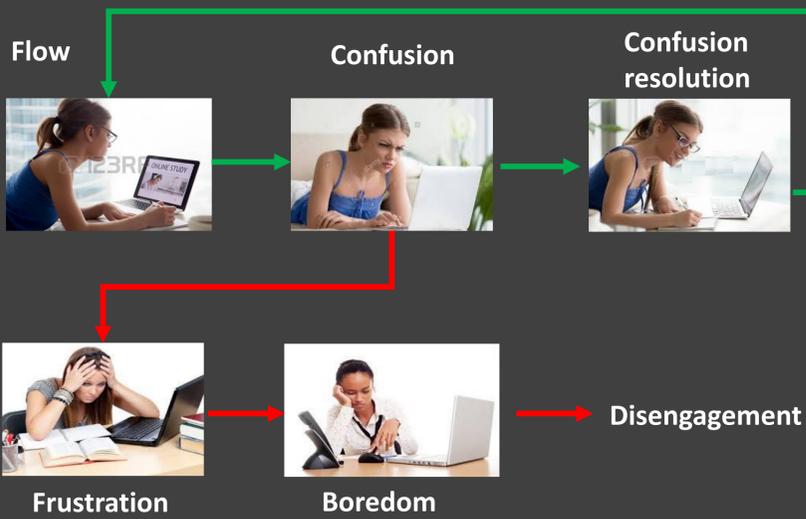


Motivation

- Online learning environments typically lack direct immediate feedback from instructors
- When learners' face an impasse they may be *confused*
- If such confusion sustains, it may lead to learners' *disengagement* from the task
- Timely and informed interventions, may help learners getting back to the tasks



Model of affective (emotional) dynamics

Challenges

- Behavioural markers of confusion vary between learners
- Contents and course design can also impact learners' experience of confusion

Related Works

Previous lab-based studies are hard to be generalized as they detect confusion through

1. Videos,
2. Physiology,
3. Sensors, and
4. Trackers

Our approach

- Our approach is based on learning analytics (LA)
- Confusion is detected in a naturalistic setting
- The design of underlying educational framework guides the likely moments of confusion
- This work may benefit from the advances in data mining and machine learning

Learning Environment

Simulation based Predict-Observe-Explain (POE):

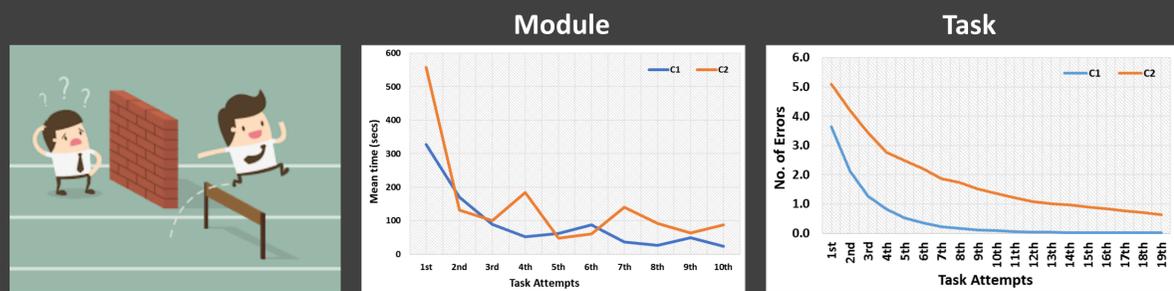
1. **Predict** phase can probe learners' prior knowledge and/or misconceptions
2. **Observe** phase allows the learners to discover any errors in their prior knowledge
3. **Explain** phase, helps the learners reconcile any discrepancies between their predictions and observations



Study 1 – Profiling learners' confusion

A profile of confused students is established. Through iterative process of data analysis two student groups emerge

- 1) Both student groups exhibit similar persistence and prior knowledge but they adopt different learning paths or processes
- 2) One group seems to struggle more as they make more attempts and spend a longer time on tasks
- 3) The other group seems to complete the tasks more easily

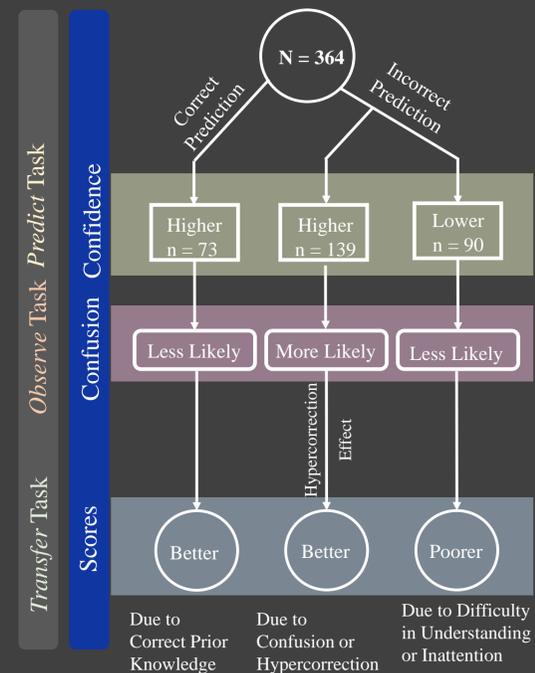


Profiling the confused learners

Study 2 – Moments of confusion

This work analyses the likely moments of students' confusion

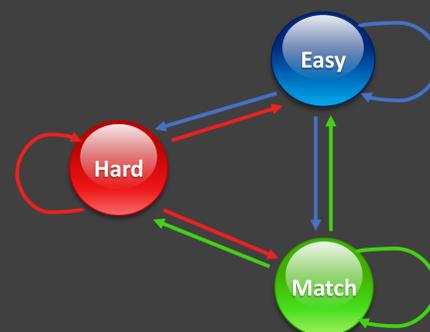
- 1) Confusion mostly occurs during **Observation**
- 2) Students who make errors, struggle more
- 3) High confidence errors are more likely to result in confusion than the errors made with lower confidence
- 4) The effort associated with confusion resolution can result in positive learning outcomes



Study 3 – Dynamics of task difficulties

Task difficulties are analysed for a better understanding of confusion:

- 1) Students' self-reports data on confidence and challenge is utilised
- 2) Higher challenge can indicate confusion and difficulty **Hard**
- 3) Higher confidence can indicate easiness of tasks **Easy**
- 4) Matching confidence and challenge indicate optimum difficulty **Match**
- 5) Task difficulties affect students' post-test performance



Future Work

In future we plan to develop proxy variables for actionable insights in simulation based environments

Implications

This study can guide the future works in online learning environments for the provision of timely and informed interventions