

# Improved Personalization in MOOCs to Enhance Student Learning



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# What is MOOCs ?



# Let's meet Jane



- 37 years old
- Software developer
- Tech Savvy
- Married
- Mother of two

# Getting to know Jane

## Motivating Factors

- Wants to advance in career
- Wants to learn new technologies
- Is limited by time



# Getting to know Jane

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- Wants to advance in career
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She chooses to enroll in MOOCs



# Getting to know Jane

## Motivating Factors

- Wants to advance in career
- Wants to learn new technologies
- Is limited by time



## Demotivating Factors

- Feels isolated
- Struggles to understand complex topics
- Feels lost, unable to figure out what to do next



She chooses to enroll in MOOCs



90 %

Dropout Rate



**USER RESEARCH:**  
UNDERSTAND USER PROBLEMS AND NEEDS



# Research Findings: User Problems



Lack of Feedback

# Research Findings: User Problems



Lack of Feedback



Absence of Pedagogical Guidance

# Research Findings: User Problems



Lack of Feedback



Absence of Pedagogical Guidance



Lack of Social Interaction

# Research Findings: User Problems



Lack of Feedback



Absence of Pedagogical Guidance

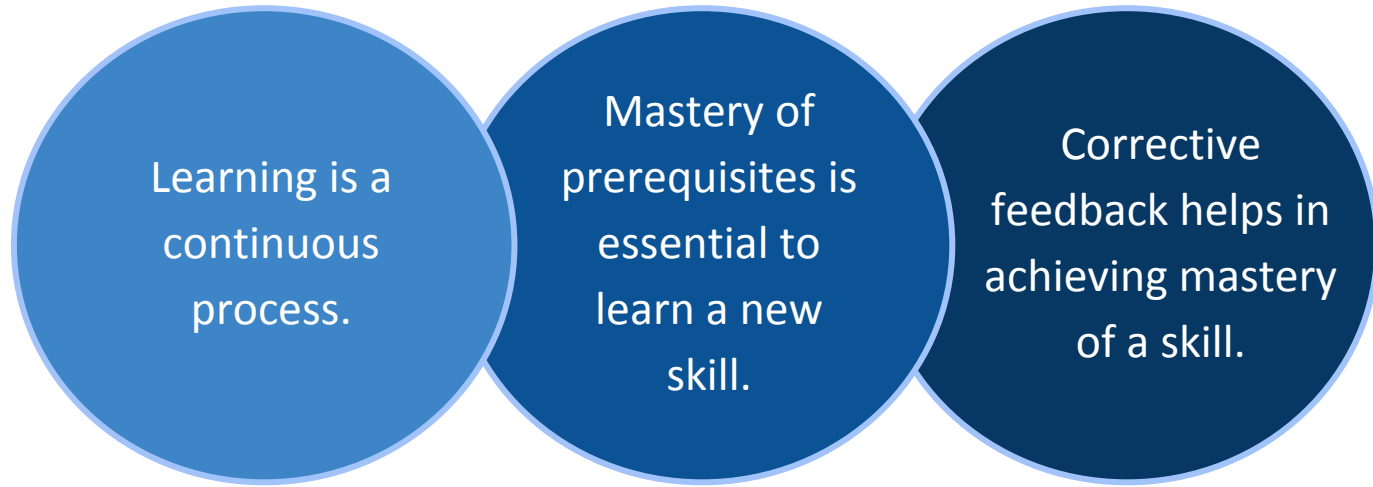


Lack of Social Interaction



One Size Fits All

# Analysis of Problems



**HYPOTHESIS:** We propose that in online platforms student learning can be increased by providing continuous feedback to students.

# Our Solution

We created a Data-Centric solution for this User-Centric problem in the form of a

***PERSONALIZED REVIEW PAGE!!!***

# Designed Features in the Review Page:

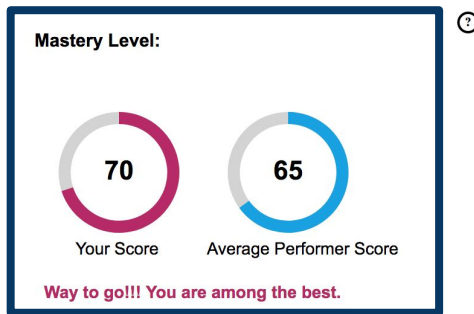
## Skill Mastery Level



## Measuring skill levels

### Skills:

#### Fundamentals:



#### Skill Resources Covered: ?



#### Suggested Resources to Improve Mastery Level:

▶ [Intro to Asynchronous Fundamentals Video](#)

📖 [Intro to Asynchronous Fundamentals](#)

# Designed Features in the Review Page:

## Suggested Review Links

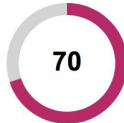


To decrease  
knowledge gap

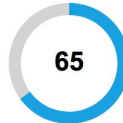
### Skills:

#### Fundamentals:

Mastery Level:



Your Score



Average Performer Score

Way to go!!! You are among the best.

Skill Resources Covered:



80% Skill resources  
viewed/attempted

20% Skill resources  
not viewed/attempted

#### Suggested Resources to Improve Mastery Level:

▶ [Intro to Asynchronous Fundamentals Video](#)

📄 [Intro to Asynchronous Fundamentals](#)



# Designed Features in the Review Page:

## Skill Progress Bar



Setting skill expectations

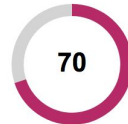
### Skills:

#### Fundamentals:

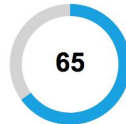
Mastery Level:



Suggested Resources to Improve Mastery Level:



Your Score



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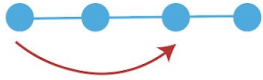


80% Skill resources viewed/attempted

20% Skill resources not viewed/attempted

# Designed Features in the Review Page:

## Course Progress Bar



Tracking course progress

### ✓ Course Progress Bar:

Course: Asynchronous Programming with Javascript

☒ Module view ☐ Section view ☐ Sub-section view

You are here



Module 1 - Asynchronous Fundamentals



Completed



Remaining



Skipped

**REVIEW PAGE**  
MACHINE LEARNING MODELS

# Behind the Scenes



Tag  
Skills

Generate the  
course skill  
taxonomy.  
Tag each  
resource.

# Behind the Scenes



Tag  
Skills

Knowledge  
Tracing

Generate the  
course skill  
taxonomy.

Tag each  
resource.

Predict a  
student's skill  
level based on  
their past  
activity.

# Behind the Scenes



Generate the course skill taxonomy.

Tag each resource.

Predict a student's skill level based on their past activity.

Identify the skills that a student needs to improve before proceeding in a course.

# Behind the Scenes



Generate the course skill taxonomy.

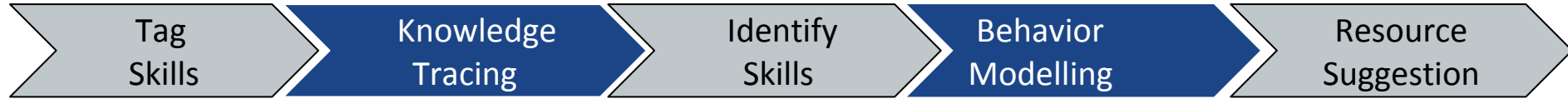
Tag each resource.

Predict a student's skill level based on their past activity.

Identify the skills that a student needs to improve before proceeding in a course.

Predict the most likely action to be taken by the student.

# Behind the Scenes



Generate the course skill taxonomy. Tag each resource.

Predict a student's skill level based on their past activity.

Identify the skills that a student needs to improve before proceeding in a course.

Predict the most likely action to be taken by the student.

Suggest resources based on skill level and behavior.



# Deep Knowledge Tracing (DKT):

For knowledge tracing, we are using Deep Neural Networks.

## Phase 1: DKT



## Phase 2: DKT with Behavior modeling

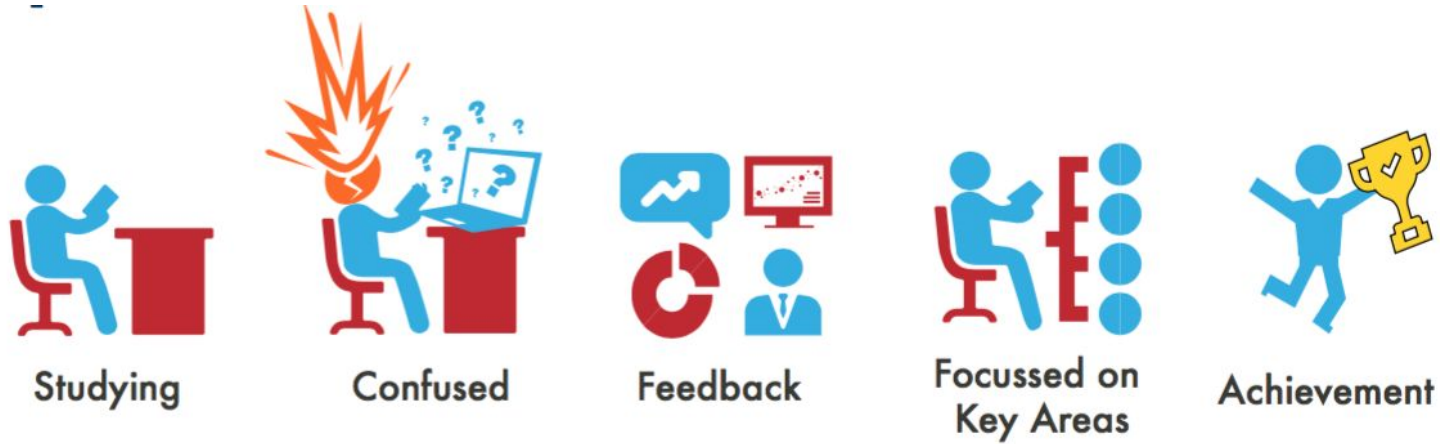


## **RESULTS AND POTENTIAL IMPACT**

# Results

- Course Progress Bar 
- Links to Resources 
- Skill Mastery Level 
- Skill Progress Bar 
- Our DKT model achieved moderate improvement from naive baseline method

# Potential Impact



- Reassurance about concept mastery
- Pedagogical guidance
- Motivational effect

# Contributions

- First research study to use DKT in MOOCs.
- A small step towards personalization in MOOCs.
- Investigated motivational effect of psychological framing on students.
- Evaluated the impact of relative scoring on learners.
- Set stage for further exploration of deep learning for personalization in online education.

# Acknowledgments



**Prof. Zachary Pardos**  
([zp@berkeley.edu](mailto:zp@berkeley.edu))

**Thank You!**

**Questions?**



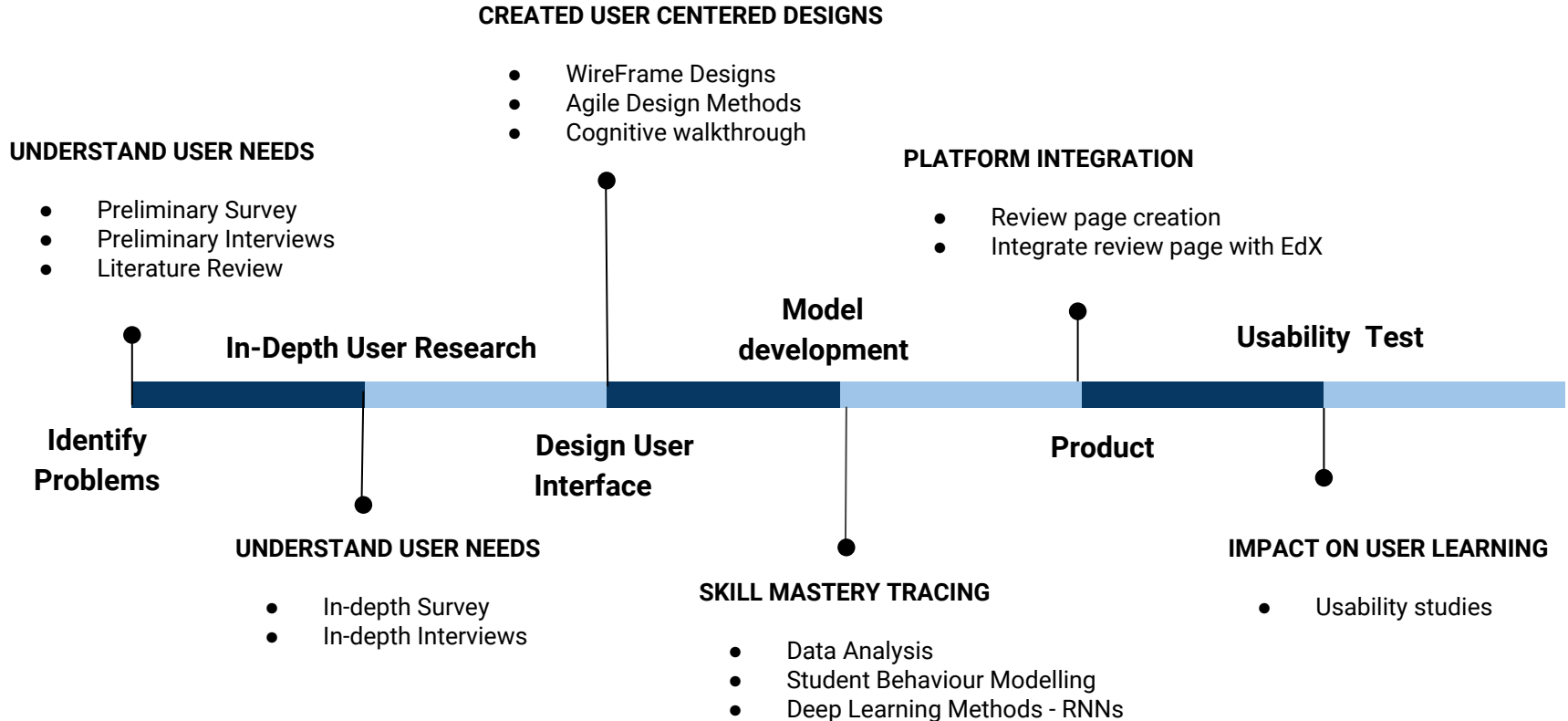
# Our Hypothesis:

- We propose that in online platforms student learning can be increased by providing continuous feedback to students.
- They can then take an informed decision about moving ahead in the course or revisiting the earlier concepts.

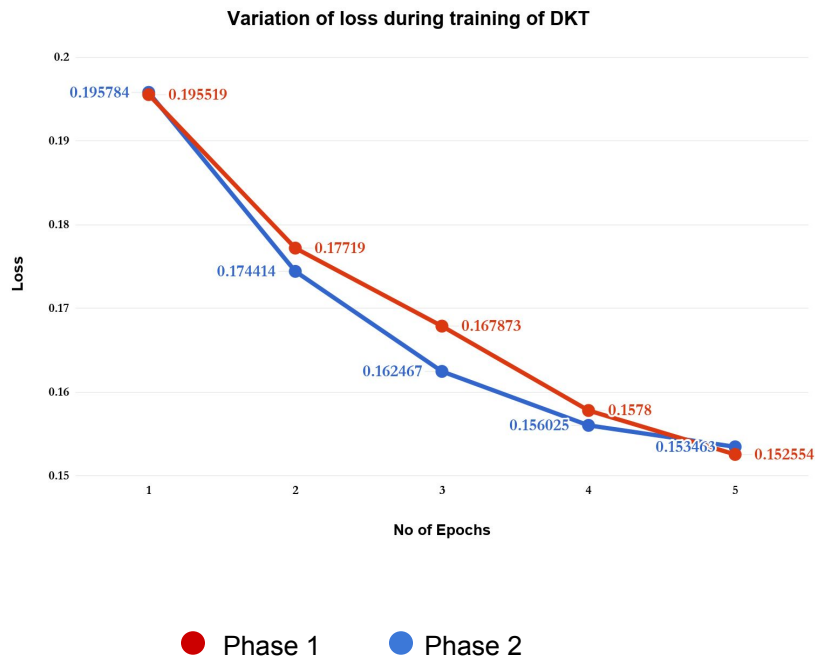
# Future Work

- **User Centered Design**
  - More design iterations and evaluations
  - Integration of front-end with back-end
  - A/B testing
- **Further research in Deep Learning**

# Our Process:



# DKT Performance on Test Data:



Model	Accuracy
Baseline	84.8
DKT	92.11
DKT + Behavior	92.19