Click on the blue headings below to go to a particular section.

tiny.cc/moocletsnotes points to this document.

Extensive relevant information about the MOOClets group (& meeting/time location) is at tiny.cc/mooclets or www.josephjaywilliams.com/mooclets

Useful Notes from Winter Quarter Meetings

Here is the link to *MOOClet Reading & Discussion Group – Winter Quarter Notes*.

Week 1: Introduction & Why focus on "MOOClets" rather than MOOCs?

Screencast:

https://www.youtube.com/watch?v=ykRIwLzKL70

Agenda

1. Introductions
2. Why focus on "MOOClets" rather than MOOCs? The advantages of focusing on modular resources or "MOOClets" rather than MOOCs.
3. Review of MOOClets insights from last quarter
4. Discussion of Topics & Agenda for this quarter.

1. Introductions

Joseph: Quick Overview

Ask Group Members:
What is your name and what do you do? (type name & website below)
Why are you interested in focusing on MOOClets/Modular Resources?
What would you like to get out of the group?
Do you have any suggestions for resources, topics, ideas to keep in mind?

Ari Korhonen, Aalto University, Helsinki, Finland (https://people.aalto.fi/ari_korhonen)
Amy Ahearn, from LSTD, Stanford Medical School, Anaesthesia & Informatics Lab.
Larry Chu, http://aim.stanford.edu/
Vera Michalchik, from Center for Teaching & Learning. What kinds of resources become useful in different topics and contexts. What makes things maximally useful & purposeful?
Mariatte Denman, Ph.D.

How to create Learning Modules. Replicate a certain Learning Experience online. Previous online models 10-15 years ago, now there's more data collection and feeding it back into a loop for improvement. Better to start at a higher level and see many examples.
Joseph Jay Williams
VPOL ID team –
Will Thalheimer, Corporate Training
Qualitative Researcher/Learning Sciences – Emily Schneider
Technology/Platform developer (ATS – Mike Widmer, LACUNA, close reading modules. Carlos Seligo. Paul Zenke.)

2. Why focus on "MOOClets" rather than MOOCs?

Consider Group Member Responses to "Why are you interested in focusing on MOOClets/Modular Resources?" and use them to improve & elaborate the notes below.

What are examples of the kinds of learning situations that you care about?

- Sexual Harassment office has created training. Animation, have to make decisions about behaviors in challenging situations.
- Animations for physical and computational phenomenon (research on learning benefits of those)
- Basic foundational principles for Teaching & Instruction
- Continuing Medical Education (across different professional domains. out of school, need refresher courses)
-

MOOClets correspond to a wide variety of existing educational interactions & resources:

- Lectures
- Textbooks
- Simulations
- Interactive activities
- Tutoring
- Peer collaborations

For doctors, gather at grand rounds, at conferences.
Delivered in compressed way, sensitive to their times & needs.

What are examples of MOOClets/Modules one could develop?

Online courses naturally extend the historical focus on in-person courses. But the future uses of blended & online education may benefit from targeting development at the level of the modular components ("MOOClets" such as videos, lessons, exercises, interactive tools) that make up courses.

The advantages of focusing on modular resources or "MOOClets" rather than MOOCs:

- **Closer match to learner needs.** People can use modular resources to learn a particular concept or skill when a specific need arises or a question has to be answered. (E.g. How to do a t-test.) Online resources reduce reliance on learning from semester-length courses taught by a single instructor to one class, as reflected in work on Just-in-Time, On-Demand, or Subscription Learning.
- **Leverage Insights & Support Blended Learning in existing educational contexts.** The modular nature of MOOClets makes it easier to create them by building on materials from existing educational environments (lesson plans, lectures, exercises, tutoring) which can be used in MOOCs *and* are then more appropriate as resources to support blended education (flipped classrooms, homework exercises). This facilitates links between recent technology/content development and existing practical needs in K-12, higher education, and the workforce.
- **Identify Generalizable Design & Pedagogical Principles** at the grain size of learning from videos, exercises, conversations, which form the components of most existing (and likely future) online courses, and often also map onto modular units in software/technology platform development.
- **Iterative Improvement as part of a Self-Improving System.** Modules can be more readily re-used and iteratively improved through practical experience, experimental and other kinds of research. Just as Wikipedia's strength was not its first 1000 articles but a system for successive improvement, a development process organized around developing educational modules can facilitate revision & improvement more than a system organized around courses.
- **Collaborative Development** by Researchers, Practitioners, and Entrepreneurs, which is facilitated by reducing the demands of the development process (e.g. hundreds of hours for a MOOC vs. time to develop an example of a lesson or exercise). Bite sized online resources provide a concrete focal point for improvement by "expert crowdsourcing" of diverse practical, scientific, and business perspectives, and can promote collaboration if the conflicts between the goals and constraints of different groups (e.g. Researchers & Entrepreneurs) can

be identified rapidly or resolved by creating multiple variations of a MOOClet.

3. Insights from pilot MOOClets meetings last quarter

Notes & Screencasts are available at MOOClet Reading & Discussion Group – Winter Quarter Notes - Google Drive.
Please add (including your work!) to 1.1.2 Examples of MOOClets or Digital Online Modules

Major Points/Themes

- MOOClets are particularly well suited to Rapid Prototyping to test modules with actual students and in experiments, rather than trying to perfect resources before release through an extensive development process – "Agile" type of approach
- A major need is using MOOClets/modules for diagnosing student knowledge & providing Just-In-Time teaching or Interventions. (Intro Meeting)
- Higher quality resources can be produced more quickly through a process for identifying & using existing repositories of modular content and adapting this to one's particular goals (Meeting on Putting together a/your MOOClet)
- Recent technological innovations include a proliferation of freely available Rapid-Authoring Software for authoring interactive modules & quizzes that require no or minimal programming but are pedagogically rich. (Meeting: Developing Adaptive MOOClets)
- Adaptive & Personalizable Learning Resources with Targeted Feedback can therefore be authored relatively easily (e.g. using Qualtrics)
- A future growth area is implementing Instructional Design principles in modular resources that can be adaptive to multiple kinds of users (Instructional Design Meeting 1 and Meeting 2)

Key Challenges & Obstacles to developing MOOClets

Specific MOOClets to be developed

4. Discussion of Topics & Agenda for next quarter

Can someone lead discussion next week? I will join remotely by Google Hangout.

Additional Notes & Resources that aren't embedded in sections above

Week 2: Rapid Authoring of MOOClets: Embedding Qualtrics into EdX to create interactive MOOClets that extend EdX's pedagogical and data analytics functionality

Agenda

A key advantage of focusing on a MOOClet/modular resource rather than a full MOOC is that it allows researchers and many others to be "course developers". Even if they do not have time to spend hundreds of hours creating an eight week MOOC, they can develop a singe lesson or interactive problem.

This meeting will consider how Qualtrics (a survey software tool freely available to anyone at Stanford) can be used to author online lessons & exercises, and how these can be embedded within EdX MOOCs.

Extending the platform using this additional software tool adds its capacities to those of the MOOC platform, such as:

- Rich pedagogical capacities – targeted feedback, adaptive learning, validated responses, control over timing dynamics, sophisticated setting of variables and if-then branching logic based on previous responses and behaviors.
- Any data collected about learners is instantly accessible in a research-friendly format.
- A/B testing or randomized assignment is possible & more flexible.
- Rapid development & use of logic without programming.
- Collaborative editing & markup on learning resources.

At the moment we used Qualtrics & OpenEdX, because Qualtrics is extremely well suited to online learning, but this extends to other MOOC platforms. Qualtrics has been linked to OpenEdX, to Coursera, and using LTI with NovoEd provides some functionality.

There are many other Rapid Authoring Tools like Qualtrics, for which a bit of groundwork simply needs to be done to link them to MOOCs.

Screencast
https://www.youtube.com/watch?v=JkUA4NTFrf0

Week 3: (Tue April 21) Combining the benefits of Rapid Authoring Tools & MOOC Platforms to create MOOClets on Statistics & Study Skills

Google Hangout on Air Link:

[The link below currently works and was posted by Joseph at 10:30 am PST. No one will actually “join” the call until 12 pm PST, but it’s available.]

https://plus.google.com/hangouts/_/hoaevent/AP36tYfTTe-tMB956rCMPRgitfnHY-Fu8MA1dKr9VX3WxyStTSIdpQ?authuser=0&hl=en

Screencast Link:

This will be posted immediately after the meeting. Email josephjaywilliams@stanford.edu or sam.maldonado@cognitivescience.co if it isn't up.

This week has two related goals:

One is to briefly review and continue last week's progress on Rapid Authoring of MOOClets: Embedding Qualtrics into EdX to create interactive MOOClets that extend EdX's pedagogical and data analytics functionality by showing how authoring of pedagogically rich interactive and adaptive exercises and content can be achieved by combining the technological capacities of OpenEdX with those of Qualtrics (embedded via iFrames).
The second is to consider what set of MOOClets/Modules would be appropriate and compelling to actually put up on a platform like EdX (or Coursera/NovoEd). For example, at class.stanford.edu there are a number of full MOOCs/Courses listed.
One idea is to list a MOOC on class.stanford.edu/OpenEdX (or www.coursera.org or www.novoed.com) that is a novel type of "course" in that it is a collection of MOOClets on (for e.g.) the introductory topic of statistical variability and how to conduct a statistical test, along with a few modules on learning and problem-solving strategies for learning statistics (and other topics) in MOOCs.
To be concrete (but very tentative) about what this might look like:

Potential Batch of MOOClets to be provided via a MOOC:

Titled "MOOClets for Introductory Statistics: Understanding variability and the logic of statistical hypothesis tests, and their relevance to real-world problems"

The first key concept here could be on understanding variability: intuitive examples of how understanding it is important for everyday problems, how it is measured and calculated (formally, standard deviation and variance), and what one can do with an understanding of it (which leads to a second concept).
The second key concept could be on the logic of conducting a statistical test: intuitive examples of how one needs to know whether differences between groups (e.g. proportion of students passing an exam after being assigned vs. not assigned to take a supplementary online homework program), how a statistical test (e.g. t-test or chi-square) is calculated using measures of variability/standard deviation, and what one can do with an understanding of what a statistical test is.

Examples of Content that can be used in this Batch of MOOClets:

> Content from OLI Statistics course, Khan Academy (and other freely licensed online material) that is relevant to High School, Community College, and Intro University syllabi/standards. [This can be easily implemented as text lessons and exercises in OpenEdX]
> Statistics exercises & worked-examples of the kind used on Khan Academy [I have already implemented these in Qualtrics]

A module from Cerego that uses adaptive learning to review foundational statistics terms & concepts (this has been embedded into EdX using LTI).

This content is not intended to but utterly new, but to synthesize the best of what exists in a modular form that can be then further improved thorugh iterative experimentation. These are MOOClets specifically designed to match the criteria we have discussed 1.3.1.1 Why focus on "MOOClets" rather than MOOCs?, such as being in the right form to be directly used by high school, community college, and Stanford University instructors; implemented in technology that makes it easy for us to do randomized experiments and collect data; being easy to update and improve and incorporate rich pedagogy not currently easily available in a MOOC, like adaptive learning and targeted feedback.

Week 4 (Tue May 13): Instructional Design Principles for creating good MOOClets – Lesson & Interactive Exercise

Hangout Link

What are simple, broadly applicable, and evidence-based principles to apply in creating modular online resources? Although interested in generally applicable principles, we will focus on an example of a lesson and interactive exercise that explain and help people learn the logic behind statistical hypothesis tests. This is the target topic for putting a MOOClet up on an actual MOOC platform, so the ideas pulled together here will be influencing this final product.

The relevant principles are likely overlap significantly with instructional design principles for creating good online courses, classes, and good pedagogy for teaching. But we'll be drawing on all of these and considering it in the context of MOOClets, and specifically, an online video/text lesson on teaching people how to do a statistical test, and/or online exercises to practice and cement this knowledge.

Statistics Lesson

Statistics Exercise

- Ask teachers: What is information/data you want to get/collect from your students? (That you couldn't collect normally?)
- What is information you would like to collect/get and show back to students?
    - How long do students take to read/watch and do exercises/assignments?
    -

ID short burst: I can't take a whole course on course design, I just want to do this one MOOClet ona video on statistics.
What is the 10-line version.
What are things people should do that they don't often think about.

Ari: PhD Students with him is collecting data and then showing them a heatmap of how they are doing relative to the whole class.
Judy: Show people relative to a **plausibly ideal student** , since the comparison is delicate. (e.g. energy savers who are above average tend to slack off…).

Continue to return to that "Short List" and Improve it: Add to it, Eliminate from it, Segment it. What's a good taxonomy. [Segment to their purpose. Things to examine in A/B tesitng Research. Parameters for instructors to set, possibly A/B Test].
[500 character limit]

Translate Learning Objectives – Final thing for people to do.
-> Write the exam question you want them to be able to anwer. (Leverages academic's domain expertise, instead of requiring specialized knowledge of how to write a learning objective).

Shorthand for student profiles/prerequisites. E.g. "Stanford students" – certain language levels, tetiary level. Very useful student.

Extreme Programming:

Instructional Design Principles

What should the typical instructor be thinking about when they design a MOOClet lesson like this?

A Fundamental – there on first pass:

- State Learning Objectives
- Have a Roadmap
- Include Self-Assessment Questions
    - Topic-specific
    - Metacognitive
- Articulate what level of student knowledge you expect, and which students these items are targeted towards. (Stanford students, comfortable with formulae).
    - Adapt content to different students (can do using Rapid Authoring Tools)
    - Make content that supports students' differential navigation of content so that they can help themselves do their own adaptation to their level of prior knowledge

B Helpful – second line of thing.

Examples to benchmark against

Free Online Textbook on Chemical Engineering

Resources to examine

http://vpol.stanford.edu/id-pedagogy/resources-and-docs

Overview Document of Questions for ID

teachingcommons.stanford.edu

MOOC on Learning Design for a 21st Century Curriculum

Yishay Mor, from Open University, now University of Surrey
Design Patterns for MOOCs, How to ruin a MOOC

Additional Notes

Resources Ari created & works with:
http://algoviz.org/OpenDSA/Books/OpenDSA/html/InsertionSort.html

Extreme Programming

How MOOC Video Production affects engagement

Week 5: Experiments

Hunger for “what to measure”?

New opportunities for Psych science.

Is it just a replication study?

BUT – not controlled anymore, how do you justify your samples…

Interesting questions:
Is it the same set of questions as before?
Is it completely new? What are the **new directions** we can explore?

Did we learn anything new?

Within-subjects studies….

Suddenly teachers are in the position of being educational researchers…

Experiment-Guided Instructional Design

What's new? Ability to conduct experiments

Experiment-Guided Instructional Design

Findings on Growth Mindset.
Design Intervention in the MOOC.

You did something. WHat's the insight .

What did you learn that Carol Dweck would be surprised by? [sophisticated analyses]

Data from empirical comparisons powerful for improving instruction, for formulating generalizable principles

Experimental Results provide natural bridging

Refining the Scope of Generalizations. Not a simple IF-THEN statement (3 vs 6 minute videos), but tons of collections of mini-generalizations.

Cost-Benefit Framework

Adversarial Collaboration, Democratic Comparisons.

How to design instruction, vs. How to improve instruction.

Experimental studies are very hard.

How to choose the instructional variables, the measurement variables?

Data collecting in response to EXPERIMENTS is much better. (vs. Fishing in the Exhaust, Assessment focus). Scott – Comparison.

Level of control.

What is the point yo uare trying to make, and what's the data in support of that?

Old data, new results.

I value the data from 200 empirical papers more than 20 MOOC databases. (Stanford's NEED).

> Segmenting the population...

> Generic questions to ask about any learning material.
Learning Measures. Got VPOL grant, what should we put in.

> What do we NEED the scale of MOOCs to learn.

AB between users, vs. AB within users.

Here are things we don't know, and would be useful to build into your studies.

What is NEW about MOOCs?
Scale.
Experiments.
Real-world + Research.
Iterative.
Crowdsourced.
Accessibility.

Within Subjects. Who responds, and who doesn't.
Then ask interesting questions about X and Y types of people.
Great if you had follow up experimental comparisons.

Anything else from the data, that would say something…

Concerns about Experiments:
Extremely hard.
What if you get an effect, but it's just due to "confounding factors"
What's the POINT, if it's really important that you do condition A for person X, conditino B for person Y. THAT's what I care about. (Tom's individual differences graph).

Week 6: (Tue June 10): Augmenting Learning from MOOClets with diverse content but common structure: Leveraging Modularity to identify Broadly Applicable Pedagogical Principles

Previously we have considered good instructional principles for creating MOOClets from scratch. A related issue is to consider how the modular structure of a MOOClet that has already been created – like

an exercise, lesson, video – makes it easier to articulate and test pedagogical principles that can be broadly applied to MOOClets that are similar in the ways that learning from them can be improved, but different in many other features.

For example, considering a given "exercise" as a MOOClet (modular component of a MOOC), learning could be improved by adding motivational messages or prompts with general questions to reflect on (e.g.tiny.cc/whatwhyhow, tiny.cc/whatwhyhow2 on Khan Academy), even if these exercises cover many different topics – algebra, statistics, negotiation strategies, product design.

Similarly, considering a video or lesson as a MOOClet (whether in a MOOC or on-campus blended course; whether a resource for Stanford undergraduates or community college or high school students), learning could be improved by instructions for students to reflect on relevant previous topics (accessing prior knowledge), quizzes during the video, or having students attempt to recall the lesson or explain it to someone else afterwards.

While the exact size of the benefit or nature of the activity might vary – and be customized based on expert knowledge of the specific learning context, the idea is that the modular structure of MOOClets makes it easier to identify such broadly applicable principles when compared to a full course.

An added advantage of focusing on such instructional principles directed at MOOClets is that, as modular components of educational contexts, these are applicable to many contexts. For example, motivational messages and metacognitive prompts to explain in a Khan Academy exercise can be extended (even if requiring adaptation) to the hundreds of exercises on their site that use an identical template. Moreover, on the face of it, these principles may apply far more broadly, since the dynamics of a Khan Academy exercise (see e.g. tiny.cc/whatwhyhow2) align reasonably closely with exercises in a variety of MOOCs, with exercises in intelligent tutoring systems, and even with classroom exercises and homework problems in completely "offline" settings.

We will discuss when and how MOOClets can be designed to support these kinds of broadly applicable pedagogical principles, and what kinds of principles are supported.

This topic is relevant to a Chapter on "Exploring Cognitive Gains" in the iNACOL Handbook of K-12 Blended & Online Learning (feel free to request access, I am happy for suggestions and co-authors).

Relevant Reading could be this paper, which focuses on the MOOClets of a single video and exercise, and draws on research on how prompting people to answer questions and explain in order to identify potential broadly applicable pedagogical principles of asking questions before, during, and after a video/exercise. Demos are shown attiny.cc/augmentedvideo and tiny.cc/augmentedexercise.

Williams, J.J. (2013). *Applying Cognitive Science to Online Learning*.*Paper presented at the Data Driven Education Workshop at Conference on Neural Information Processing Systems.*

J. Kay, S. Kleitman, and R. Azevedo. Chapter 11. Empowering teachers to design learning resources with metacognitive interface elements. In R. Luckin, J. Underwood, N. Winters, P. Goodyear, B. Grabowski, and S. Puntambeker, editors, Handbook of Design in Educational Technology, 124-134. Taylor and Francis, 2013. [PDF]

Judy Kay mentions that the first part could be implemented in EdX and other platforms as an alternative "submit button" where students provide a confidence rating instead of just "submit".

http://www.win.tue.nl/~mpechen/

Personalized interventions – work well for some students, vs. others
Moving in between small curricula units, back and forth.

Easier to do Multidisciplinary Research when looking at an individual module.
How to transfer insights ACROSS disciplines.

Much more control.

ACM has some standardized curricula that could be a good basis for MOOClets - CC 2010

Undergrad CS: http://www.acm.org/education/CS2013-final-report.pdf

Computing Curricula 2005
Information Systems 2010

Rock Star professors – joint contribution.

Judy Kay

A couple of MOOClets

Metacognitive/Judging Project

Start you off with Self-Assessment.
Grade themselves according to the Rubric we were going to use.

Didn't work AT ALL.
Profoundly unpopular.

Did a big sell on why it was good.

Lichao Li, MSc (2008) A Reflective Learning Framework for Programming.

Identify how **sub-groups** respond to the experimental manipulation.
Not just do A/B testing, but identify how it interacts with features of the student, and features of the problem.

Learning with Actionable Attributes: Attention – Boundary Cases
http://en.wikipedia.org/wiki/Uplift_modelling
http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5693407&tag=1

"Trading Off Scientific Knowledge and User Learning with Multi-Armed Bandits"
Yun-En Liu, Travis Mandel, Emma Brunskill, Zoran Popović.
To appear at Educational Data Mining (EDM) 2014.
Who is it working for?

Checklist for Faculty/Course Developers (not expert Instructional Designers)

Learning from Videos
From Exercises

Course on Course design – when you're moving from in person to online/blended

Metacognitive Guidelines:
Think about…
Have you thought about?

Assuming you've done this course… but everyon'es got a lot on their mind.

How well do you think you know XX?
[But we need to give them some payoff…]

Put a "Question Mark" next to… "What do you know about?"... (let them find out WHY we're asking them about this)

Backwards Design (Ari's process).

- Give them problems.
- Ask metacognitive questions afterwards...

Course Design
How to structure their courses
Leverage affordances of online medium

Providing examples of what people are doing...

Lessons learned, best practices [Case study, reverse engineering. This is this component… what went into making this an effective exercise]

"Best Practices" – what's worked for people.
Been effective in certain areas, for certain disciplines.

Specific Examples – pull out general principles.

Personalizing Messages/Content (e.g. by Interests/Gender)

Candace Walkington & Matt Bernacki are doing work in this area with mathematics problems
Neil Heffernan has as well

Summer Period

Week 7: (Tue June 17): Metacognition & MOOClets (Training general metacognitive strategies by targeting them at modular exercises and lessons): Judy Kay on "Scaffolding metacognition, starting small but with confidence"

Taking last week's theme – that modular components make it easier to articulate broadly applicable instructional principles – a step further, we will discuss how general metacognitive strategies can be promoted with relatively straightforward and readily scalable strategies, like prompting people to rate their confidence in the correctness of answers they give.

Judy Kay (visiting from the University of Syndey) will talk about ""Scaffolding metacognition, starting small but with confidence" and how this could be easily integrated into MOOC platforms current exercises. An abstract and relevant paper to read for background is below:
It is becoming increasingly easy for teachers to create many forms of digital learning resources, such as web-based materials, quizzes and games. Extensive research in metacognition provides strong evidence that metacognitive interface elements could make such materials more effective. This discussion will explore a proposal for a modest start towards bringing metacognitive elements to broader use; replacing the regular submit button with an interface element that enables the learner to report their confident in the task just done. We will share results of previous work that can inform the ways that learners, teachers and course developers gain benefits, then move on to the next steps and links to MOOClets.

Potential Reading

J. Kay, S. Kleitman, and R. Azevedo. Chapter 11. Empowering teachers to design learning resources with metacognitive interface elements. In R. Luckin, J. Underwood, N. Winters, P. Goodyear, B. Grabowski, and S. Puntambeker, editors, Handbook of Design in Educational Technology, 124-134. Taylor and Francis, 2013. [PDF]

Slides from presentation

http://rp-www.cs.usyd.edu.au/~judy/Talks/2014_MOOClet_Confidence.pptx

Notes

Adopting the stance of *showing* users their data changed the way we were designing.
E.g. “Beliefs” about quitting out, instead of “misconceptions”.

Involve the students in the process.

ProGoSs (Program Goal Progression)
Will take any taxonomy you like.
> Tested with Bloom.
> With neo-Piagetian.

Confusion Matrix.

Ideas

Personalization **USING** their confidence ratings (you were *really* wrong).
How do we change **Feedback?** The kind of feedback.
And based on their SKILL LEVEL.

Supports Data-Mining. (within context of Causal Graphical Models?).

Preparation for Future Learning…
Link to confidence judgments?

Prompting people to explain (how something works) changes their judgments of understanding.
Explanation, Imagination, & Confidence

Have them rate quality of explanations.

Have them rate similarity and difference between explanations (or solutions).

Have them make **multiple categorizations.**

What **KINDS OF CONFIDENCE** questions to ask?
> How confident are you?
> How likely are you to get it right?
> In general, or specific task or fact or problem? (globally, too vague)
    How good at “statistics”? What is the extension of that statement?

> How much more would you want to restudy this?
> How much support do you need in answering such a question?
> How well someone else would understand it?
Growth Mindset question?

How *calibrated* are you?

Group aggregates (how many people got it right/wrong, how calibrated they were).

What should the widget look like?

Interface elements shouldn't demand people's effort.
An **alternative** to a submit button.

Extra/Broader References

The literature on having students grade each other – they can be good, **when** they are taught to do it.

Extra Rough Notes

Fundamental Natural Kinds – Categorization, Comparison, Causality, Analogies/Relations, Explanation….

Week 8: Topic: Using Modules to bring together A/B Testing, Assessment, Personalization & Adaptive Learning Systems. Talk: Mykola Pechenizkiy of Eindhoven on "From A/B testing to personalization with uplift classifiers"

Talk: Mykola Pechenizkiy of Eindhoven on "From A/B testing to personalization with uplift classifiers"

Abstract:
MOOC and ITS powered education provides an excellent opportunity for conducting online controlled experiments or A/B testing. Such experimentation allows to find out whether a particular intervention or teaching approach is more effective (on average) than the other in reaching some desired outcome, e.g. maximizing the effectiveness of feedback to students.

However, in many cases a particular intervention may be beneficial for some students but have no effect or have even a negative effect on the performance of other students.
In this talk I will tell how predictive modeling can be used to analyze the results of A/B testing to induce uplift classifiers that can help us to choose which intervention is the most appropriate in which situation.
We formulate three supervised learning approaches to select an appropriate intervention at an individual level. We emphasize that not all instances (students) are equally sensitive to this choice. Accurate choice of an action is essential for those instances, which are sensitive to this choice. We focus the supervised learning process to such cases. The potential of the underlying ideas is demonstrated with synthetic examples and a case study with real datasets.

Bio:

Mykola Pechenizkiy (PhD) is Assistant Professor in Information Systems at the Department of Computer Science, Eindhoven University of Technology, the Netherlands. He has broad expertise and research interests in knowledge discovery, data mining and predictive analytics, and particularly in their application to various real world problems in industry, commerce, medicine and education. He develops generic frameworks and effective approaches for designing adaptive, context-aware predictive analytics systems dealing with evolving data. In recent years, Mykola has been active in the area of Educational Data Mining (EDM); he co-edited the first Handbook of EDM, co-organized several events including EDM 2011 and LASI 2014, and served asa guest editor of the special issues including the special issue on EDM with ACM SIGKDD Explorations.

Potential Reading:

Zliobaite, I., & Pechenizkiy, M. (2013). Predictive User Modeling with Actionable Attributes. arXiv preprint arXiv:1312.6558.

Uplift Modeling

Topic: Using Modules to bring together A/B Testing, Assessment, Personalization & Adaptive Learning Systems.

A system that allows authoring & modification of different versions of online education modules or MOOClets (crowdsourcing & collaborative development) to be presented randomly (A/B testing) or conditional on features of learners (Personalization) or other content characteristics (Adaptive Learning) deploys modularity to great advantage.
For example, consider a collection of mathematics exercises (like that on www.khanacademy.org). The exact same infrastructure that allows randomized assignment & A/B testing of different versions of exercises can be used to allow conditional logic – showing different versions of an exercise based on measurements of a student's attitudes and learning strategies, a learner's current state of knowledge, or features of content and what has occurred before. At the same time, the capacity that allows representing multiple versions of a resource (for random assignment or adaptation) also leverages the power of synergistic or adversarial collaboration in creating new resources or improving existing ones, because multiple versions of an exercise or lesson can be created and tested against each other.

Notes on Meeting

Mykola Pechenizkiy

Applied Data Mining Researcher (Interesting ways of using techniques, like cost-sensitive classification, versus a new kind of method for classification).

Visiting Zach Pardos, Ryan Baker in Columbia's TC before. The people behind OpenEdX.
Working on "Web Analytics", where Recommender systems can support Personalization.
But interested in moving into educational settings: E.g. Educational paths that students take through a course.

Kohavi GScholar Results on Online Experimentation

Online controlled experiments at large scale
PDF

Web-facing companies, including Amazon, eBay, Etsy, Facebook, Google, Groupon, Intuit, LinkedIn, Microsoft, Netflix, Shop Direct, StumbleUpon, Yahoo, and Zynga use online controlled experiments to guide product development and accelerate innovation. At Microsoft's Bing, the use of controlled experiments has grown exponentially over time, with over 200 concurrent experiments now running on any given day. Running experiments at large scale requires addressing multiple challenges in three areas: cultural/organizational, engineering, and trustworthiness. On the cultural and organizational front, the larger organization needs to learn the reasons for running controlled experiments and the tradeoffs between controlled experiments and other methods of evaluating ideas. We discuss why negative experiments, which degrade the user experience short term, should be run, given the learning value and long-term benefits. On the engineering side, we architected a highly scalable system, able to handle data at massive scale: hundreds of concurrent experiments, each containing millions of users. Classical testing and debugging techniques no longer apply when there are billions of live variants of the site, so alerts are used to identify issues rather than relying on heavy up-front testing. On the trustworthiness front, we have a high occurrence of false positives that we address, and we alert experimenters to statistical interactions between experiments. The Bing Experimentation System is credited with having accelerated innovation and increased annual revenues by hundreds of millions of dollars, by allowing us to find and focus on key ideas evaluated through thousands of controlled experiments. A 1% improvement to revenue equals more than $10M annually in the US, yet many ideas impact key metrics by 1% and are not well estimated a-priori. The system has also identified many negative features that we avoided deploying, despite key stakeholders' early excitement, saving us similar large amounts.

http://en.wikipedia.org/wiki/Information_systems

http://paul-hadrien.info/backup/LSE/IS%20470/week5.pdf

Related areas Mykola mentioned:
Propensity Scoring

Targeted Learning

Week 9: TOPIC: Metacognitive & Motivational MOOClets to teach General Strategies for Learning.

TALK: Inga Glogger on "Preparing learners to make the most of Online Learning & MOOCs: training and facilitating self-explanation strategies"

From 12-1 Inga Glogger will present a study design aiming to test the transfer effects of a short strategy-training on learning from a MOOC lesson, developed in collaboration with Joseph Jay Williams.

Abstract

When people learn with a learning environment, it is important that they process the given information actively and focus on core information. Especially when learning with MOOCs, where there is little external or social support and many distractions, learners need strategies to focus on and process actively the principles to be learned. Training learners to use such strategies typically requires some facilitation to overcome a phase of enhanced strategy application without improving learning outcomes. The study aims to test the (transfer) effects of a short strategy-training together with such a “procedural” facilitation on learning from MOOCs. The conditions will be a training, a training plus facilitation, and a control condition. The training will focus on principle-based self-explanation and high-quality use of this strategy. The strategy facilitation will provide support for the increasingly self-regulated use of the strategy during learning in a MOOC. Strategy application as well as learning from the MOOC’s contents will be assessed. The study will contribute to the development of training procedures preparing learners to profit more from future online learning.

Bio

Inga Glogger is a postdoctoral researcher and lecturer at the Department of Educational and Developmental Psychology (with Prof. Alexander Renkl) at the University of Freiburg in Germany. Her research focuses on training and assessing process-oriented learning strategies (e.g., by learning journals) and instructional design that aims to educate teachers in assessing learning strategies.

She is also interested in instructional methods that prepare students to learn (prior knowledge is largely missing), such as inventing with contrasting cases or self-explaining worked examples, and that attend to special prior knowledge (prior knowledge is fragmented or incorrect).

TOPIC: Preparing learners to make the most of Online Learning & MOOCs: training and facilitating self-explanation strategies

Modules that teach students general learning strategies or beliefs that help motivate them have several valuable features and offer particular opportunities for linking research on metacognition and motivation with powerful practical benefits for students.

Practical Benefits

From a cost-benefit analysis perspective, the same time and energy that could be used to teach some specific content (e.g. a geometry principle) might have a far larger effect if it taught a general skill that was then applied to many instances of specific content. For example, if teaching a strategy for how to study worked examples of math problems in order to identify principles increased learning from many subsequently studied problems.

Moreover, MOOClets that teach generally applicable skills can then scale broadly because they can be inserted in a large number of courses of different kinds.

The main obstacle is whether such general strategies are in fact teachable through relatively limited exposure. There are many empirical findings revealing the difficulty and failures in teaching general strategies, particularly divorced from specific content.
On the other hand, a very broad review of literature across different disciplines does reveal examples of successfully teaching domain-general beliefs and strategies that have a lasting effect, which we can discuss in more depth. For example, see "WISE" or High Impact from Brief Exposure Interventions in social psychology. And programs for teaching comprehension strategies like Reciprocal Teaching.

Research Opportunities

Even if randomized experiments to present (different versions of) MOOClets teaching general skills were to reveal relatively small effects, they have the distinctive advantage that these effects can be manifested across a wide range of measures of different learning, and that such effects can continue as a learner moves through materials of many different kinds.

Experimental manipulation of cognitive (rather than metacognitive or motivational) factors like prompting people to explain a concept are expected to impact some very specific knowledge and restricted (although usually carefully calibrated) set of measures of learning.

Experimental manipulation of different version of MOOClets teaching general skills might actually be better suited to research in less controlled environments and where researchers have less sway over which measures of learning are collected. The first reason for this is that such manipulations can impact variables that reflect learning even when these are not tailored to detecting such effects (e.g. accuracy in solving problems, performance on quizzes).

The second reason is that such manipulations can have effects which are pooled across the course of multiple lessons and throughout a course. For example, even if providing lessons on metacognitive skills had a tiny influence on students' success on a particular problem, such effects could be detected in a month's assignments or the final grades in a course.

Notes on Meeting

Potential Reading

J. Kay, S. Kleitman, and R. Azevedo. Chapter 11. Empowering teachers to design learning resources with metacognitive interface elements. In R. Luckin, J. Underwood, N. Winters, P. Goodyear, B. Grabowski, and S. Puntambeker, editors, Handbook of Design in Educational Technology, 124-134. Taylor and Francis, 2013. [PDF]

Week 10: Creating Motivational MOOClets – Introductions, Emails, Lessons, & Messages – that are Broadly Applicable, have Far Reaching effects, and Provide a Useful Paradigm for Research

Background Research Literature on Motivation & Mindset

We will consider some of the empirical research that has documented substantial benefits towards hard-to-change real-world outcomes like grades (see Mindset: Teach a growth mindset of intelligence to boost motivation and learning, and "WISE" or High Impact from Brief Exposure Interventions) to outline principles for developing MOOClets to increase motivation – Introductory Lectures, Email Announcements, Lessons, Messages, Forms of Feedback, Instructor Guides. We will also examine several existing examples of these resources, and pool knowledge to provide feedback on these or to create new ones.

Examples of Resources: Lessons, Instructor Guides, Digital Interactive Cognitive Aids

Examples of these resources are available in tiny.cc/moocletsnotes to people in the MOOClets Group (tiny.cc/joinmooclets), such as Lessons (Animated 3-4 minute Videos explaining that intelligence is malleable, a video by a MOOC instructor explicitly explaining what a Growth Mindset is, blog post, lesson & activities augmented with Cognitive Support to promote learning of a Growth Mindset); Interactive Digital Coaches to reshape attributions; and a (preliminary) Instructor Worksheet for fostering Growth Mindset

Practical Context: Course(s) on Logic

We will have guests Dave Barker-Plummer and Su Su, since the practical context we will focus on will be for Dave Barker Plummer, Jon Barwise, John Etchemendy and colleagues' upcoming MOOC on Logic, which is based on their Language, Proof and Logic text. Some of this is pretty advanced material, but part of it forms the basis for many introductory courses in Logic (in Philosophy, Mathematics, Computer Science, general undergraduate breadth requirements), you can see the Table of Contents or Textbook. It covers topics like variables, conditionals, truth tables. A related course is taught by Keith Devlin as Introduction to Mathematical Thinking and there is an Introduction to Logic MOOC on Coursera.

Logic is a nice topic to think about because it's also generally applicable to anyone and any domain in terms of critical thinking skills and general reasoning, and "logical reasoning" is an extensive topic of study in cognitive psychology. On the motivational side, it's an area about which students may hold beliefs about not being good at math or computer science or hard sciences.

Notes from Meeting

Apply OLI approach “in miniature”.

Su Su. Psychology Perspective.

Instructor Perspective & Details of the Course

Already short on time/bandwidth for content.
Hard to add extraneous content.

Logic MOOC.

September.

Hard to imagine this kind of **Active Help Seeking:**
Last thing they want to do is look for that.
“Optional Office Hours”...

Where are cases where people would go for this help?

Be CLEAR on whether “Get more help” is for content, general strategy, or motivational.

Target Malleable Factors

Self-check questions.
In-video questions.

Ideas

General WISE interventions – Mindset, Sense of Purpose, Interpreting Feedback for Development, Sense of Belonging, Implementation Intentions.

Specific Changes

Introductory Framing

- Right before the Assignment: “Don’t expect these to be solved quickly. It’s likely that these might require thinking carefully about how to solve these problems, or reviewing material in order to think through it.”
- Above the Self-Check page: These provide you with an opportunity to check your understanding, so you can spot gaps and deepen it.
- Before peer feedback, explain that the point is to help someone else understand concepts better and see what they can improve.

Emails & Announcements

- Encouraging

After Exercises & Assignments

- After they get something wrong, or get assignments results back.

- Click this link for some tips on how to do better next time.
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Optional Resources

- A “Keeping yourself motivated” section that has additional message from the instructor, or explanation of what a Growth Mindset is
- Hyperlinks to “DIgital Tools” that talk students through challenging moments

On-Request Help or Messages

- Provide a link with the option for students to request help or more information.