Online Courses: Learning and Artificial Intelligence

Studium Generale

Jeffrey S. Cross, Professor, School of Environment and Society; General Manager Online Education Development Office, Tokyo Tech, Tokyo, Japan

Lecture Content

1. About me and my hometown
2. Introduction - ice breaker
3. Online Educational Technology
4. Trends in Educational Technology
5. Examples of Educational Technology Research
6. AI Examples from my lab
7. Summary / Conclusion

My Academic Pathway in the USA

https://www.k-state.edu/media/mediaguide/stock-photo.html

https://es.wikipedia.org/wiki/Universidad_de_Arkansas#/media/Archivo:Old_main_fayetteville.jpg

https://iowastate.photoshelter.com/galleries/C0000rWLI9E_oKgc/G0000J2URC8AfrrQ/Campus-Stock-Images

Kansas

https://www.facebook.com/ksurodeo/

Arkansas

https://en.wikipedia.org/wiki/Donald_W._Reynolds_Razorback_Stadium#/media/File:09-02-06-RRS-Ozarks.jpg

Iowa

Figure removed due to copyright restrictions.

Student festival

BS, ChE: Kansas State University 1982-86

MS, ChE: University of Arkansas 1986-88

Ph.D. (ChE): Iowa State University of Science & Tech. 1988-92

From Corporate Researcher to Professor

1992 Graduate Ph.D. (Chem. Engr) Iowa State University, USA

- Molybdenum oxide film process and characterization

1993 NSF-STA Post-doc Fellow, NIRIM(NIMS) Tsukuba, Japan

1994 NSF-CGF Post-doc Fellow, Fujitsu Lab, Atsugi

1996 Researcher, Fujitsu Lab, Atsugi

- Ferroelectric capacitors for non-volatile memory

2003 Senior Researcher, Fujitsu Lab

2003 Visiting Assoc. Prof., Tokyo Tech

2006 Visiting Prof.,Tokyo Tech

2008 Prof., ENG, Tokyo Tech

2014 Online Educ. Dev. Office

2016 Prof. Env. Soc., TSE & Energy course

https://www.titech.ac.jp/public-relations/about/campus-maps/campus-highlights/seasons

Questions for thought #1

What is educational technology? examples?

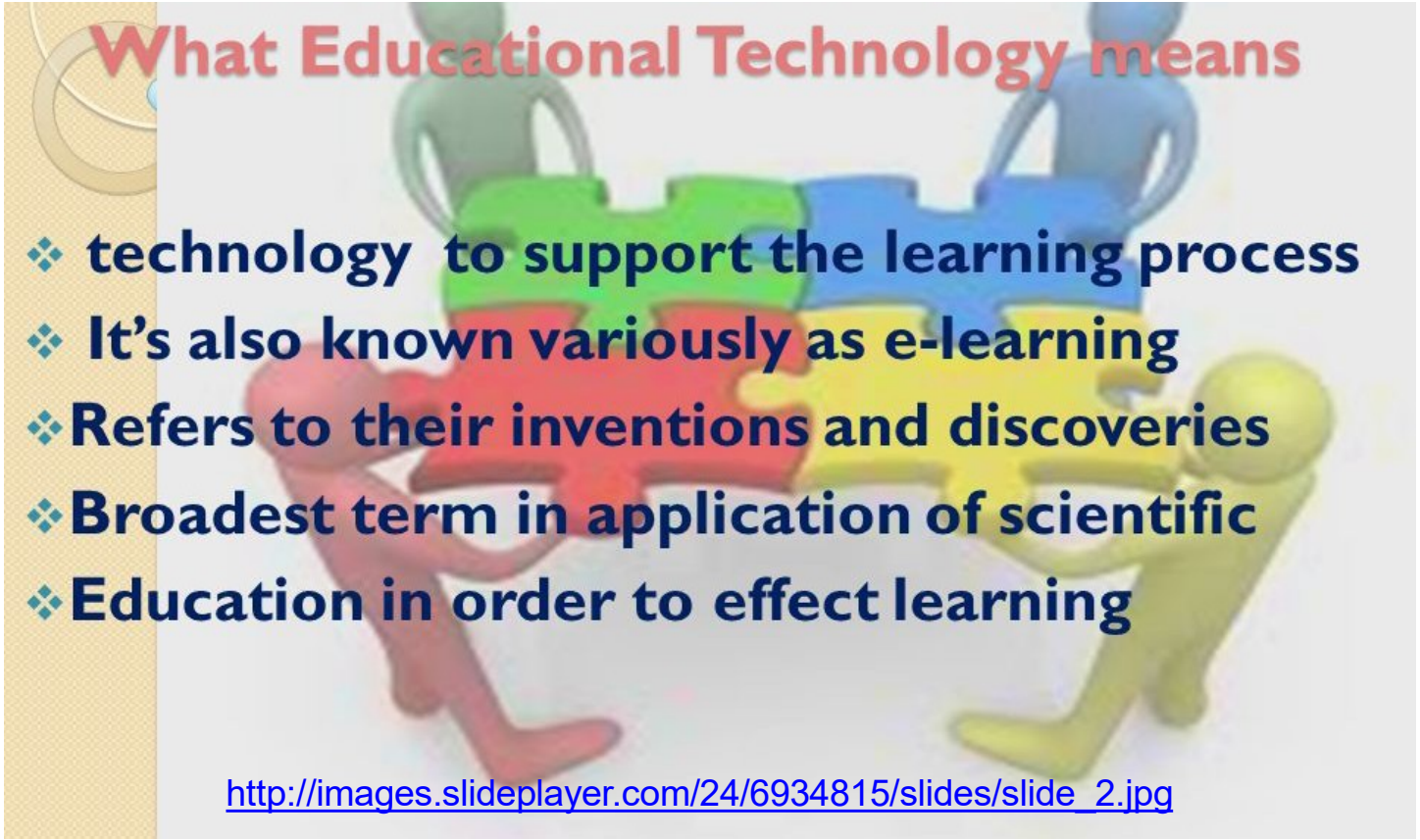
What is online educational technology?

What is a MOOC?

What is Lifelong learning?

Think about it for a minute and share your thoughts!

Ed tech intro – digital/IT



http://images.slideplayer.com/24/6934815/slides/slide_2.jpg

14th Century Lecture Room

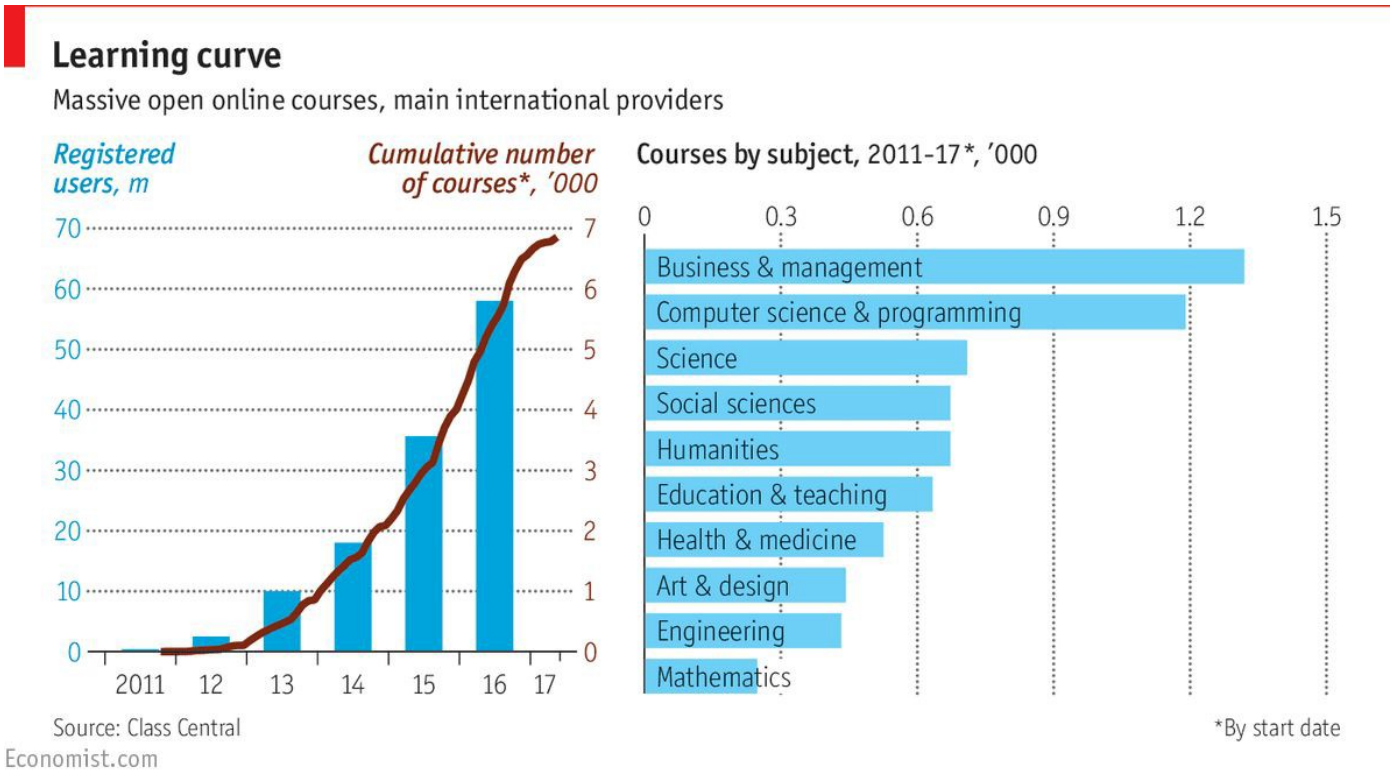
Lecturer speaking from a book.

Learners, what are they doing?

What is different today about Teaching and Learning in a classroom lecture?

https://en.wikipedia.org/wiki/Scholasticism#/media/File:Laurentius_de_Voltolina_001.jpg

Online learning and online courses



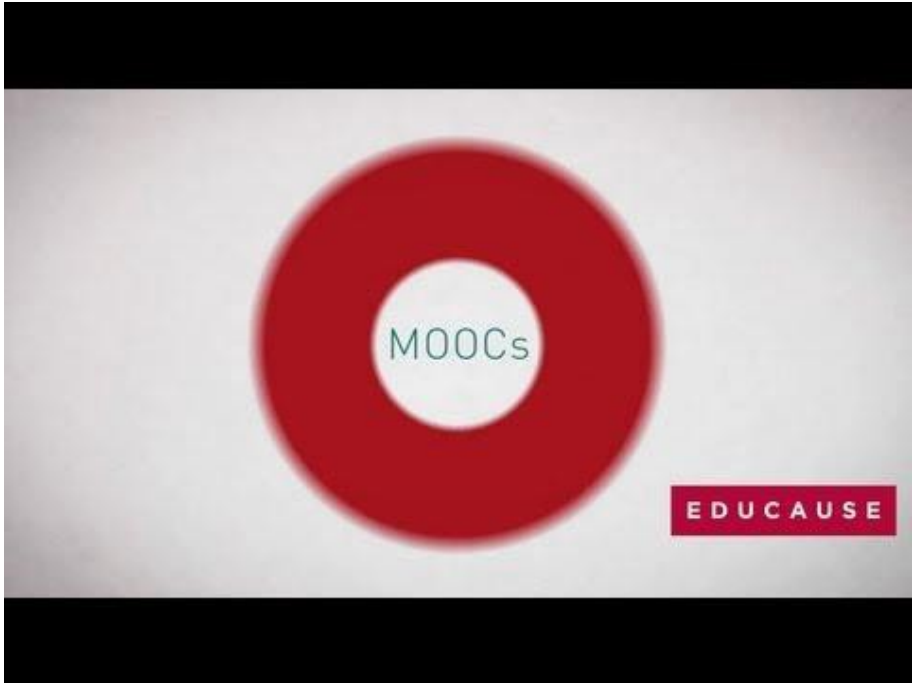
MOOC – Massive Online Open Course

Providers: edX, Coursera, Udacity, Future Learn, JMOOC….

What is a MOOC?

Massive Online Open Course or MOOC see this youtube video

https://youtu.be/XGMrzQ7YOfI

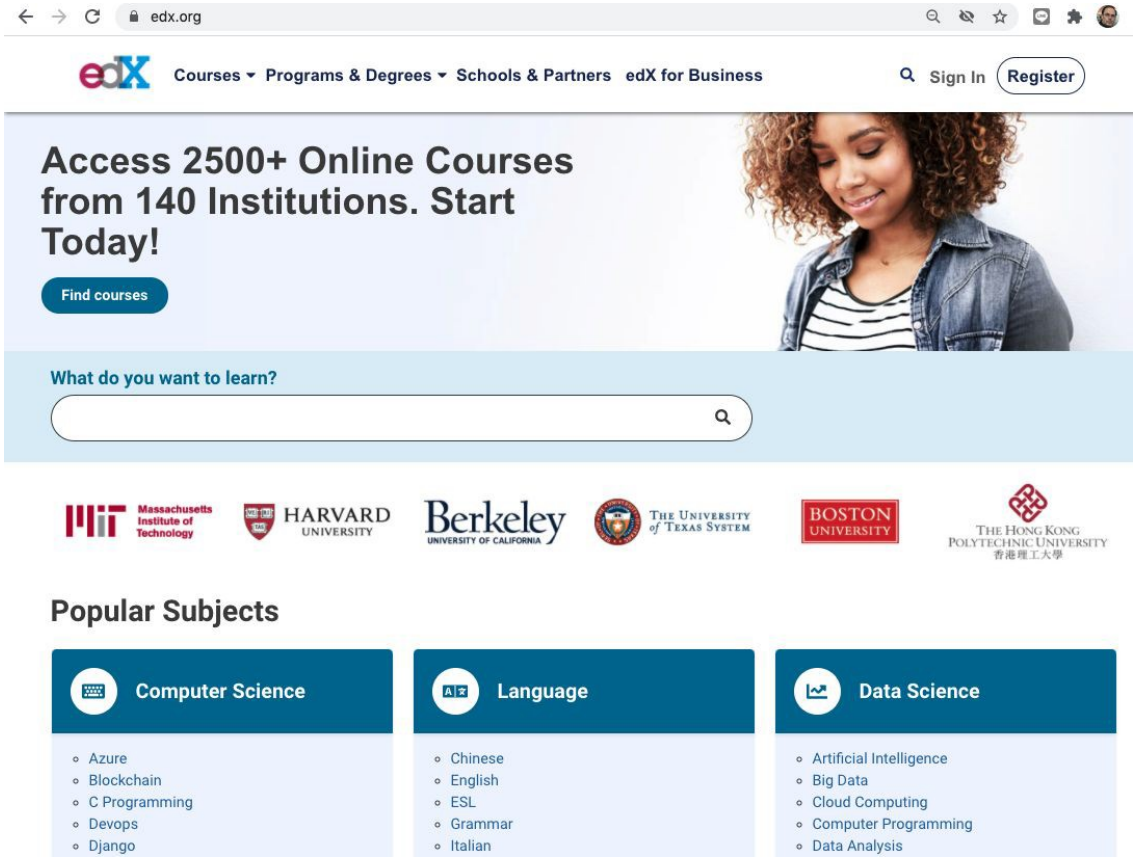


Question for thought #2

What does an online course using a learning management system allow that a conventional course such as that shown below does not? (photo with Creative Commons License)

Think about it for a minute and share your thoughts!

Online Courses edX Website



Started in 2012
Non-profit organization started by Harvard & MIT
https://www.edx.org
Japan Univ. Members: Tokyo, Kyoto, Osaka, Tokyo Tech and Waseda

Courses offer a certificate and some courses are taught for credit but these are not free

edX courses and program offerings

- Individual online courses are offered for free (no assessments or homework)
- MicroBachelors Program

  Undergraduate-level, for career advancement or a degree path
- MicroMasters Program

  Graduate-level, for career advancement or a degree path
- Professional Certificate

  From employers or universities to build today's in-demand skills
- Online Master's Degree

  Top-ranked programs, affordable, and fully online
- Global Freshman Academy

  Freshman year courses for university credit from ASU
- XSeries

  Series of courses for a deep understanding of a topic
- Executive Education

  Courses designed for business leaders for developing strategic skills

TokyoTechX Channel on edX Website

https://www.edx.org/school/tokyotechx

Tokyo Institute of Technology MOOCs

Browse free online courses in a variety of subjects. Tokyo Institute of Technology courses found below can be audited free or students can choose to receive a verified certificate for a small fee. Select a course to learn more.

VERIFIED

TokyoTechX

Introduction to Electrical and Electronic Engineering : 電気.

Current

Starts: May 31, 2017

VERIFIED

TokyoTechX

Science and Engineering Ethics 科学技術倫理

Starting Soon

Starts: June 28, 2017

VERIFIED

TokyoTechX

Modern Japanese Architecture: From Meiji...

Current

Starts: April 19, 2017

VERIFIED

TokyoTechX

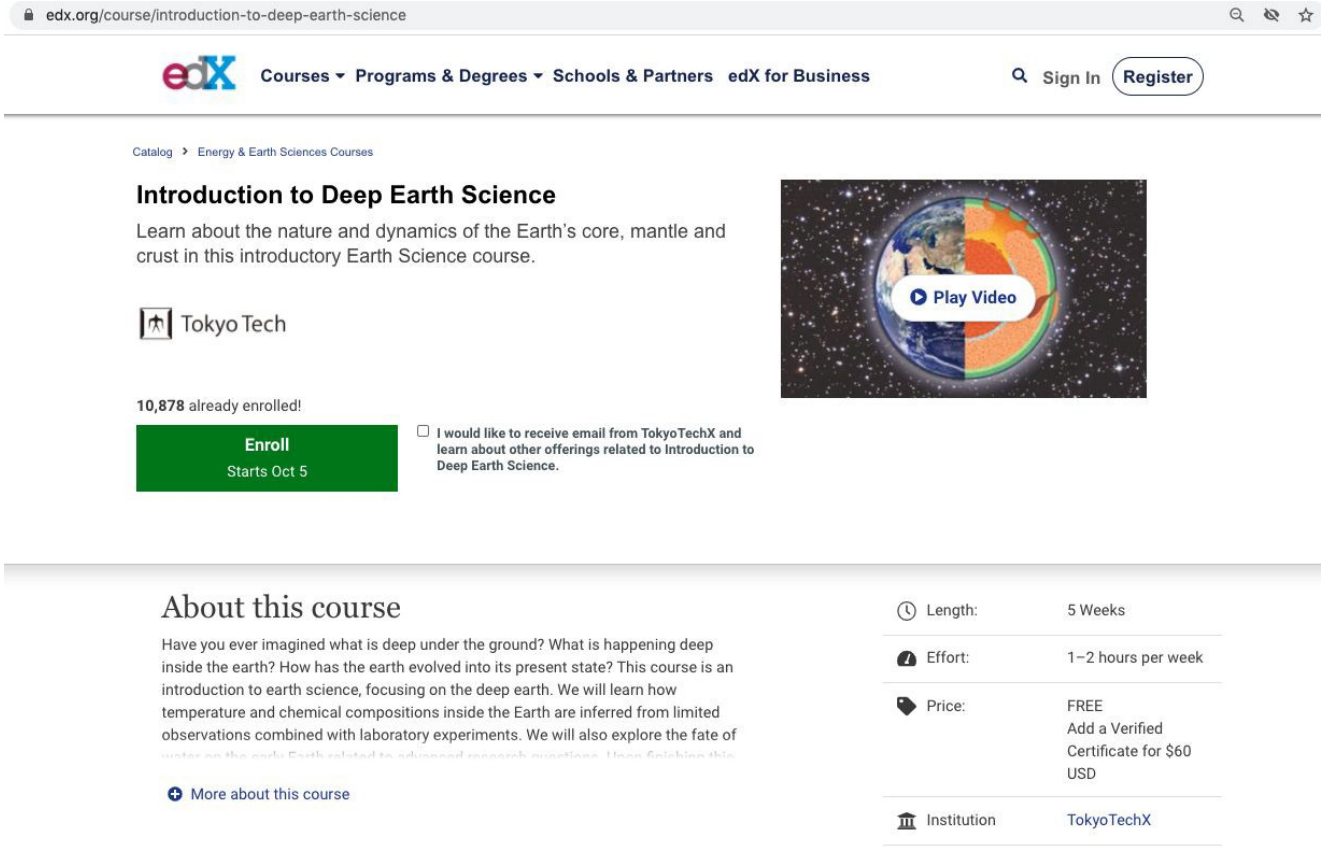
Introduction to Deep Earth Science

Current

Starts: November 10, 2016

edX Course Introduction to Deep Earth Science

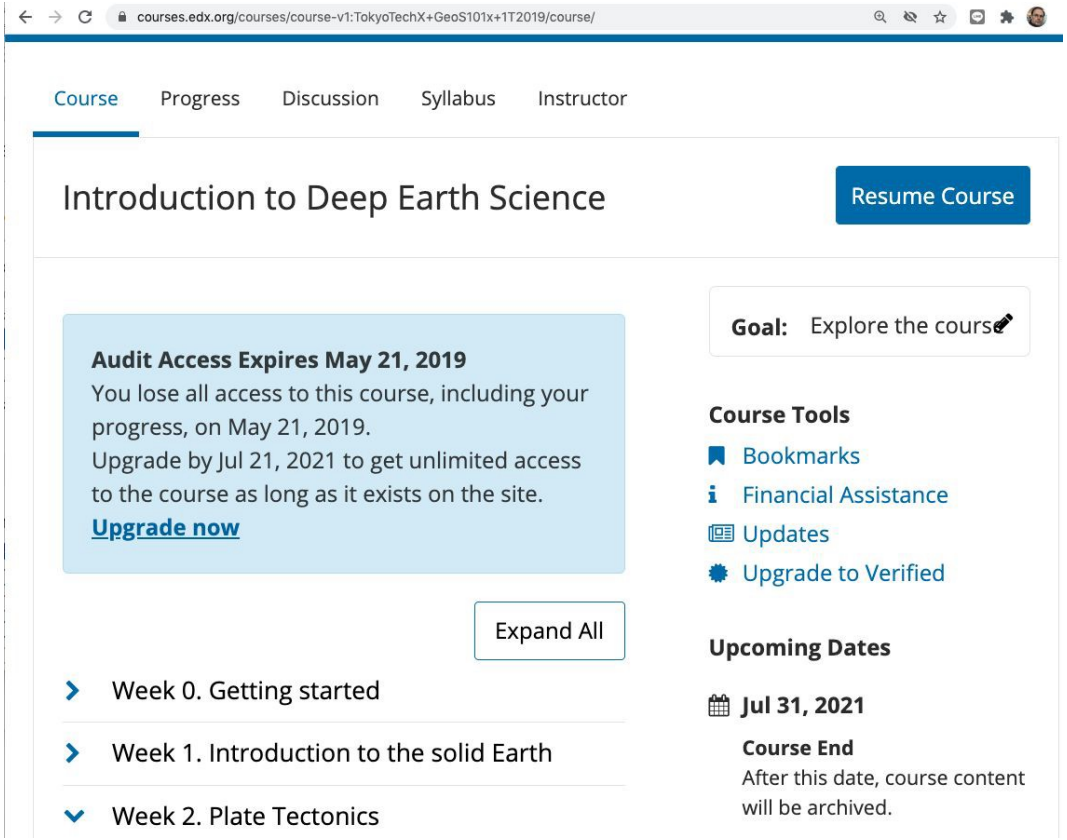
https://www.edx.org/school/tokyotechx



edX Course Introduction to Deep Earth Science

https://www.edx.org/school/tokyotechx

After registering for the Course you would See this

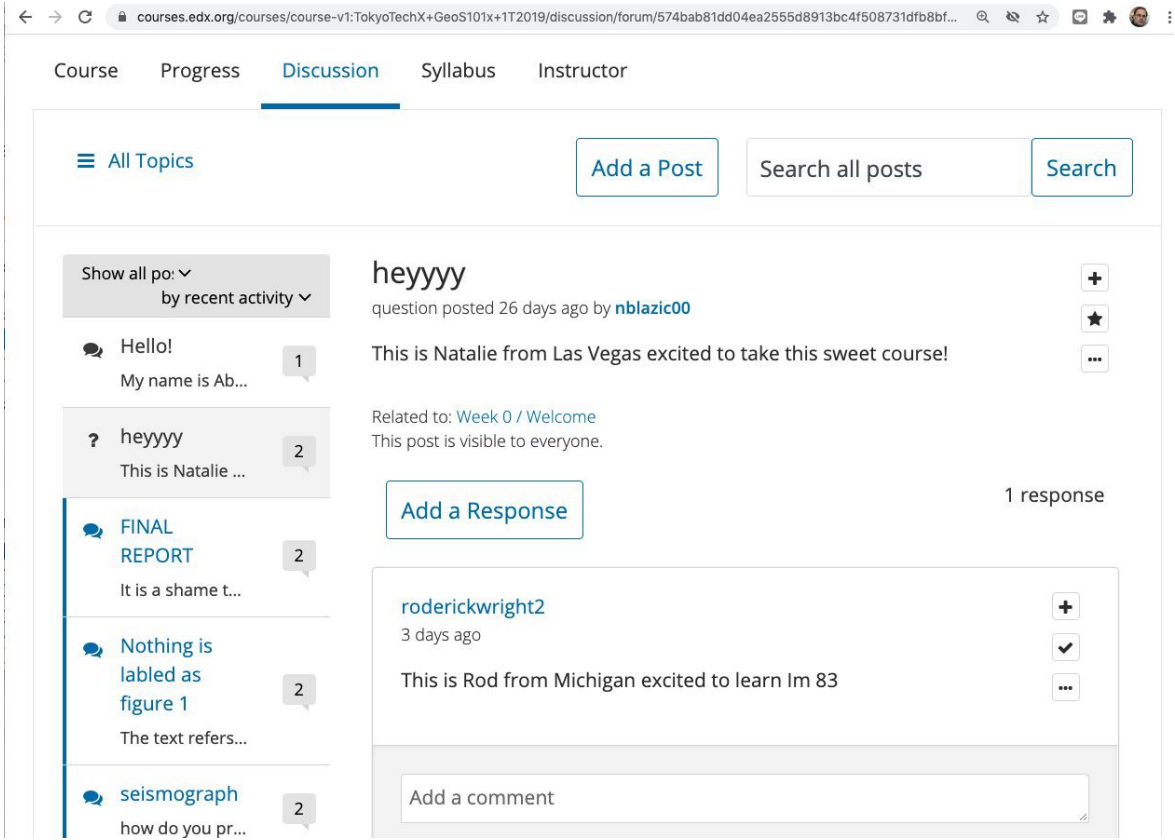


edX Course Introduction to Deep Earth Science

https://www.edx.org/school/tokyotechx

Discussion board where Learners post questions And learners or staff Respond.

Learners frequently introduce themselves - Social learning or Learning community

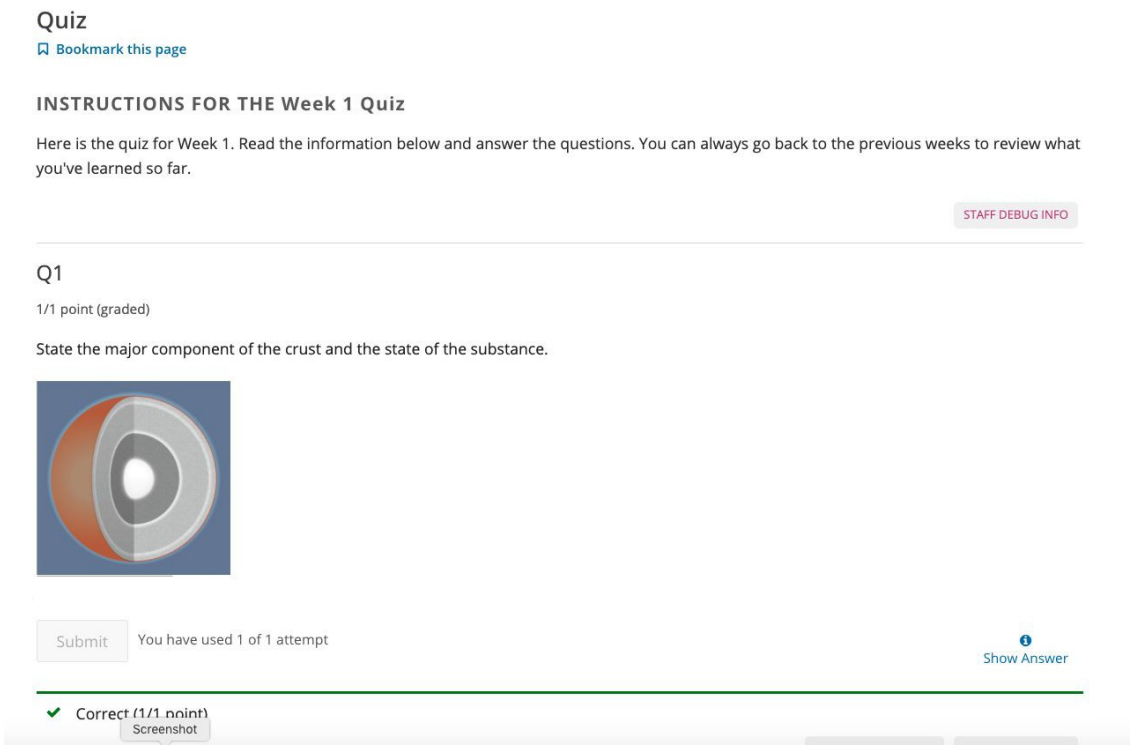


edX Course Introduction to Deep Earth Science

https://www.edx.org/school/tokyotechx

Assessment gives immediate feedback.

Give hints and show correct answer with explanation



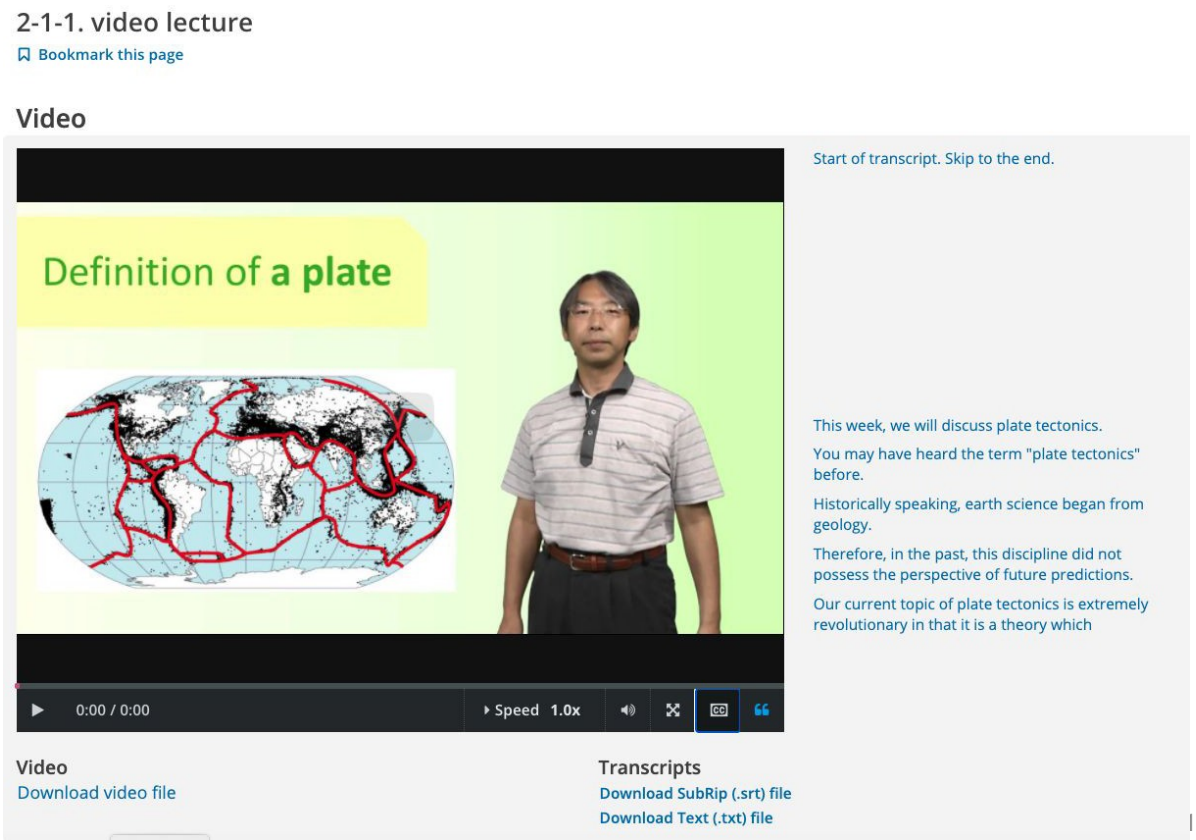
edX Course Introduction to Deep Earth Science

https://www.edx.org/school/tokyotechx

Video lecture in the course

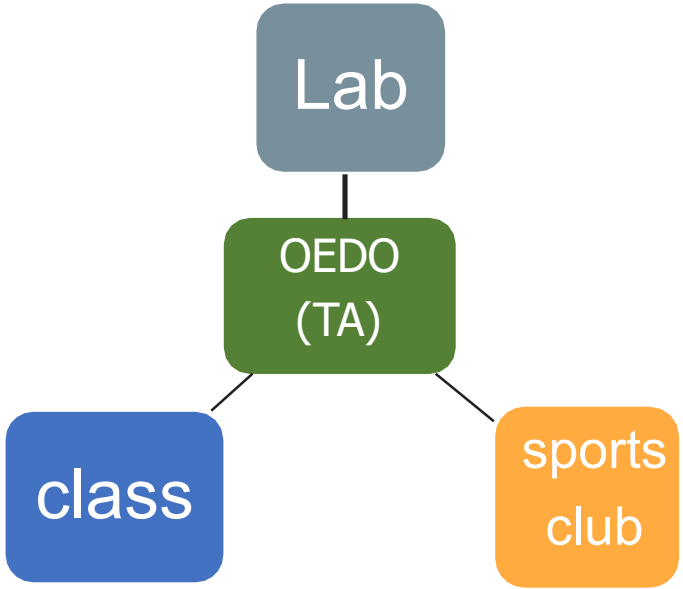
Right side there is a transcript (CC). CC is timed and linked to the video. Read transcript or play the video.

Video and transcript can be downloaded.

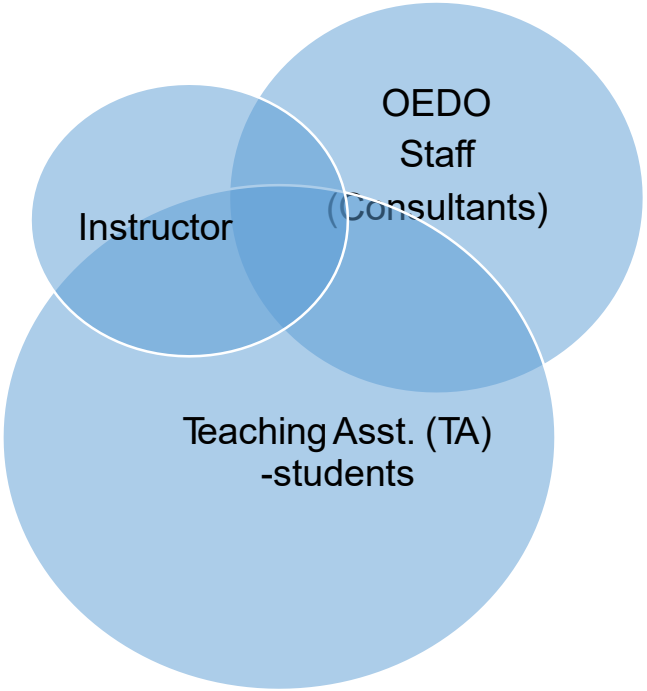


Tokyo Tech MOOC making model

Tokyo Tech edu - OEDO 4th place on campus for learning by teaching



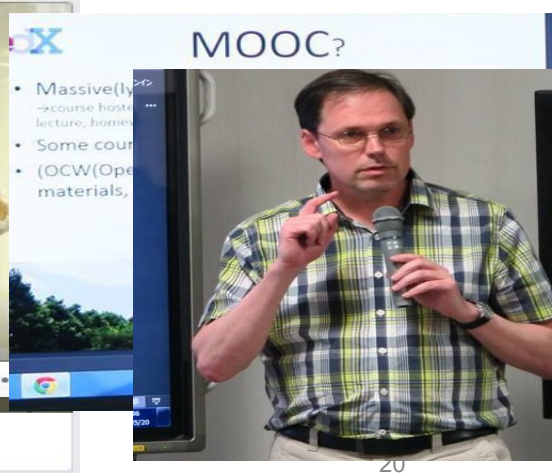
OEDO MOOC making model



Teaching is learning, where do you learn on campus?

Tokyo Tech OEDO MOOC making with TAs

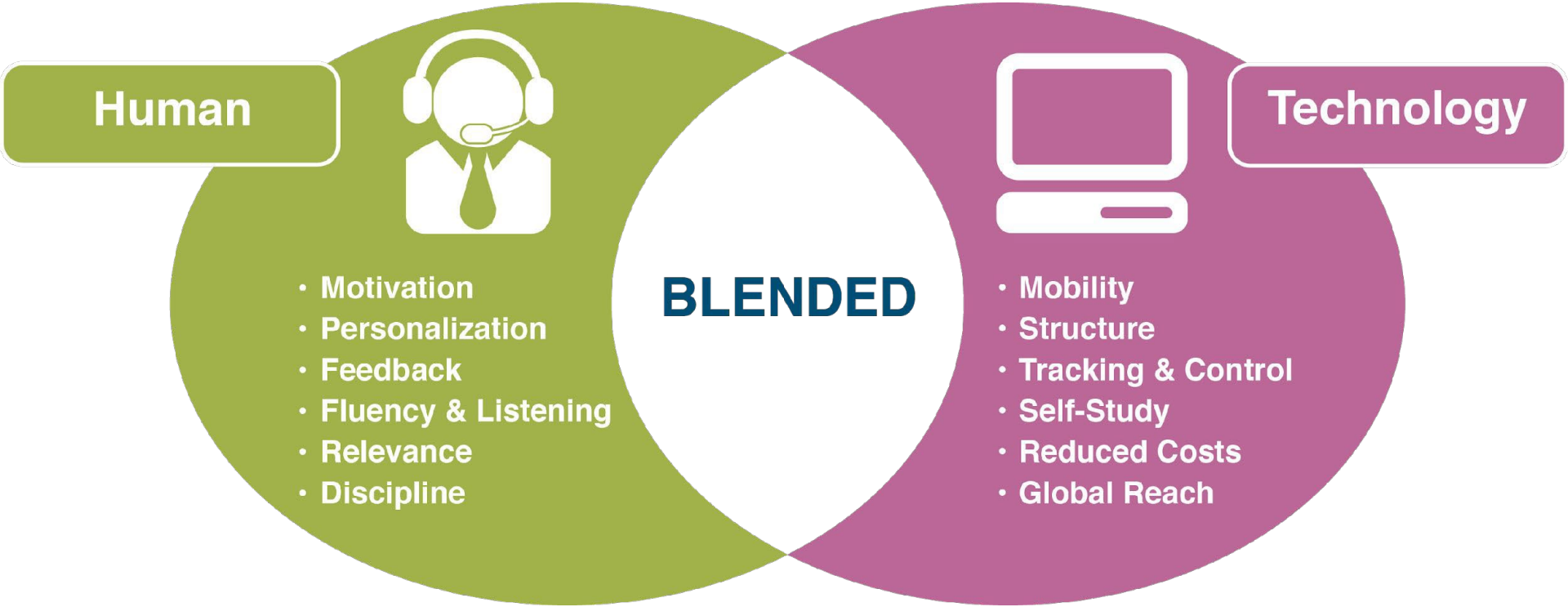
TA during training



What is needed to make an online course?

1. Learning management system (LMS): displays course content, manages interaction with learner, collects data, manages content
2. Course online grade recording system - LMS
3. Content: video, text and assessment (quiz, report…)
4. Human resources to create course: expert, instructional designer, video technician, staff or TAs to create course
5. Staff to manage the online course (?s, problems, complaints, grades)
6. Facilities: studio for recording video, video equipment, computers and software, audio equipment
7. Internet access, internet browser and WebServer
8. Data storage system (AWS) - records learner interactions with content (clickstream)

Blended or Flipped Learning



http://www.globalenglish.com/why_PEBS/blended_learning

Video use in University Courses Expanded

- Online Video use in higher education (Univ.) accelerating world-wide
- Youtube, Vimeo…. Many sites where video can be uploaded for free
- Video allows for incorporating educational materials into course which not possible during classic lecture format (interview, demos…., guests)
- New concepts on teaching such as blended learning or flipped classroom
  – classroom time is used for discussion and problem solving where lecture materials can be video recorded in advance
- Education research has shown enhanced learning using blended learning

Playing HQ Lecture Videos vs Class Lecture

Students can pause video, replay video (speed-up/slowdown)

- control pace yourself
- videos can be more dense in content than lecture
- Introduce materials not possible in lecture

Time control – viewing

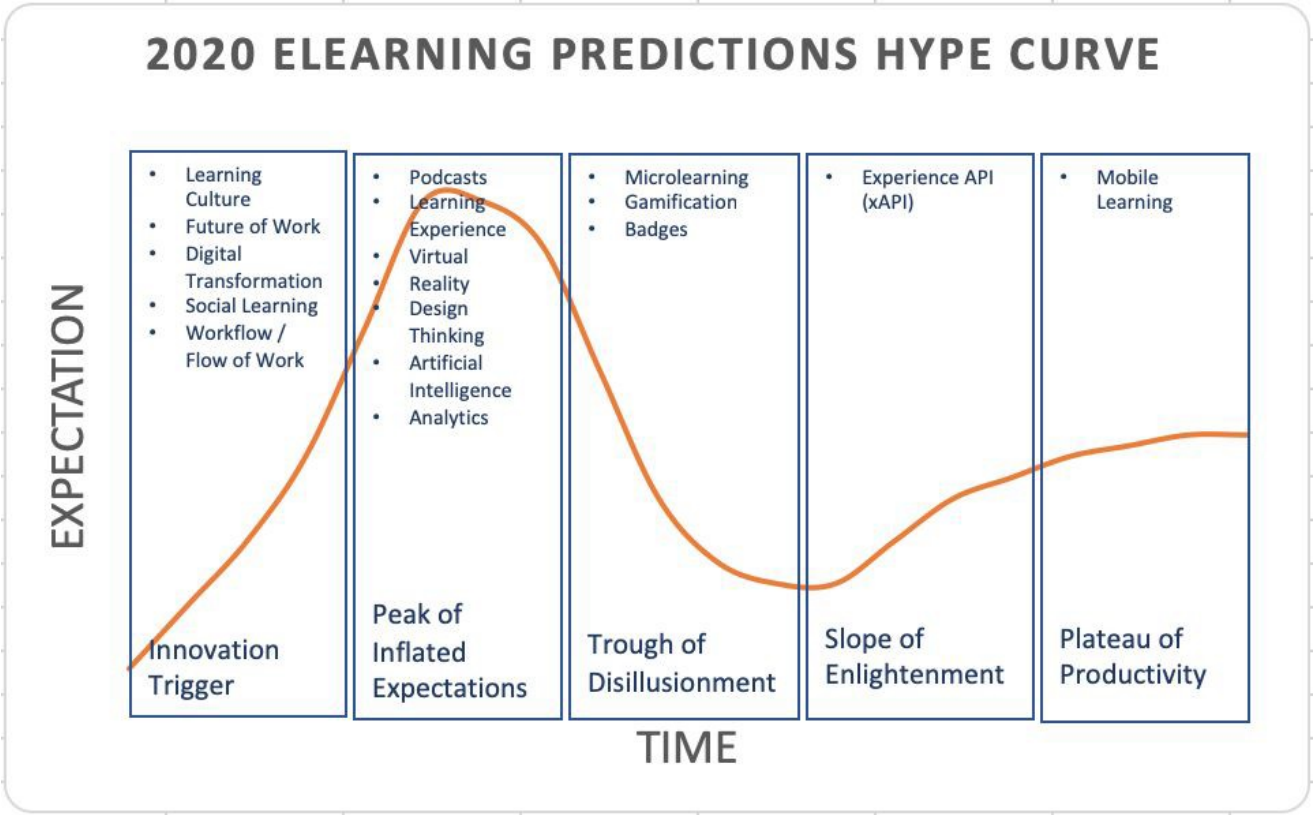
- cross-cutting lectures
- analysis of video viewing

Videos can be dramatical, visual, & persuasive/personal

Video allows greater engagement – internet connection

UBC Lecture by Prof. Gregor K.
https://youtu.be/e8Q5WaLL_Pw

Trends in Educational Technology Research



- A hype cycle is a graphic image of a technology & use versus time.
- The graph on the left is created by using data from Twitter.
- Some topics discussed in succeeding slides.

Understanding the educational technology Hype Curve (hype or excitement changes over time)

https://www.glassdoor.com/blog/jobs-that-didnt-exist-15-years-ago/

Learning Culture and Future Jobs

Learning culture and **future of work** are considerations for educational technology.

After your graduation, you will need to continue to learn since technology impacts us. Have you heard of Society 5.0? Therefore life-long learning on job/home is important.

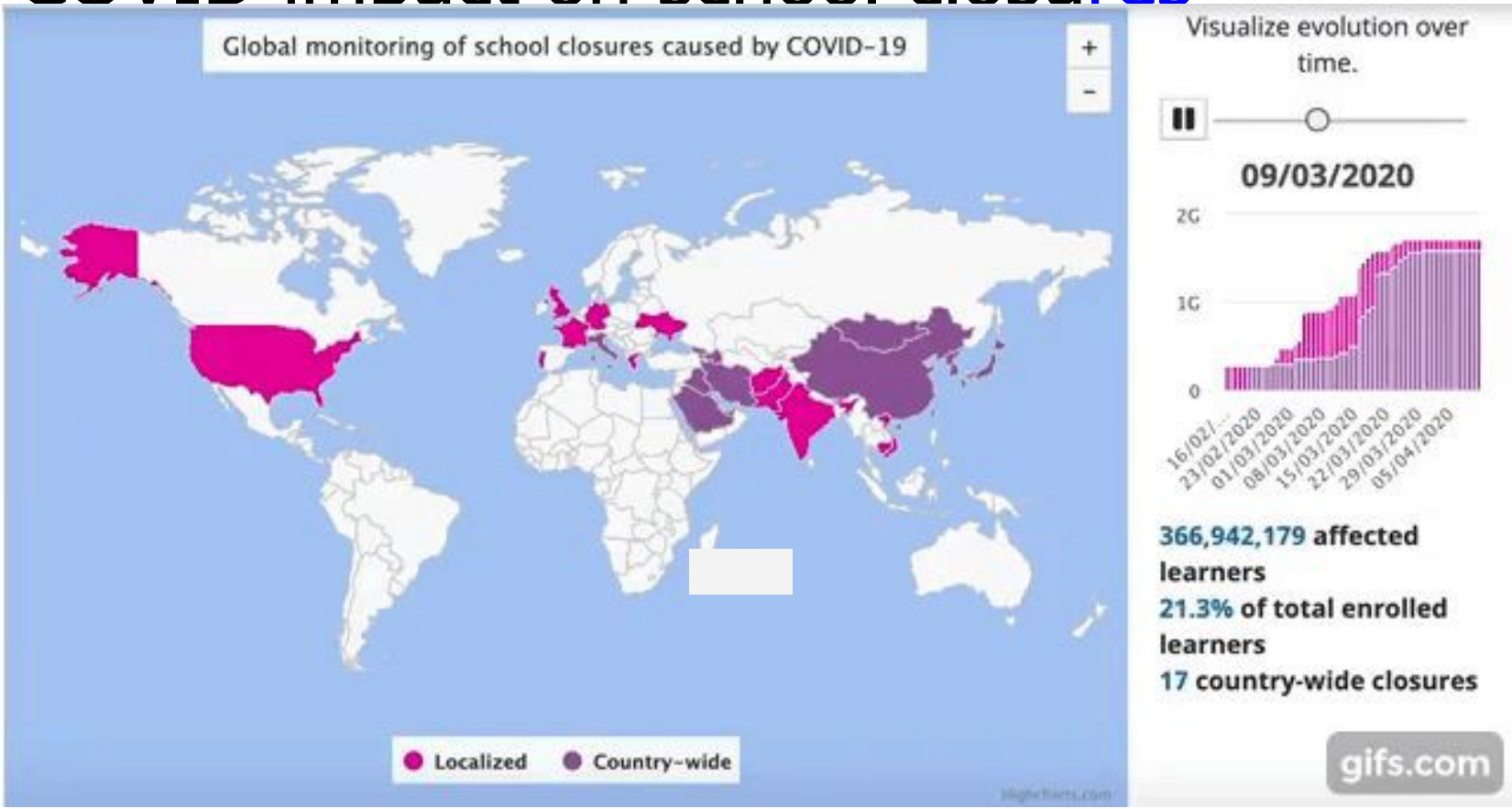
https://www.youtube.com/watch?v=4_Um62YaYoQ

IT related Jobs that did not exist 15 years ago:

- Content-related
  - Social Media Manager
  - Podcast Producer
  - Content Moderator
- Data-related
  - Data Scientist
  - Employment Brand Manager
- Software
  - Mobile Application Developer
  - AI Careers (Engineers, Chatbot Copywriters, etc.)
- Gig Economy-related
  - Ride-sharing Drivers (Uber)
  - Virtual Assistant

COVID impact on school closures

https://en.unesco.org/covid19/educationresponse/



Social Learning Importance

https://en.unesco.org/covid19/educationresponse/

- In university courses, learners learn in various ways but often from their **interactions** with instructors and fellow learners of the course material.
- **Collaboration software** such as discussion forums, messaging tools, and video-conferencing applications provide social interactions to support and engage learners.
- Important of social learning has become more important since **COVID19** pandemic forced closures and instruction needed to shift quickly to the online format.

Podcasts for Education

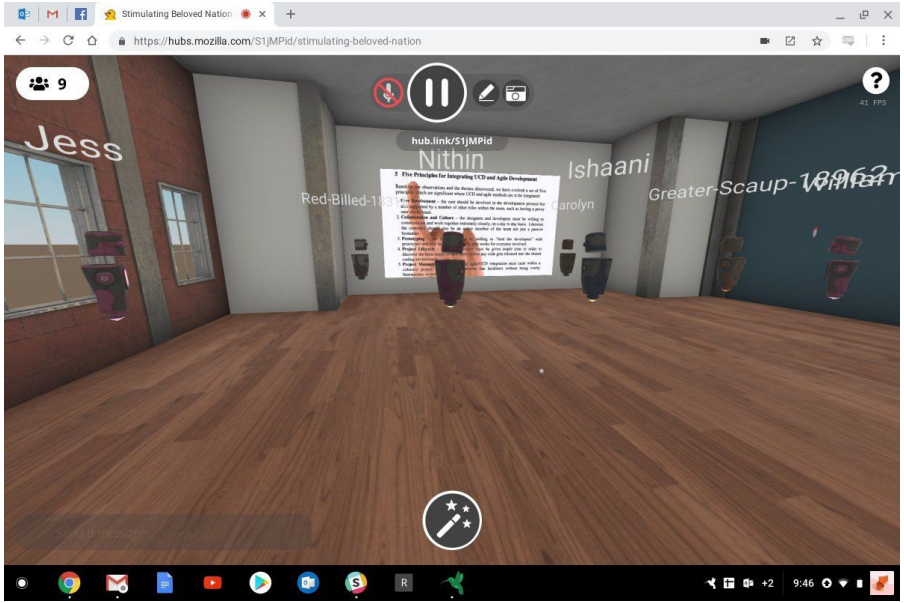
https://apps.apple.com/jp/app/apple-podcasts/id525463029

- Podcasts started out as pre-recorded audio file for iPod devices.
- Podcasts remain a popular content delivery platform.
- Educational content (audio or lecture recording) has made its way to podcasts.
- Podcasts are unique platforms as they allow passive content consumption by the learner (doing something else, running, cooking etc.)

Virtual Reality (VR) and Simulation

- Research on virtual reality in education relies on the assumption that the brain learns more effectively when it is actively doing something.
- VR allow interactions of learner with a virtual environment (deep sea, on a boat, inside human body…)
- Need a headset device etc.

https://c21u.gatech.edu/blog/building-camaraderie-scale-exploring-virtual-reality-vr-georgia-techs-omscs-program



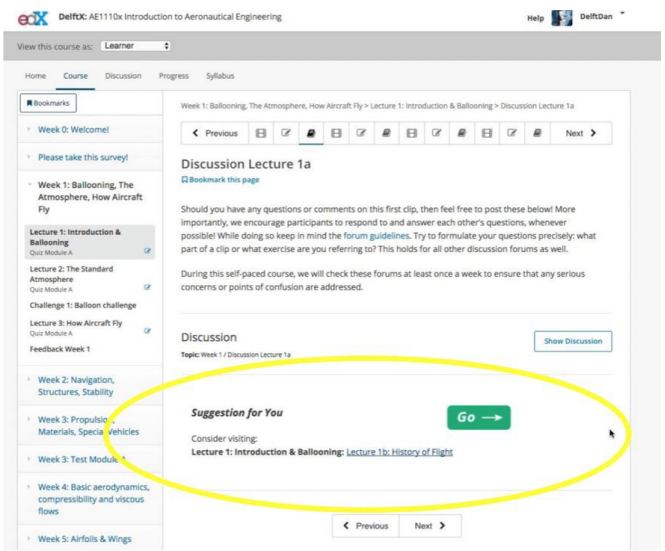
Georgia Institute of Technology's experiment on virtual classroom

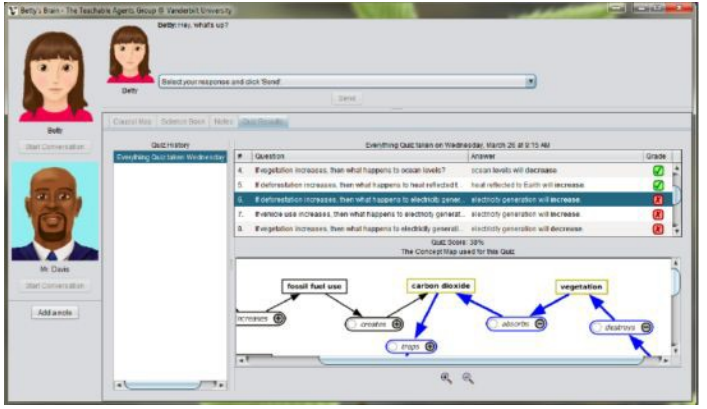
Artificial Intelligence Use in Education

- AI in education examples adaptive learning (modifying learning paths to optimize learning) and intelligent tutoring systems (computers used for teaching with minimal human intervention).

University of California Berkeley's research on adaptive learning through a recommender system

ref. Pardos, Z. A., Tang, S., Davis, D., & Le, C. V. (2017, April). Enabling real-time adaptivity in MOOCs with a personalized next-step recommendation framework, Proceedings of the Fourth (2017) ACM Conference on Learning@ Scale (pp. 23-32).





Vanderbilt University's Betty's Brain, an Intelligent Tutoring System that enables learning by teaching.

https://wp0.vanderbilt.edu/oele/bettys-brain/

Gamification and Badges

- Gamification is using leisurely gaming to inform instructional strategies.
- Gamification research is interested in what keeps a student motivated and engaged.
- Does receiving a badge motivate learners to complete an online course?

https://www.slideshare.net/PlayMoolah/innovation-in-action-managing-change-in-practice

PlayMoolah's gamified financial literacy course

https://www.khanacademy.org/badges

Khan Academy's badges

BADGE TYPES

Meteorite badges are common and easy to earn when just getting started.

Moon badges are uncommon and represent an investment in learning.

Earth badges are rare. They require a significant amount of learning.

Sun badges are epic. Earning them is a true challenge, and they require impressive dedication.

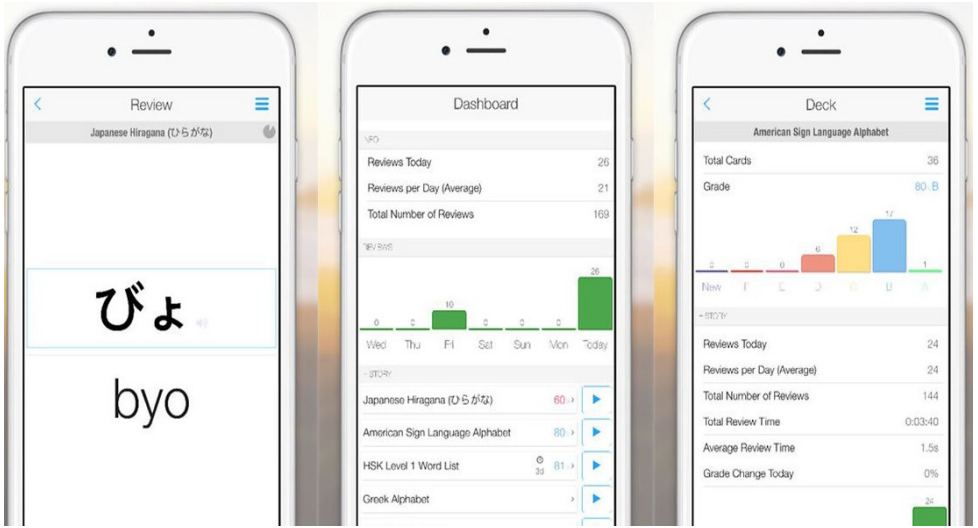
Black Hole badges are legendary and unknown. They are the rarest Khan Academy awards.

Challenge Patches are special awards for completing topic challenges.

Microlearning and Mobile Learning

- Mobile Learning, or learning using mobile devices, is another educational technology research theme.
- Many mobile with a cellphone users learn in bursts (e.g. during train rides), microlearning, or learning in small chunks (e.g. using flashcards), is a topic of research.
- In developing world mobile learning is very common.

https://www.ankiapp.com/



Anki flashcard mobile application

https://elearningindustry.com/learning-analytics-analyze-lesson

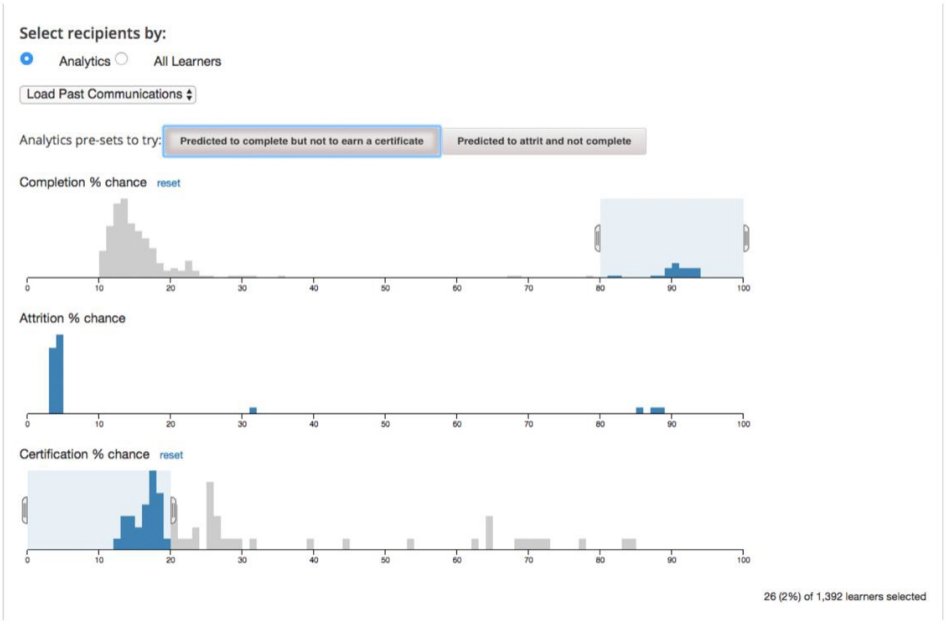
Analyzing Your Lesson To Discover More With Learning Analytics

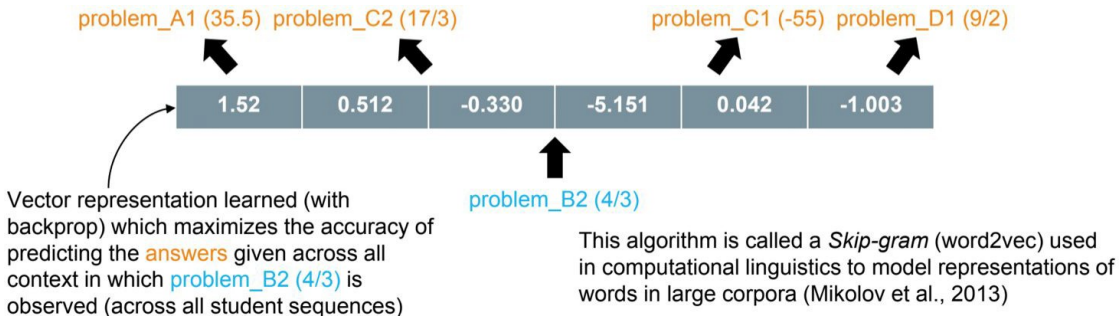
- Online learning allows instructor to monitor students interaction with course
- Instructor can access the data and assessments (grade) in realtime before class starts
- Instructor can adjust course content based on students learning - blended learning
- Learning Analytics

Learning Analytics

- Learning analytics is the collection and analysis of learner data to optimize learning (warning, reminder, predictions).

- On right predict whether a student will finish online course based upon homework completion





University of California Berkeley's research on learner engagement (top) and student misconception (bottom) using learning analytics

Course Video Interactions

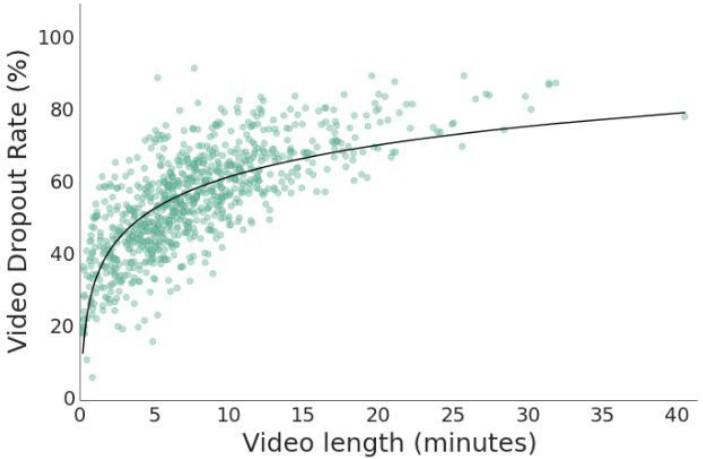


Figure 1. Longer videos exhibit higher dropout rates. Our linear regression model uses the log-transformed video length (x-axis) to predict the dropout rate (y-axis). The model fits the data well with r=0.55 with 95% CI = [0.50, 0.59].

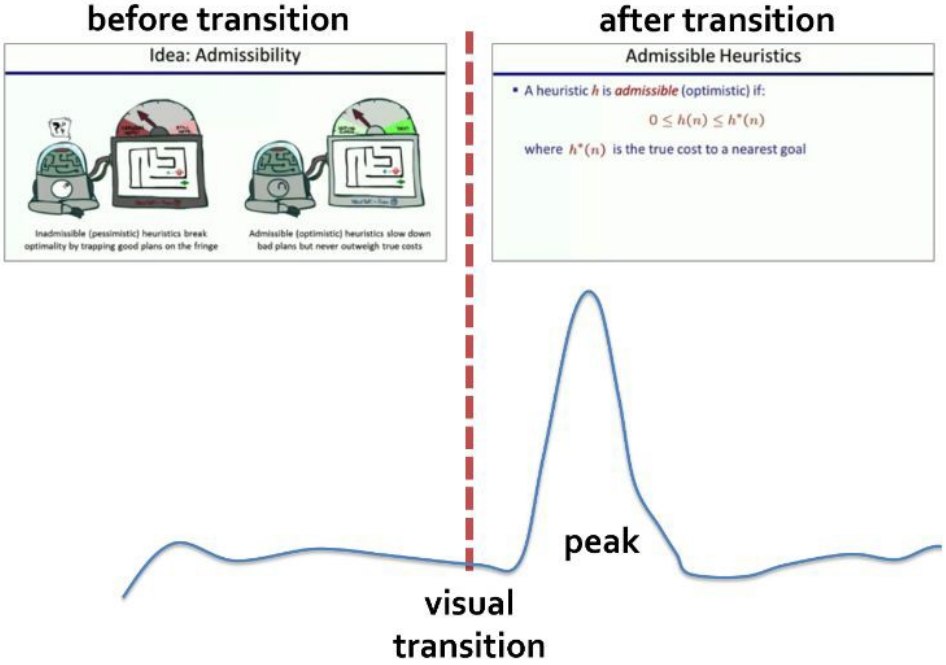


Figure 6. This peak represents the start of a new concept. The instructor started presenting a formal definition of a concept (admissibility) after changing the slide. The peak occurred when this concept explanation started.

Kim, J., Guo, P. J., Seaton, D. T., Mitros, P., Gajos, K. Z., & Miller, R. C. (2014, March). Understanding in-video dropouts and interaction peaks in online lecture videos. In *Proceedings of the first ACM conference on Learning@ scale conference*(pp. 31-40). ACM.

Deep Earth Science (DES) Tokyo Tech 1st MOOC analysis

About the course:

Language English

Length 4 weeks
Effort 2-3 hours/week

Start Date October 7th, 2015
End Date November 30th, 2015

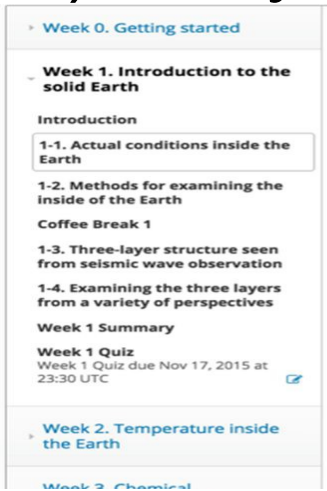
Total enrollment 5403
Verified enrollment 17

Niche course

21% of enrolled watch First video

Lecture 1 (6:10 min)

Week	Completion rate (%)	Start	Finish	Drop
1	77.9	1118	872	246



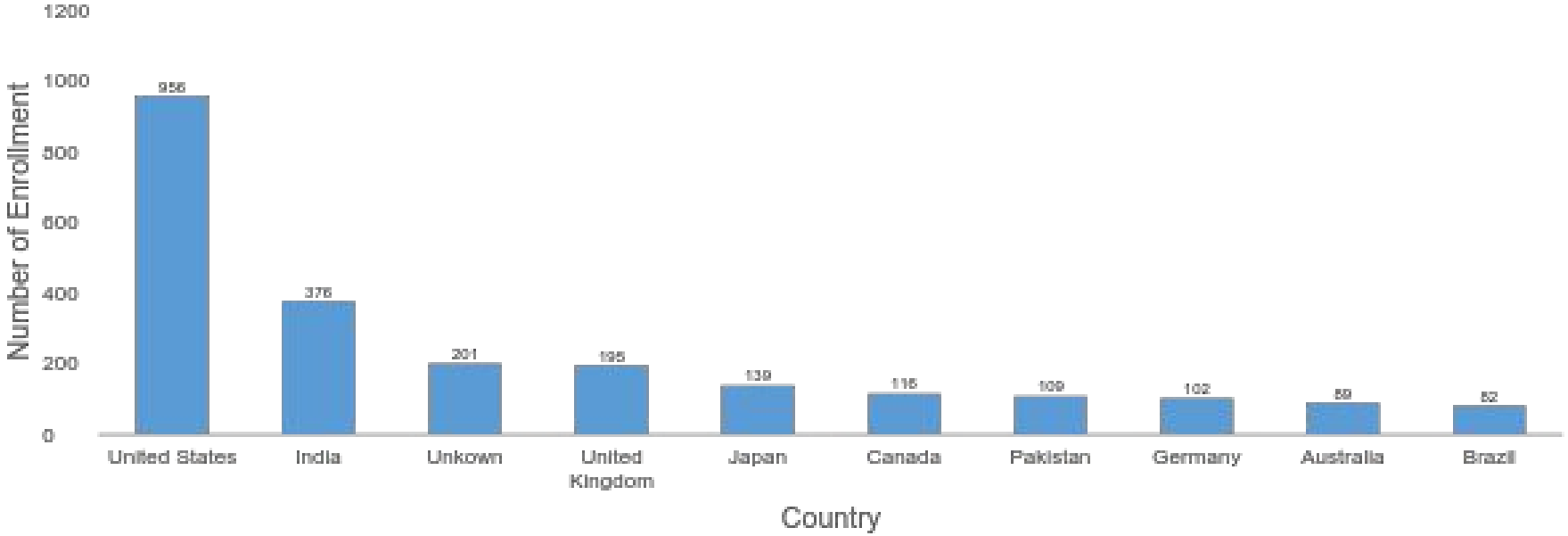
	Week 1	Week 4
No. started	1118	268

23.9 % of students completed 4 weeks course.

Week 1 video making

Course Learners Enrollment By Country

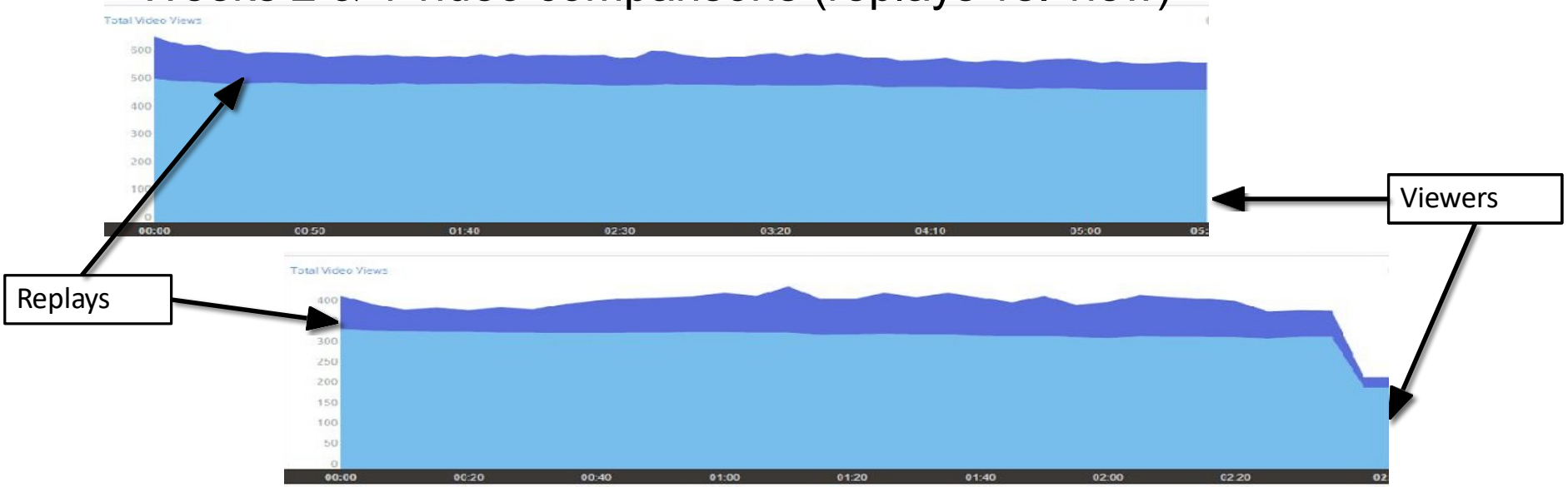
Geography:



https://openedx.atlassian.net/wiki/spaces/COMM/pages/90538191/Open+edX+2016+Presentations

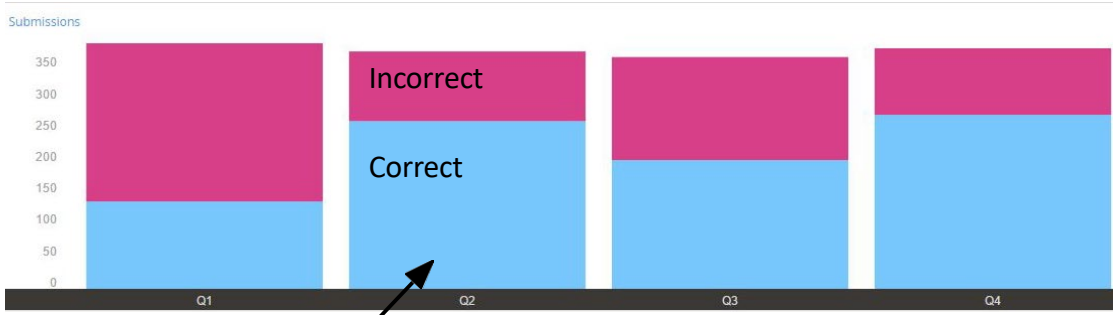
MOOC video analysis views and replays

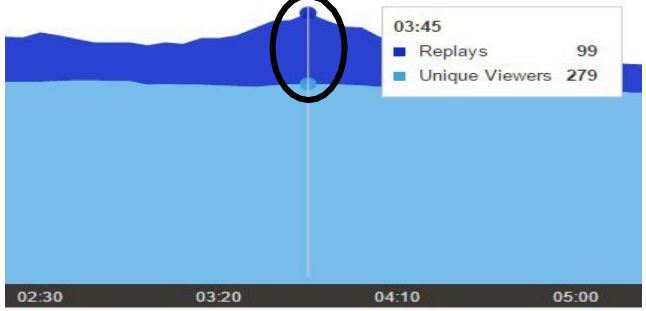
- Course consists of videos, text, quiz, homework
- Weeks 2 & 4 video comparisons (replays vs. view)

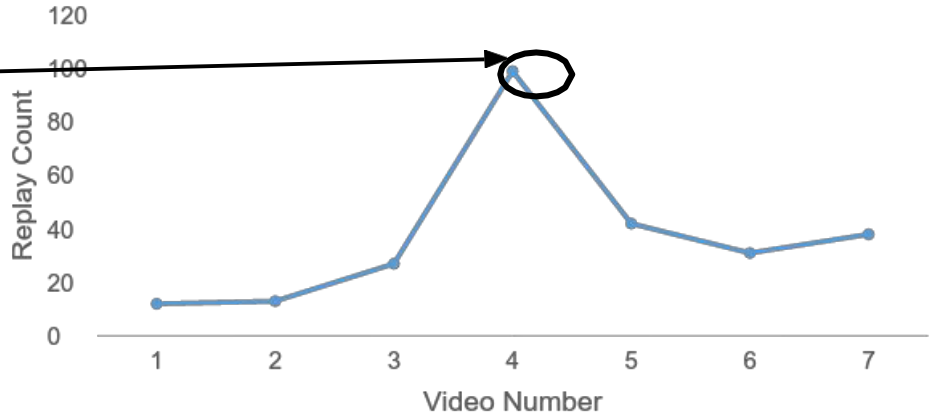


https://openedx.atlassian.net/wiki/spaces/COMM/pages/90538191/Open+edX+2016+Presentations

Example of Analyzing Video replay & quiz







The most replayed video is usually the one containing the answers to the quizzes questions.

https://openedx.atlassian.net/wiki/spaces/COMM/pages/90538191/Open+edX+2016+Presentations

Electrical Engineering Online Course lecture videos in Japanese and Dubbed into English

Dubbed video in English using Google API
https://youtu.be/_cLVisxGtuQ

https://youtu.be/S2nc9InNQ9Y

Question # 3 for discussion

What differences do you notice between Japanese and English lecture voices (timing)?

Is a Human voice better to listen to than the AI generated voice?

Cross lab *AI in Education* Research Group

The students in the AI in Education group at the Cross lab work on a variety of topics:

Cheyvuth
Self-Efficacy of Cambodian Undergraduate Students

John
AI-based Writing Assistants' Impact on English Language Learners' Writing Fluency

Luc
University Students and Elementary School Teachers Lifelong Learning Through Play

Dorj
A Chatbot for a TSE Professor's Laboratory Using Combined Architecture

May
Personalized Online Adaptive Learning System

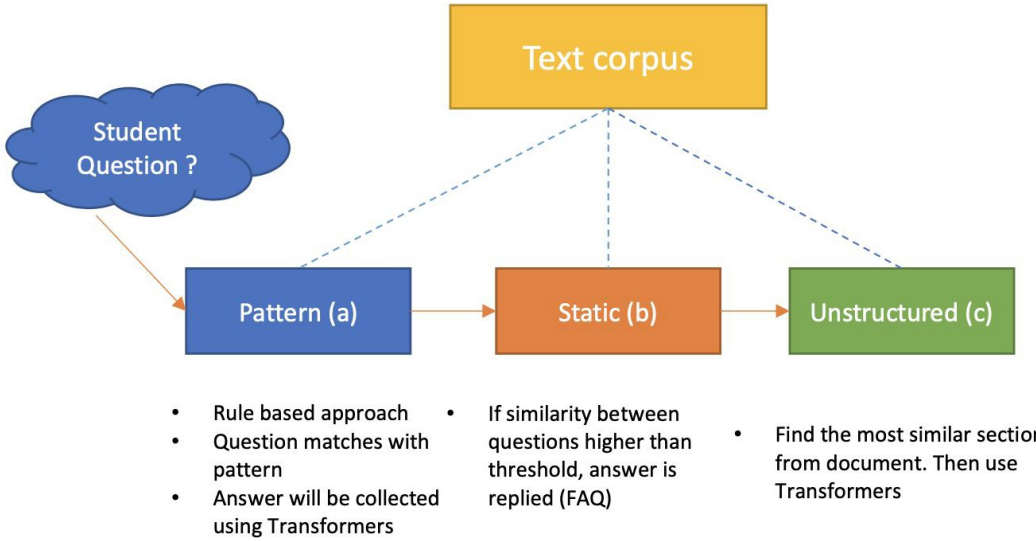
Batjargal Dorjzodovsuren (DORJ)

AI in Education Group
at the Cross Lab

A Chatbot for a TSE Professor's Laboratory Using Combined Architecture

Chatbots provide information by using Artificial Intelligence (AI) after training on text (web, report).

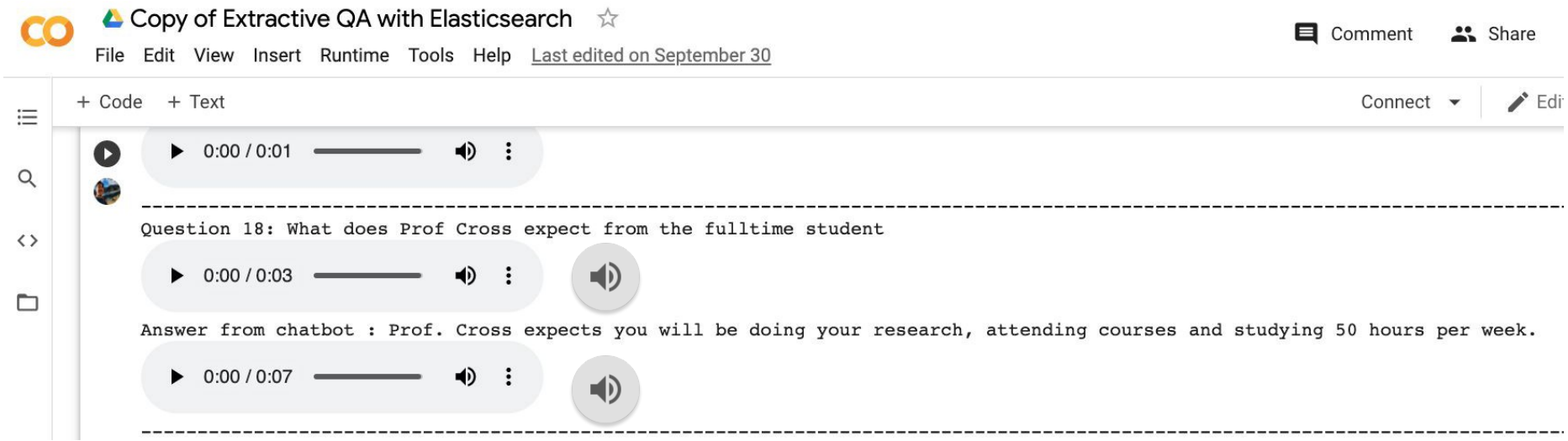
chatbot similar to one-on-one instruction.

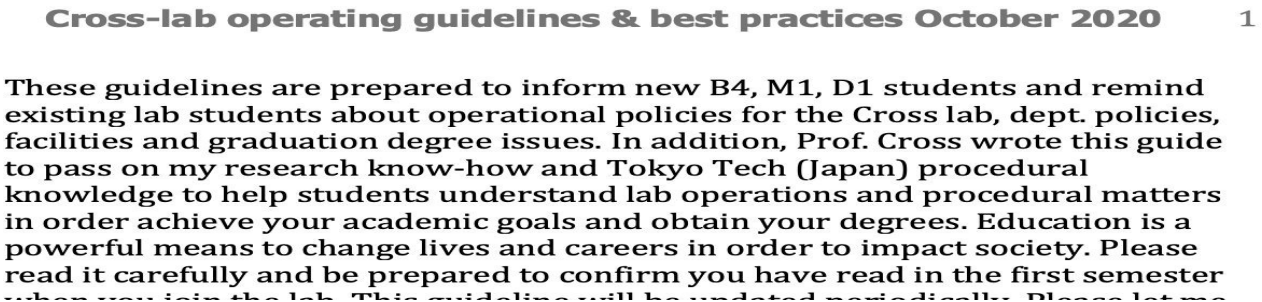


Dorj - took the Cross lab student guide 15 pages and made a chatbot from it which answers new lab student questions with text and audio.

A Chatbot for a TSE Professor's Cross' Laboratory Q&A from lab manual.

AI in Education Group at the Cross Lab





Cross-lab operating guidelines & best practices October 2020 1

These guidelines are prepared to inform new B4, M1, D1 students and remind existing lab students about operational policies for the Cross lab, dept. policies, facilities and graduation degree issues. In addition, Prof. Cross wrote this guide to pass on my research know-how and Tokyo Tech (Japan) procedural knowledge to help students understand lab operations and procedural matters in order achieve your academic goals and obtain your degrees. Education is a powerful means to change lives and careers in order to impact society. Please read it carefully and be prepared to confirm you have read in the first semester

15 page lab guide

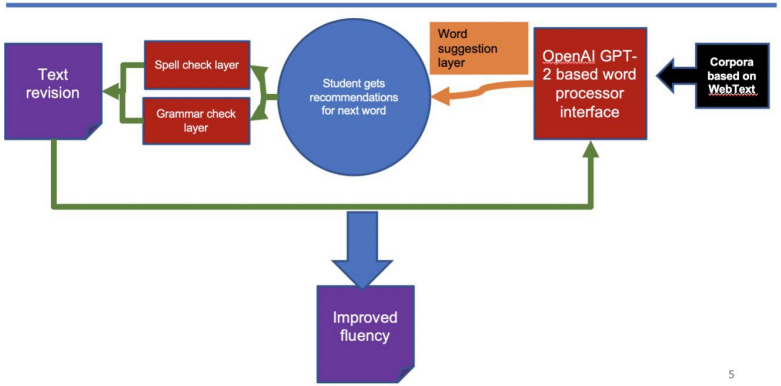
John Maurice Gayed (JOHN)

AI in Education Group
at the Cross Lab

AI-based Writing Assistants' Impact on English Language Learners' Writing Fluency

Input words in a sentence (essay), output is next word prediction (%)

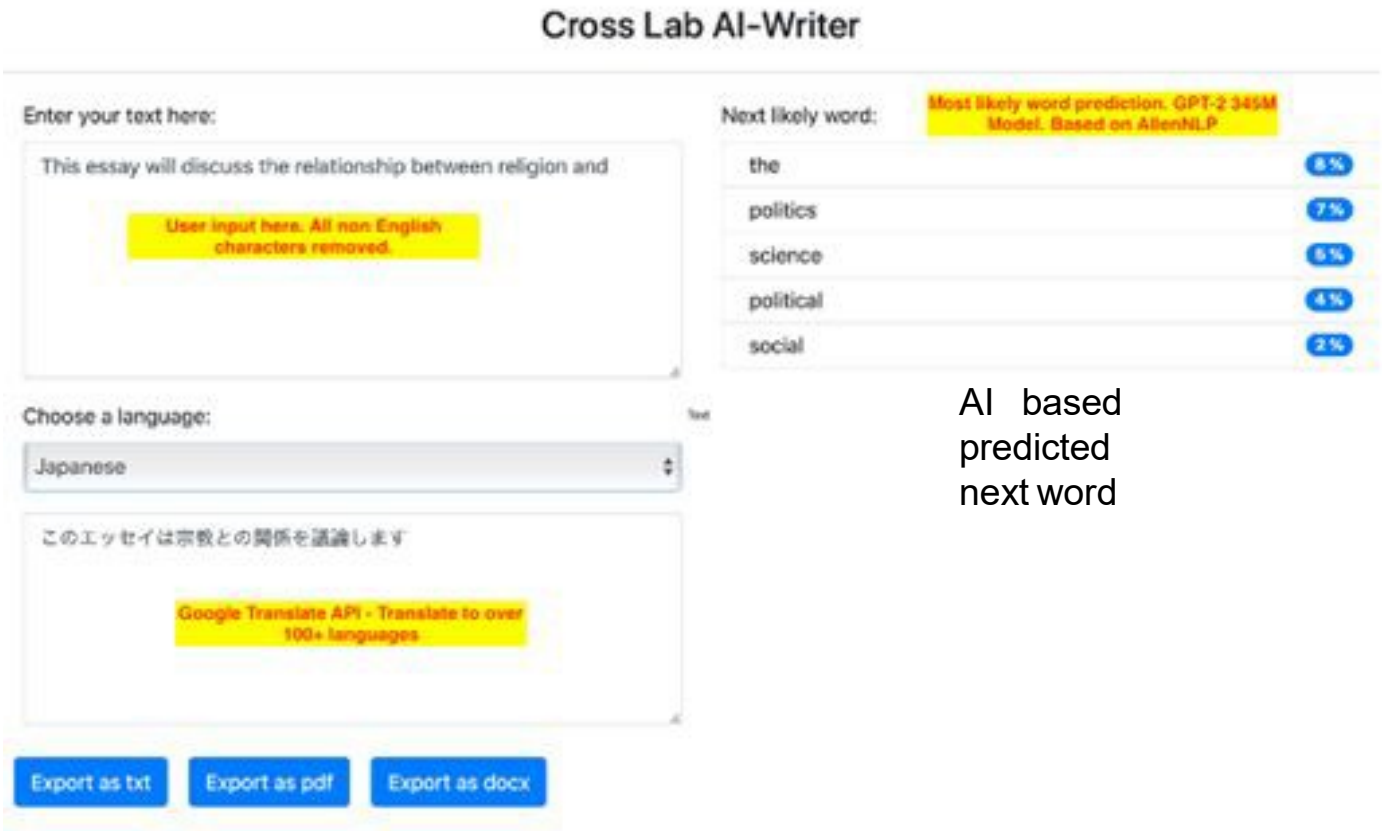
Allen Institute for AI. Language Modeling Demo.
https://demo.allennlp.org/next-token-lm?text=This%20research%20will%20



AI system based on Open AI's GPT-2 language model.

Expect AI-based writing assistants can improve students' writing fluency.

Type text here in English In web app



AI based predicted next word

Choose 2nd language, AI based translation

Question # 4 for discussion

Which do you prefer when seeking information, ask a person (me) a question or a chatbot about today's lecture in English?

If you could ask the question in written Japanese or spoken Japanese versus speaking the question in English, would that impact your above response?

A person’s culture impacts one’s impression about Robots interaction

WIRED BACKCHANNEL BUSINESS CULTURE GEAR IDEAS SCIENCE SECURITY SIGN IN

JOI ITO IDEAS 07.30.2018 07:00 AM

Why Westerners Fear Robots and the Japanese Do Not

The hierarchies of Judeo-Christian religions mean that those cultures tend to fear their overlords. Beliefs like Shinto and Buddhism are more conducive to have faith in peaceful coexistence.

https://www.wired.com/story/ideas-joi-ito-robot-overlords/

Use of AI is not always faster than humans

- In dubbing EE lectures videos into English using Google Text to Speech (TTS) API which generates an audio track, it required 7 hours of caption editing, TTS conversion and mp4 video file preparation for 1 hr of lecture video.
- Closed captions had to be edited manually by a TA into complete sentences with timestamps (took 5 hours for 1 hour of video).
- It would have been faster (take less time) to read aloud closed caption lecture while recording then re-edit the videos with English audio track then using TTS Google API which needs transcript with timestamps for each sentence.
- Using AI based processes is not always faster than doing process manually with people with video editing skills for a process that involves several steps.

Summary / Conclusion

- Due to COVID-19 online education has greatly expanded worldwide (merits and demerits).
- Online courses allow learner interactions with the course to be analyzed
- Online learning has created jobs in the field of educational technology
- AI can be used to enhance personalized learning experience and provide learner support
- Does AI actually improve learning or speed up learning efficiency? To be determined (tbd).

Acknowledgements

Tokyo Tech Online Education Development Office, Staff and Teaching Assistants

Tokyo Tech Center for Innovative Teaching and Learning

Tokyo Tech Cross lab AI in Education research group students, in particular May Carlon who prepared some of the slides.

edX and open edX LMS

THANK YOU

For CREDIT students only: REPORT questions

1. Please list the types of online courses and programs edX offers ? Which are free?
2. What do online courses with videos/reading passages/assessments allow the instructor to do that a traditional lecture based course taught in a classroom with a Professor using a chalk board and graded paper exam/quizzes does not?
3. What is a learning management system and how is it used in online courses?