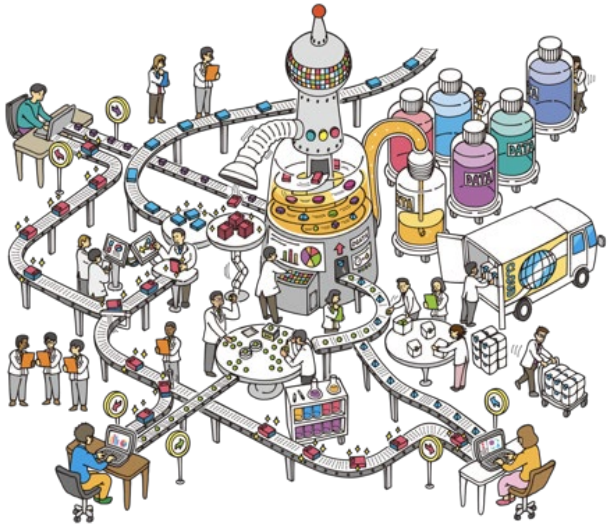


Learning and Evidence Analytics Framework (LEAF)

Design and Large -scale Implementation of LA driven infrastructure

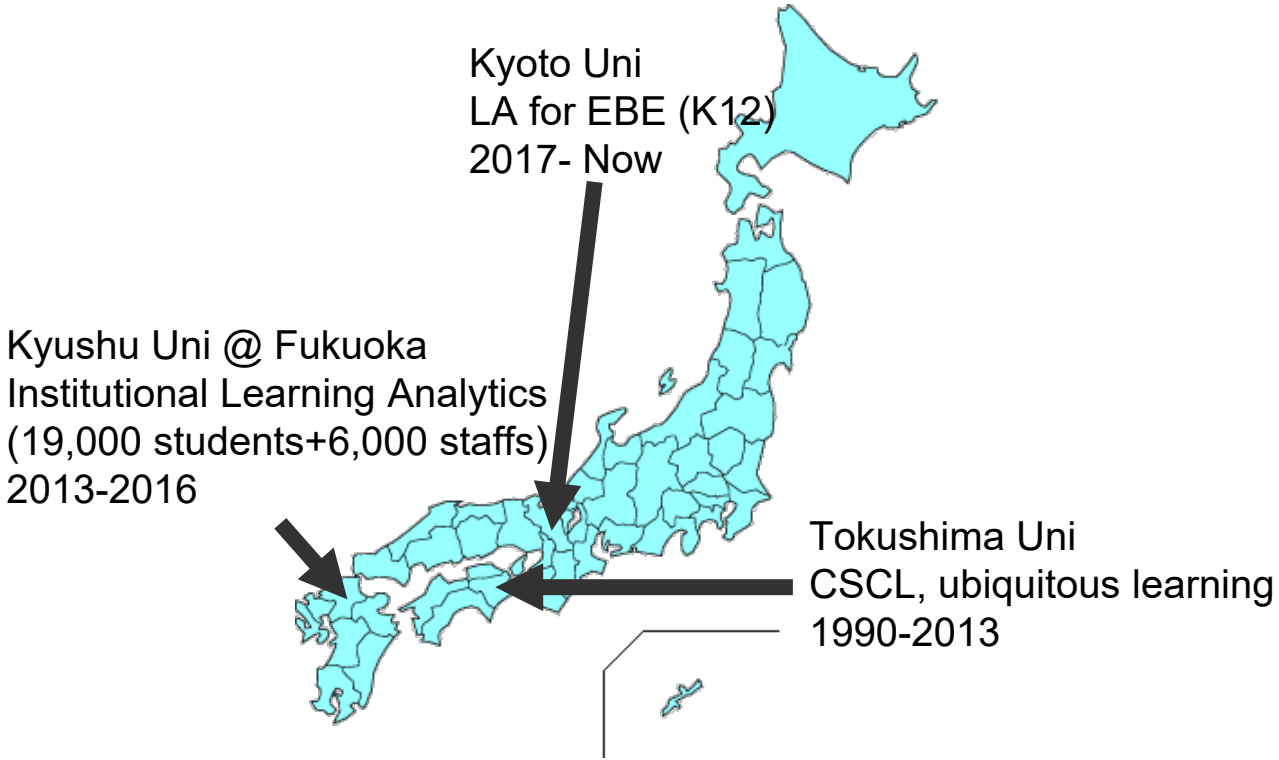
Prof. Hiroaki Ogata

Kyoto University, Japan

24-25 August, 2021

Learning and Educational Technologies Research Unit

My mobile learning journey in Japan



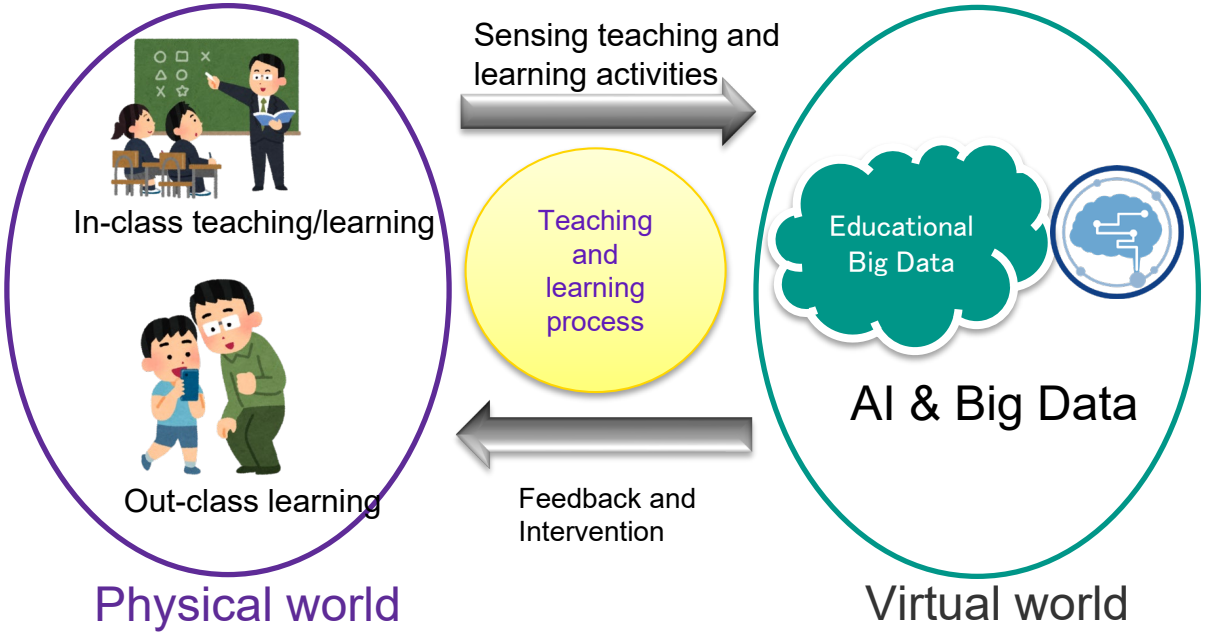
Question:
How do you know how the students are learning during the classroom?

Question:
How do you know how the students are learning outside the classroom?

Learning analytics can provide a tool to enable you to know how the students are learning inside and outside classroom.

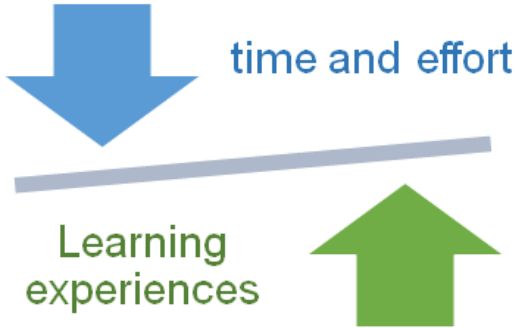
What is learning analytics?

To improve teaching and learning processes through insights from the data collected in ubiquitous (both physical and virtual) learning environments.

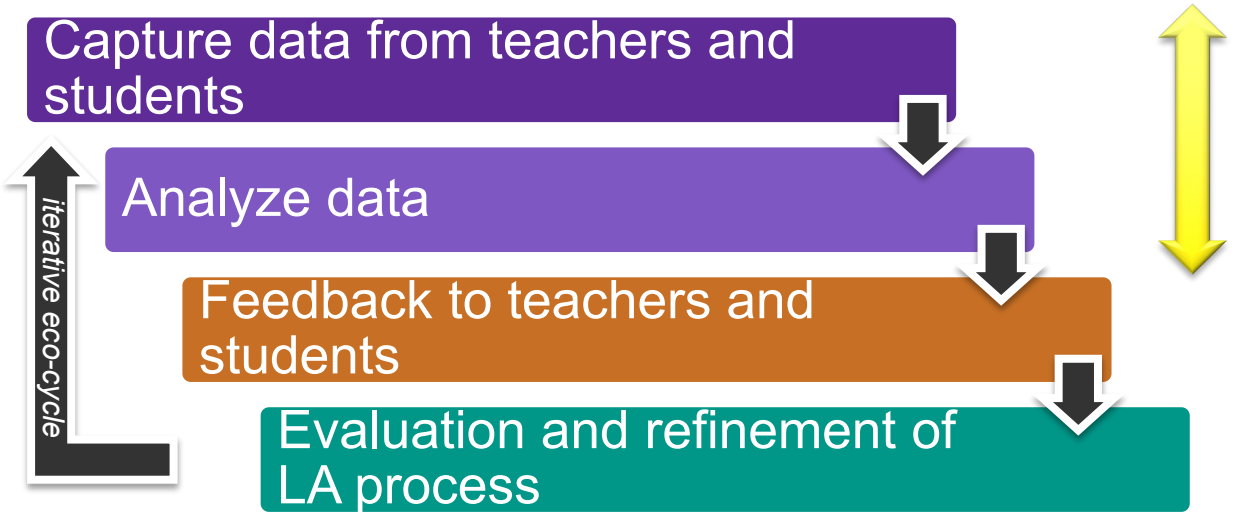


Objective of our learning analytics project

1. Maximize learner's learning performances
2. Minimize teacher's time and efforts



Steps of Learning Analytics



Question:
What kind of educational data do you have for your classroom?

How do you use the educational data for your classroom?

Types of Educational Data (Edu-data)

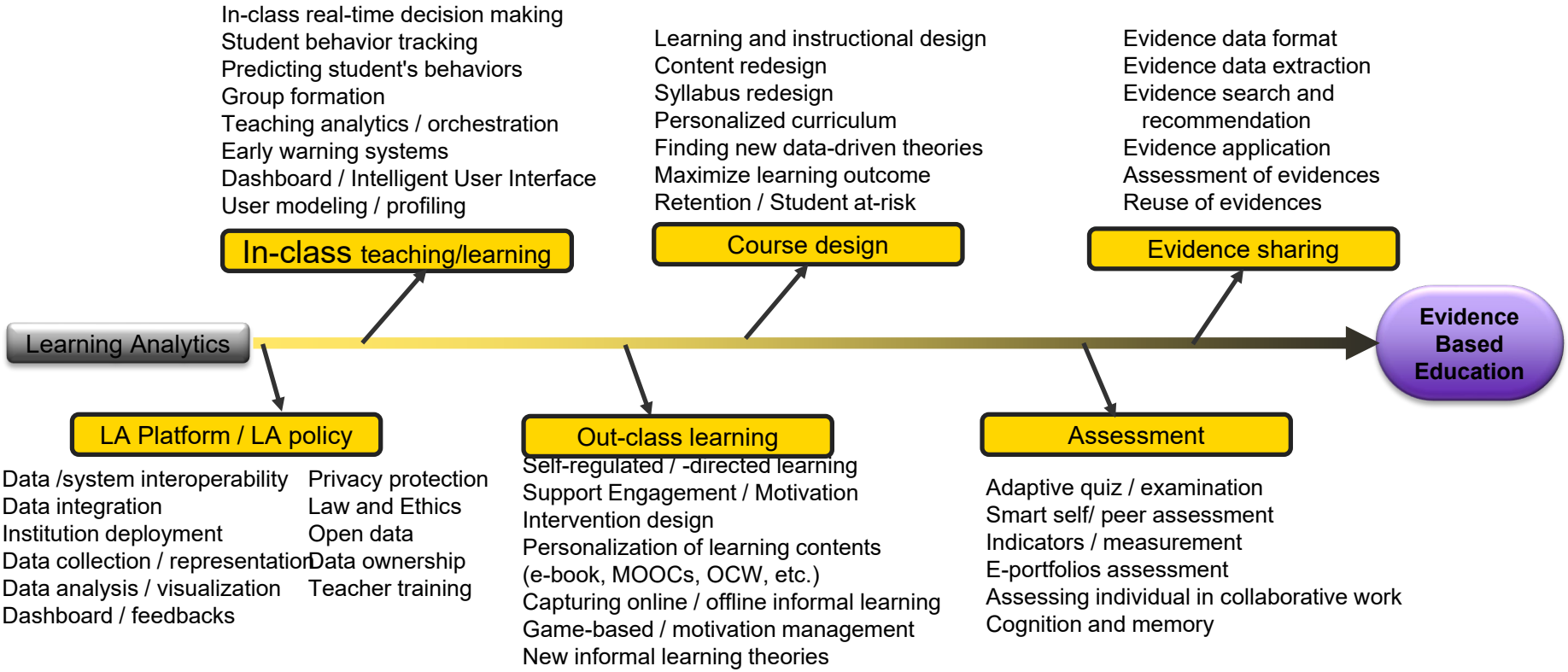
Types of Edu-data	Examples
Course data	Course name, syllabus, student enrollment
Textbook data	Textbook, slides, workbooks, web pages
Person data	Teacher, students, teaching assistance
Score data	Final score, quiz results, assignment score
Process data	LMS, e-book, video lecture, e-portfolio, CBT
Environmental data	Classroom video, temperature, humidity
Physiological data	Pulse, steps, gaze, electroencephalograph

Recording the learning and teaching process is important!

How to use educational data?

Level	For whom	Examples
Individual	Student	・Provide Personalized learning materials and quizzes ・Promote students success
	Teacher	・Support improving a course design and learning materials ・ Reduce teacher's workload, e.g., automatic feedback to students
	Parents	・Increase awareness of their children's learning progress
Institution	Management	・Optimize the curriculums to enhance the quality of education programs ・ Increase the accountability of stakeholders
Country and region	Policy-makers	・ Create and evaluate the policy based on evidence
	Researchers	・ Find new evidences by using educational big data
	Citizens	・ Share the issue and solutions based on educational big data

From Learning Analytics to Evidence-based Education



GIGA school project in Japan (2020-21)

Japane[illegible] government has distributed “one personal computer for one stude[illegible]n-wide from elementary to junior high schools by March, 2021. (9+ [illegible] for 30,000+ schools)

The total budget will be 461 billion [illegible] billion USD).

The next plan will be the collection and use of educational da[illegible] collected from EdTech tools.

We will be getting ready for nationwide LA.

Educational institutions in Japan

	Total	*National*	*Public*	*Private*
Elementary	19,892	70	19,591	231
Junior high	10,270	71	9,452	778
High	4,897	15	3,559	1,323
University	782	86	93	603
Total	35,841	242	32,695	2,935

MEXT (May, 2018)

Japanese education system

K-12:

Common curriculum designed by MEXT (Ministry of Education, Culture, Sports, Science and Technology)

Textbooks provided by MEXT free of charge

Teacher-centered classroom

University (Higher education):

The entrance exam is very difficult, but the graduation is not.

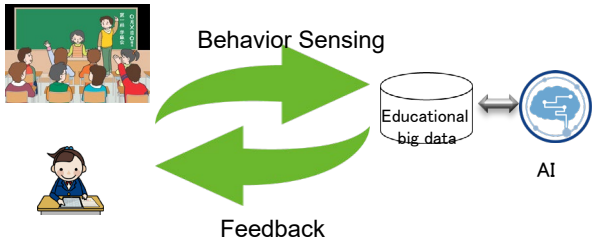
The tuition is $5,000/yr for public university and $10,000/yr for private university and is paid by the parents in most cases.

https://www.mext.go.jp/

日本学術会議
SCIENCE COUNCIL OF JAPAN

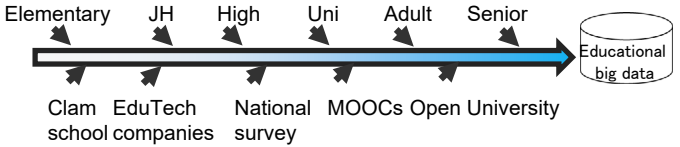
Educational data (edu-data) subcommittee for nation-wide data collection and use

① Define the types and use of edu-data



- What kind of edu-data should be collected and shared in nationwide?
- How should edu-data be used by each stakeholder?
- How can AI and other technologies support education and learning?

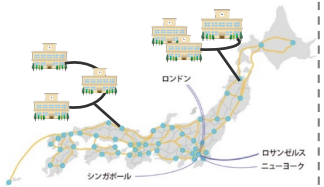
② Establish an eco-system for edu-data



- What kind of the guidelines are necessary for edu-data management?
- What kind of information systems should be implemented to collect personal learning and teaching data?
- The standard of data format and semantic meanings of edu-data is necessary.
- What kind of organizations should be involved for this?

③ Build-up ICT infrastructure for edu-data

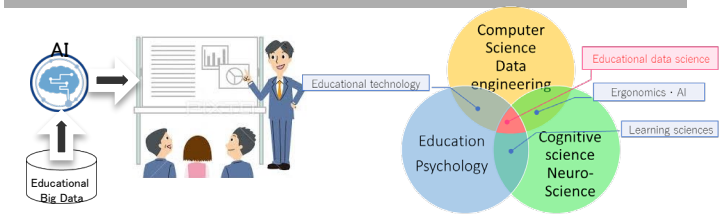
One PC per one student



High-speed School network

- What kind of ICT environment is necessary to collect and use edu-data?
- How should one PC per one student be implemented nation-wide?
- How should the school network be keep secured and useful?

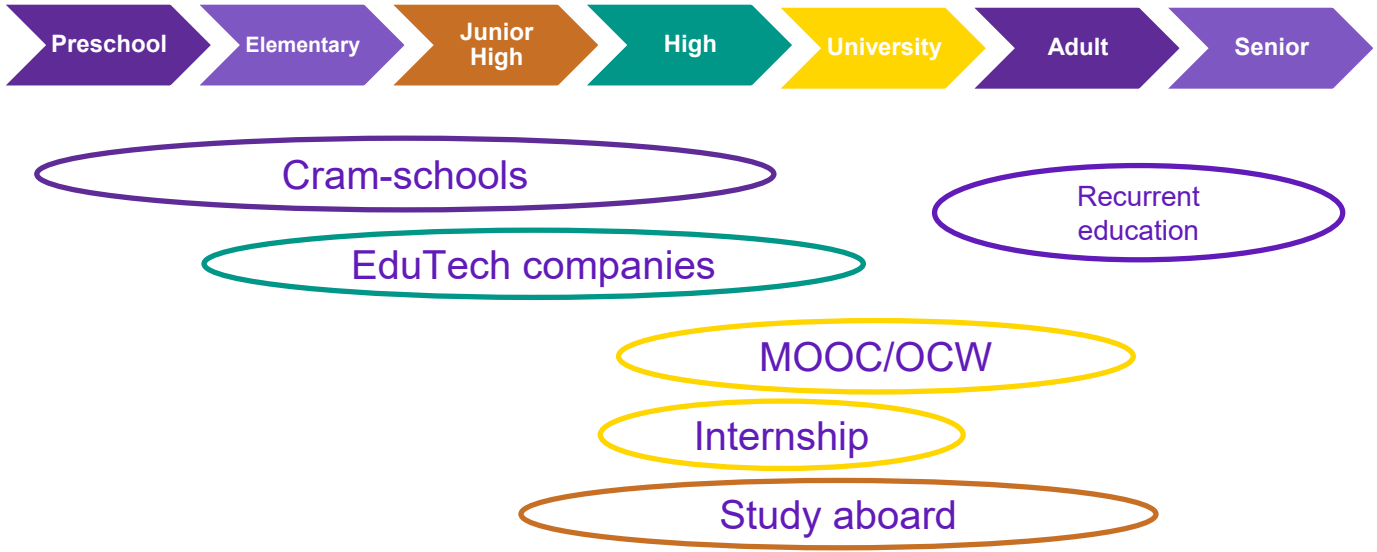
④ Nurture stakeholders: teachers, students, parents and researchers...



- How to nurture teachers and ICT-support staffs to improve teaching by using edu-data.
- How to teach data-literacy for teachers, students, parents, etc.
- How to nurture researchers to do research by using edu-data.

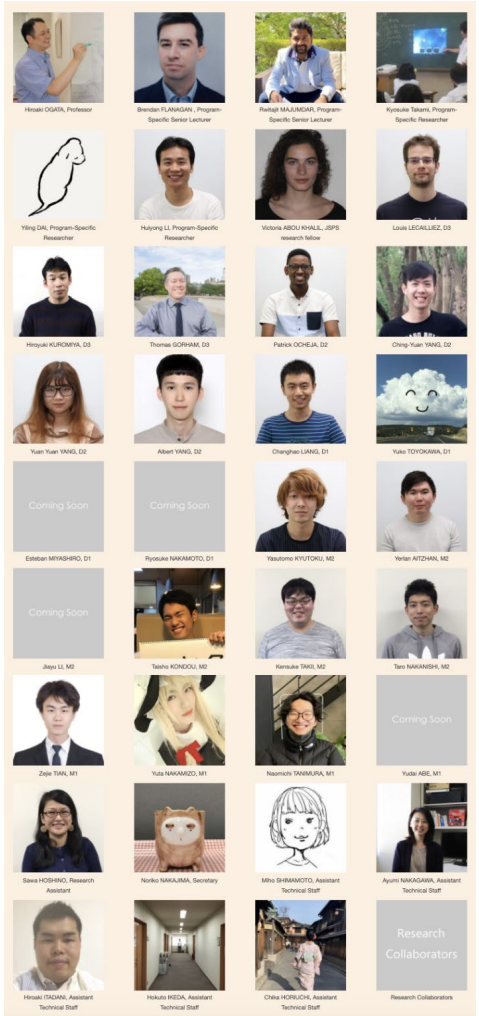
Our Research focus

To record all the learning and teaching processes throughout lifetime and nationwide and to use the data for improving education.



Technology -enhanced and Evidence -based Education and Learning (TEEL) platform

LMS (Moodle, Sakai)
BookRoll (e-book reader)
LAViEW (LA Dashboard)



Kyoto University's Learning and Educational Technology Research Unit

35 research members from 10 different countries.

We working on multiple projects related to large scale implementation and evaluation of learning analytics and AI enhanced learning systems.

Please check our projects in the following links
https://www.let.media.kyoto-u.ac.jp/en/project/
https://eds.let.media.kyoto-u.ac.jp/?page_id=1228&lang=en

In this presentation we shall discuss the following

- Learning and its analytics in Japanese context.
- Learning and Evidence Analytics Framework (LEAF) components and its usage.
- Open discussion.

Our current research projects

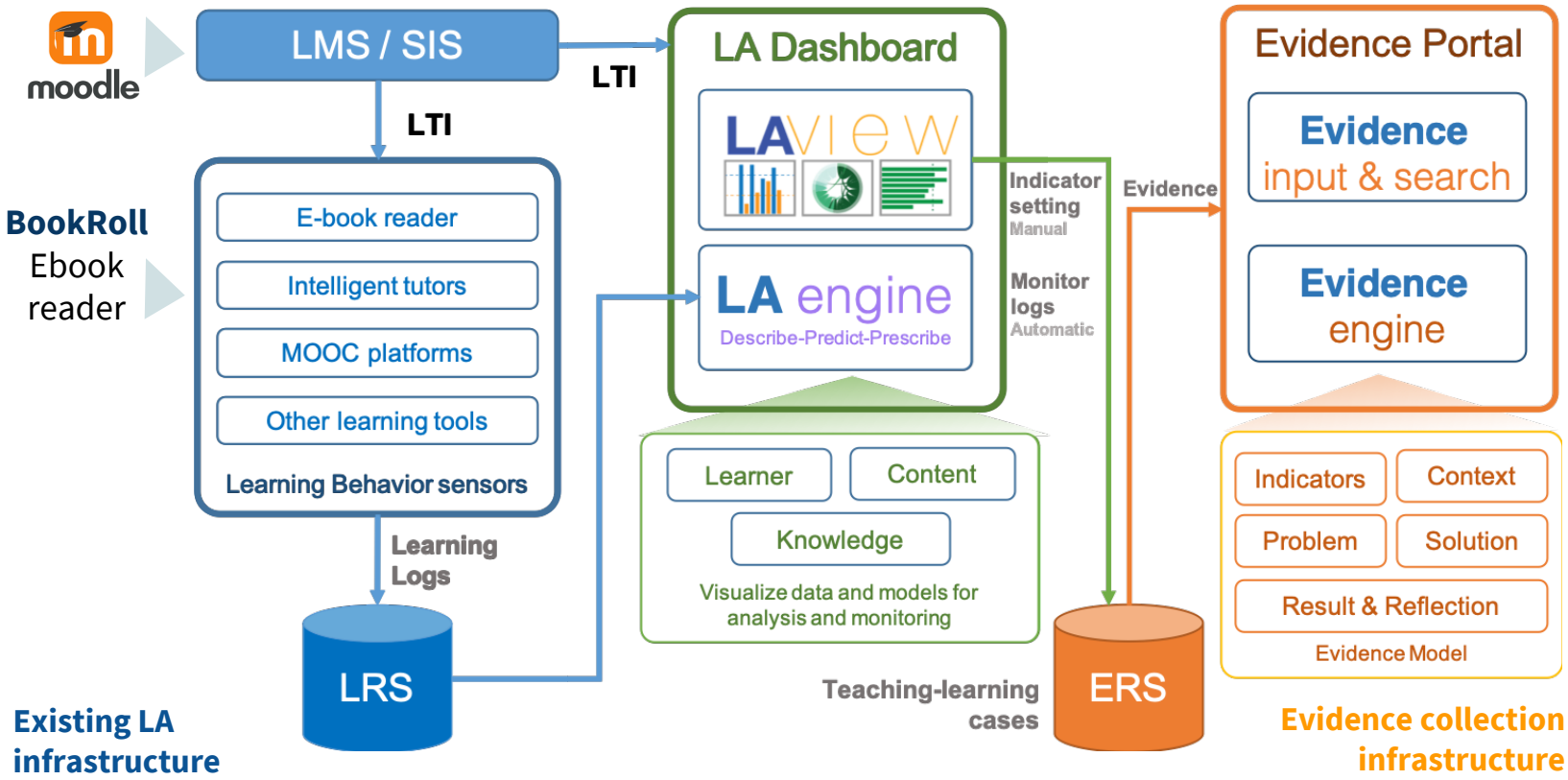
①JSPS Research Grant (S),
Development of Infrastructure for learning analytics and educational big data,
(2016.5 - 2021.3) 2,000,000 USD

②Special Innovation Program (SIP) on AI & Big Data from the Cabinet Office of Japan,
Evidence-based Tailor-made Education,
(2018.11 - 2023.3), 10,000,000 USD

③ Innovative Education Pilot Studies from Ministry of Education
Group Learning Analytics in Kyoto City
(2019.9 – 2022.3) 300,000 USD

④NEDO, EXAIT: Research and development of Educational Explainable AI Tools by co-evolution of learner's self-explanation and AI generated explanation
(2020.7-2025.3) 5,000,000 USD

Learning Evidence Analytics framework



Ogata H., et al., Beyond Learning Analytics: Framework for Technology-Enhanced Evidence-Based Education and Learning, ICCE2018, pp.486-489, 2018.

User-Centric LA platform

Easy to start LA

- Teachers and students can use the current LMS to start LA.

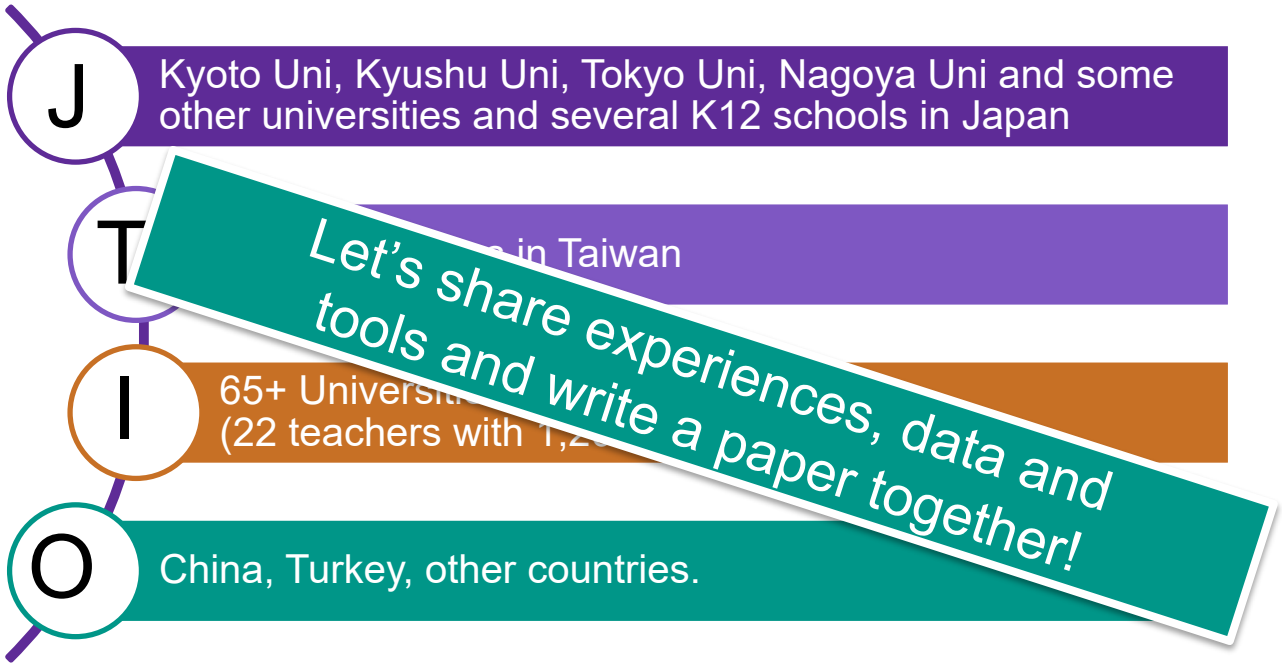
Easy to use data for LA

- Researchers can easily use anonymized data for research.

Easy to plug in tools for LA

- Teachers and researchers can add more learning behavior sensors into the current LMS and add more data-analysis tools into the dashboard.

LEAF framework is used in



Rwitajit MAJUMDAR, Jayakrishnan WARRIEM, Hiroyuki KUROMIYA,Gökhan AKÇAPINAR, Brendan FLANAGAN & Hiroaki OGATA, Learning Evidence Analytics Framework (LEAF) in Practice: A2I2 based Teacher Adoption Approach, 27th International Conference on Computers in Education, Taiwan: Asia-Pacific Society for Computers in Education (ICCE2019), pp. 351-353, Kenting, Taiwan, 2019.12.2-6.

BookRoll

eBook Reader

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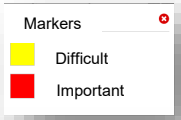

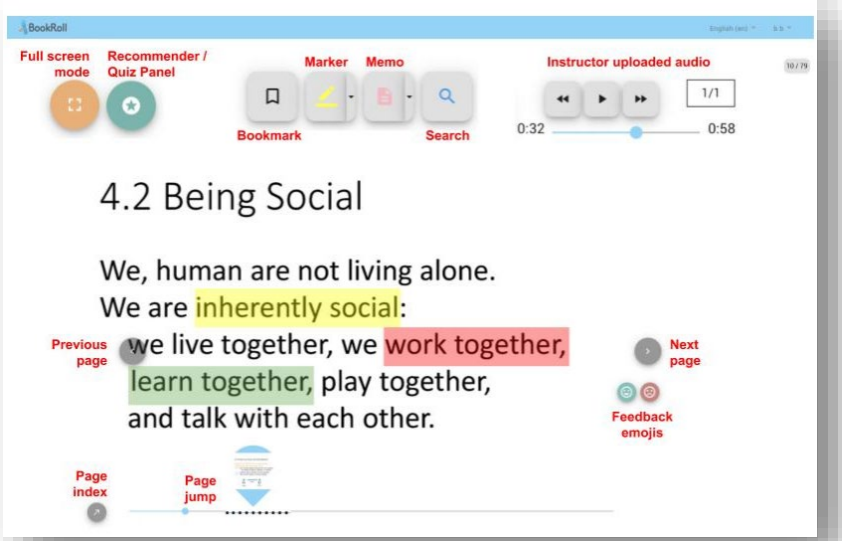

Sample Log Record

id	ssokid	operationname	operationdate	contentsid	devicecode	memo_text	page_no	diftime	color	markertext
6965898	004b4d54	OPEN	2018-04-16 19:18:13	2a38a4a9316c49	pc		1	0		
6965899	004b4d54	ADD MEMO	2018-04-16 19:18:13	2a38a4a9316c49	mobile	陽性と陰性をひっくり返して適合	1	66		
6965900	004b4d54	PAGE_JUMP	2018-04-16 19:19:19	2a38a4a9316c49	pc		4	0		
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6965903	004b4d54	NEXT	2018-04-16 19:22:58	2a38a4a9316c49	mobile		5	0		
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15 actions: Next_page, Previous_page, Page_jump, Makers, Comment, Open, Close, …
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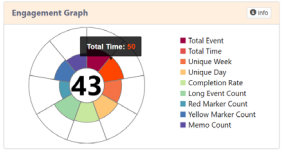
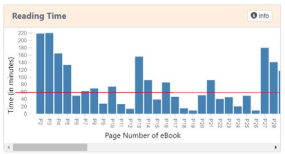
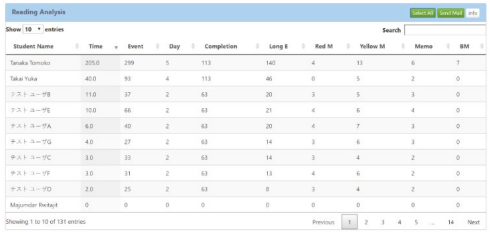
Teaching and learning dashboard to trace learning activities







What parts are difficult and what parts are important for students in reading?

maker heatmap

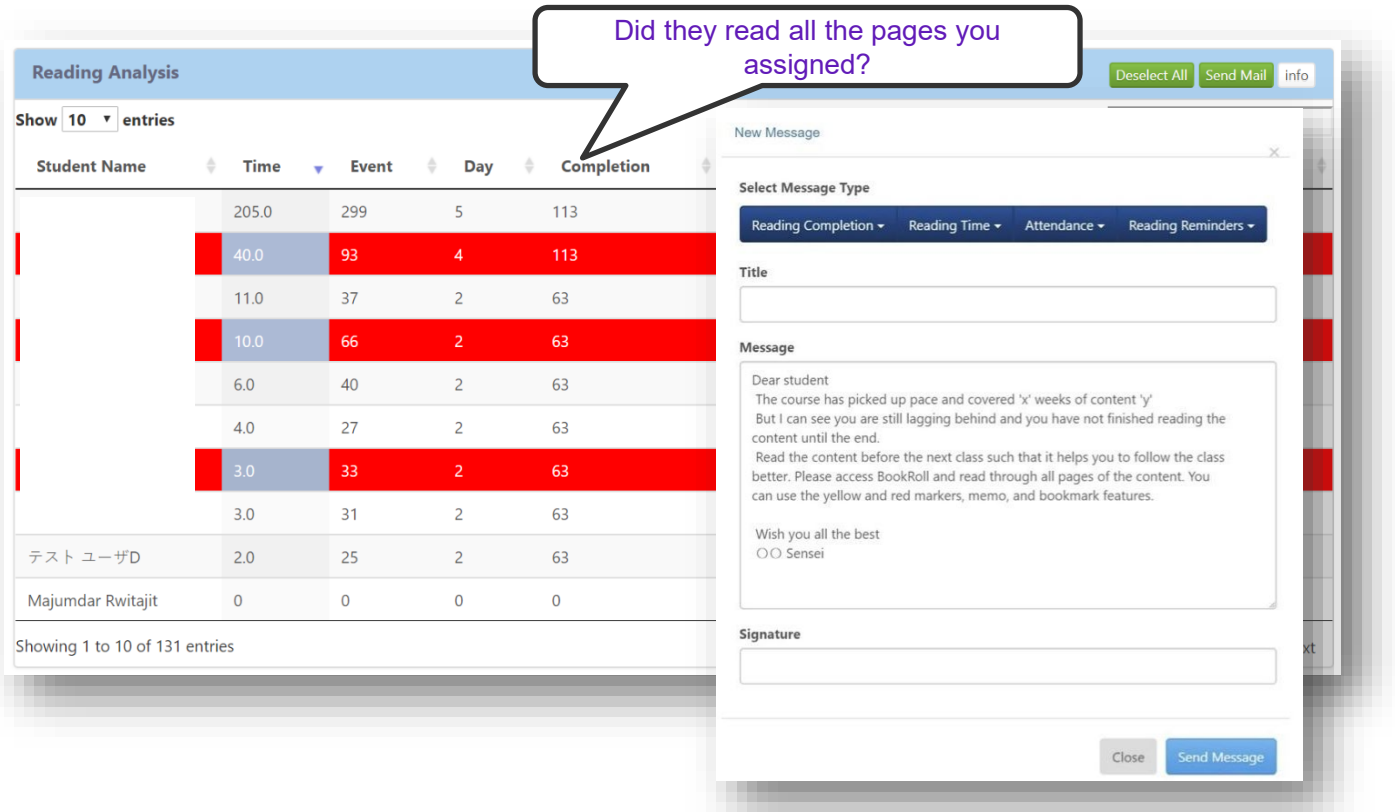
More difficult

More important

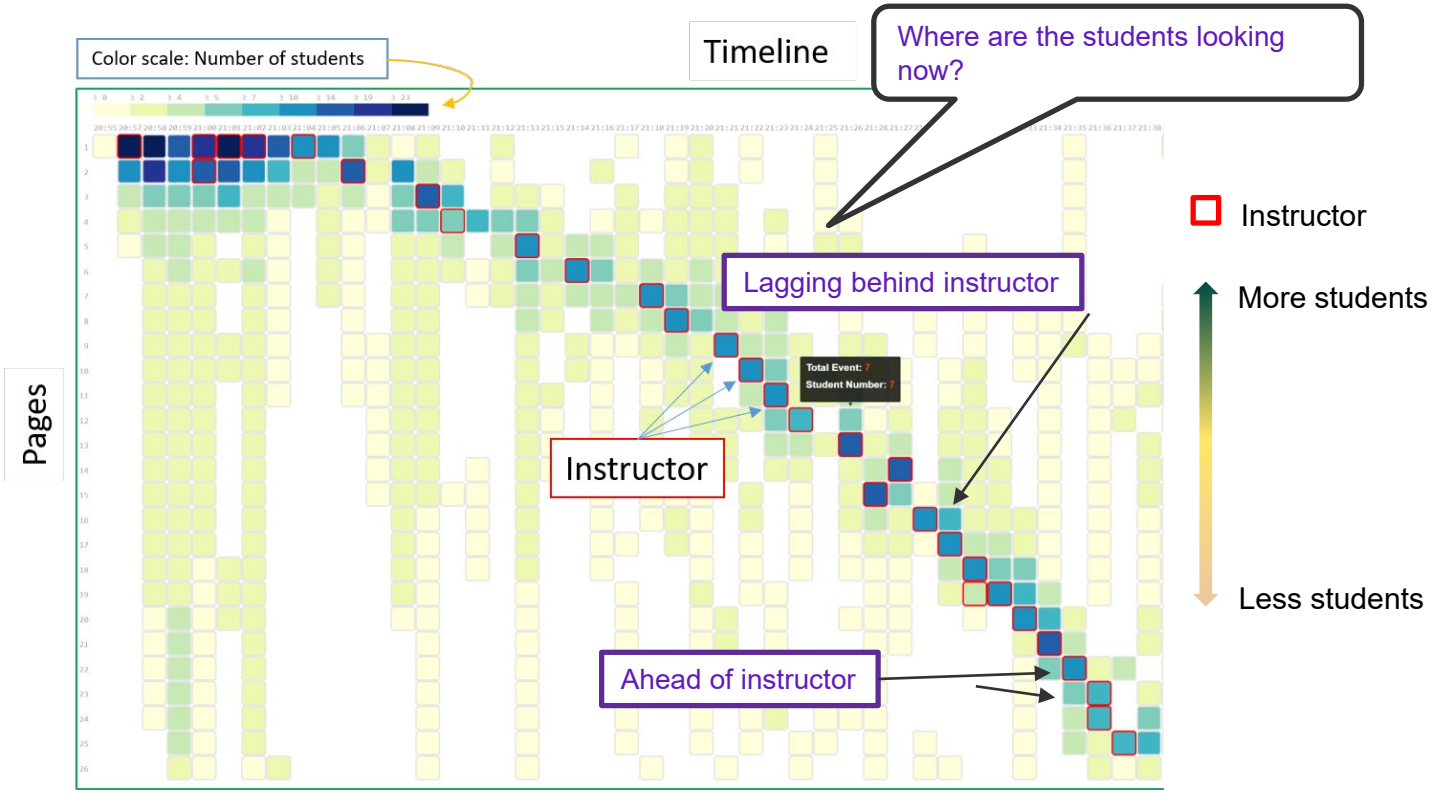
Rwitajit Majumdar, Arzu Akçapınar, Gökhan Akçapınar, Brendan Flanagan and Hiroaki Ogata, LAView: Learning Analytics Dashboard Towards Evidence-based Education, Companion Proceedings of the 9th International Conference on Learning Analytics and Knowledge, 2019

Page-wise annotations and reading behaviors

Interventions can be sent by email

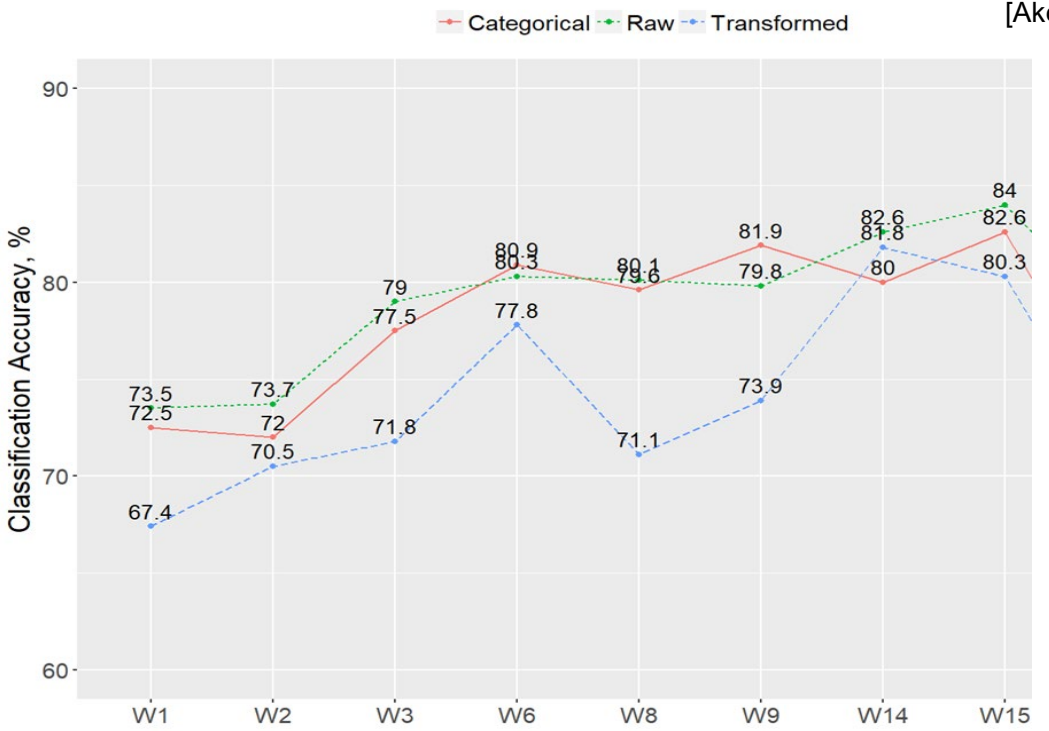


In-class real-time page transition



Prediction of the student's final score at the beginning of the course by using BR logs

[Akcapinar et. al., SLE, 2019]



Akçapınar, G., Hasnine, M. N., Majumdar, R., Flanagan, B., & Ogata, H. (2019). Developing an Early-Warning System for Spotting At-Risk Students by using eBook Interaction Logs. *Smart Learning Environments, 6*(4), 1-15. doi:doi.org/10.1186/s40561-019-0083-4

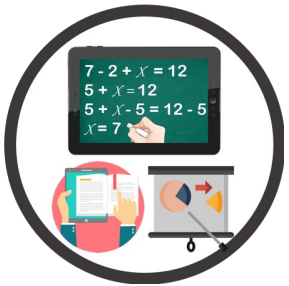
BOLL system – BlockChain for education

1. Connect educational data of learners across different systems.
   - Decentralized, identity management, transfer, trace, anonymize, secure and verify records.
2. Enable access to learning resources and usage information across different systems.
   - Access, transfer, and share learning materials with usage visualization.
3. Evaluate the usefulness and impact of connected lifelong learning on teaching in different systems.
   - How students and teachers improve learning and teaching respectively using knowledge of lifelong learning.

Certificates

Scores & Grades

Group Activities



Interactive usage

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Connect learning logs across different systems

- Manage different user ID’s.
- Link the data in different systems to the same user.
- Ensure secure communication between these systems.
- Enable interpretability of connected data.

Verification and tamper-proof

- Enable verification of learning logs.
- Prevent falsification of certificates and learning logs.
- Ensure secure access to learning logs.

Access management and availability

- Provide a secure access to learning logs.
- Enable access grant and revocation at any time.
- Ensure learning logs and associated permissions are always available.

Analytics and research

- Enable tracking of access to learning logs and usage of learning resources.
- Anonymize data for research across different systems.

Decentralized

Transferability

Traceability

High security

Verification

Full access control

P2P access

Fault-tolerant

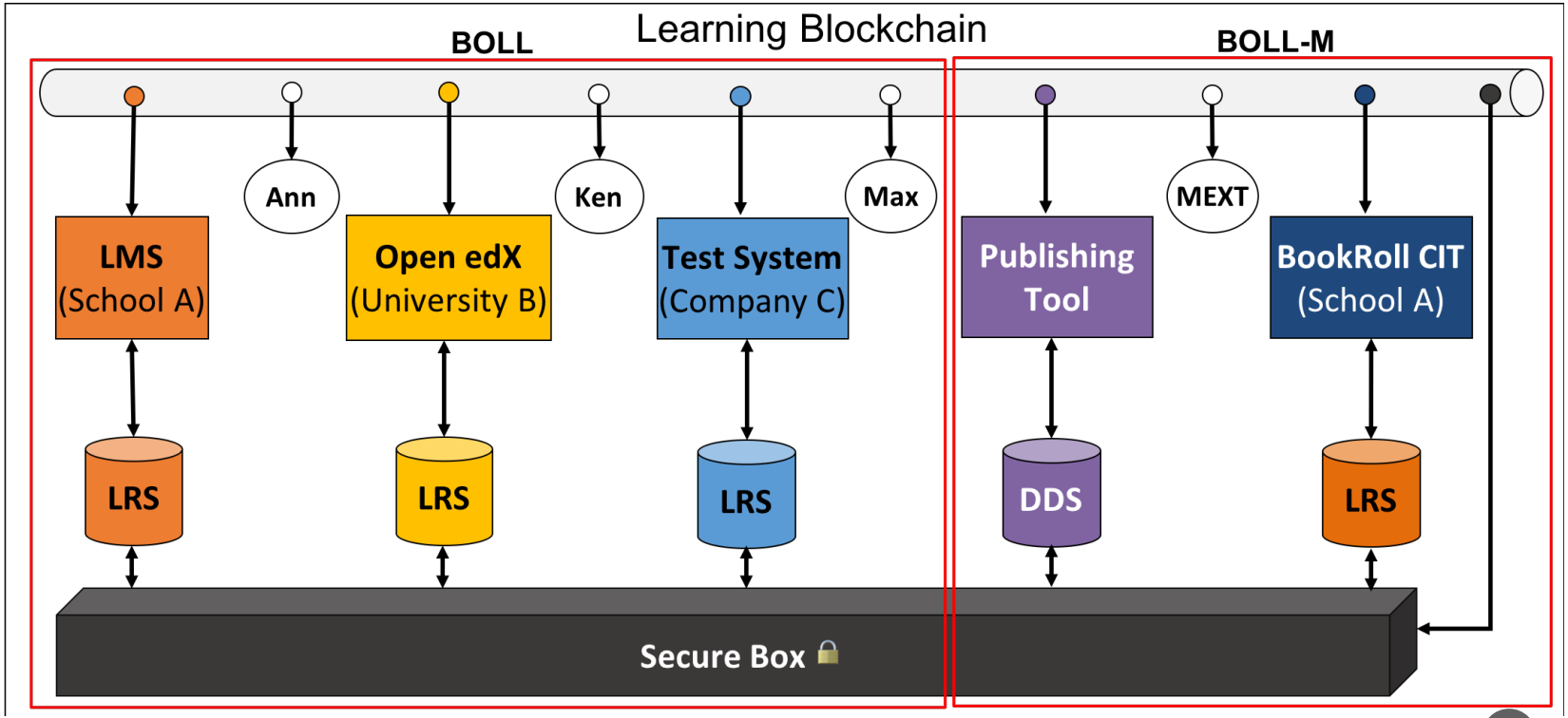
Anonymize

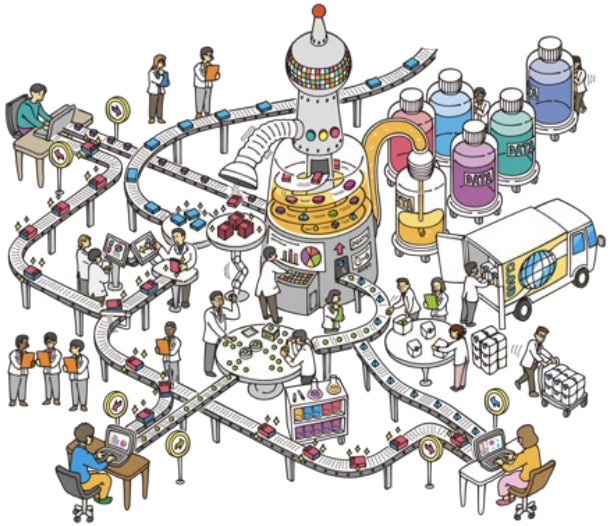
Our Originality

Aspect	Blockcerts	EduCTX	QualiChain	IMS CLR	Proposed System
Share certificates or credits without alteration	O	O	O	O	O
Verification of academic credentials	X	O	O	O	O
Connect lifelong learning log across different systems	X	X	X	△	O
Access learning resources in different systems	X	X	X	X	O
Anonymized lifelong learning logs for research	X	X	X	X	O

Patrick Ocheja, Brendan Flanagan, Hiroshi Ueda, Hiroaki Ogata, Managing Lifelong Learning Records Through Blockchain, Research and Practice in Technology Enhanced Learning, 2019.

Proposed Solution to Problem #1 + #2 + #3





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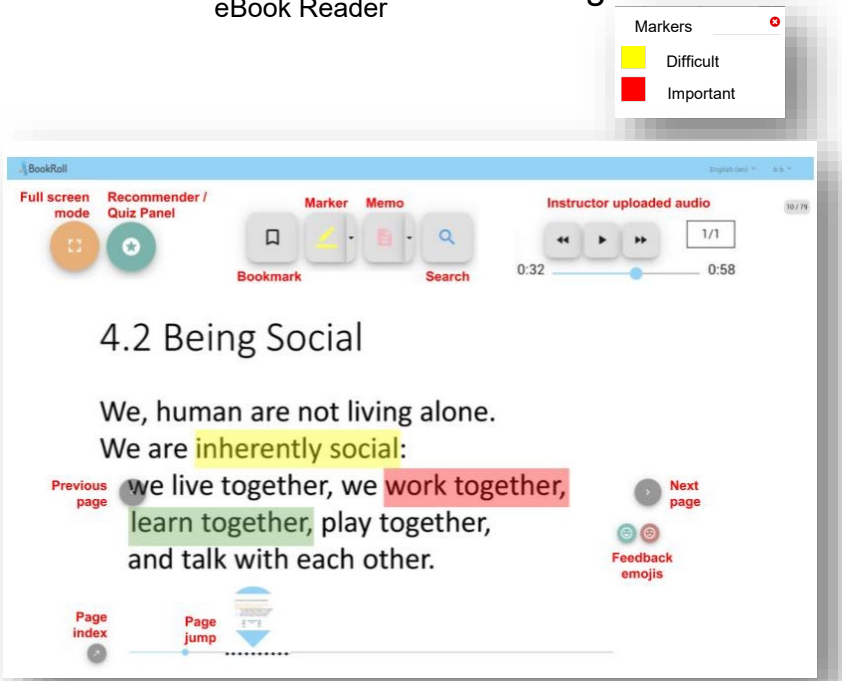

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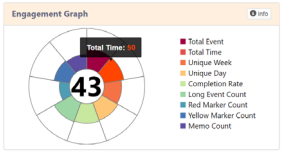

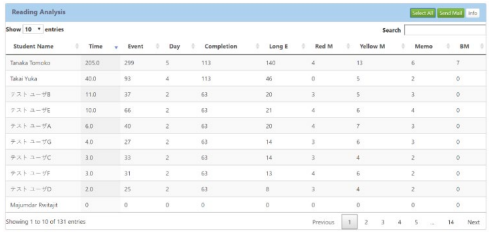

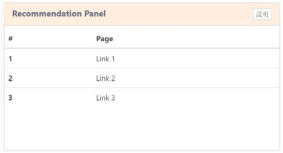

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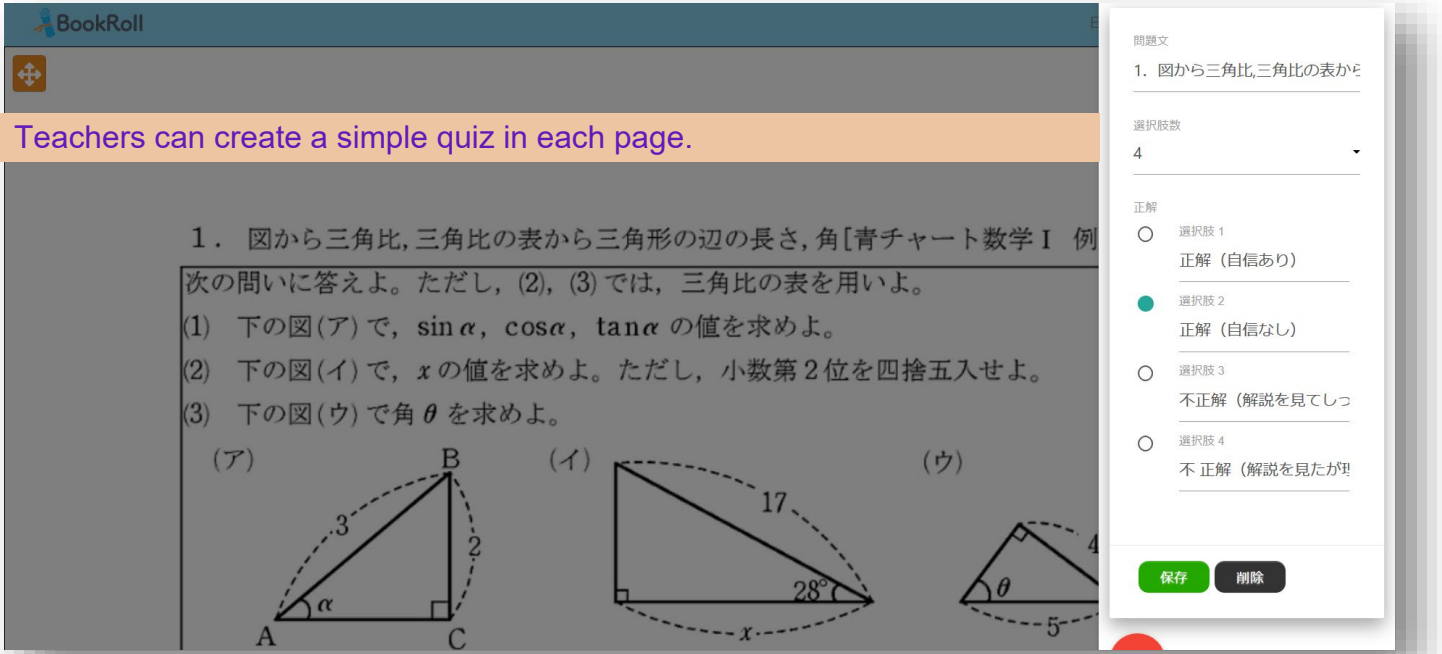
Page-wise annotations and reading behaviors

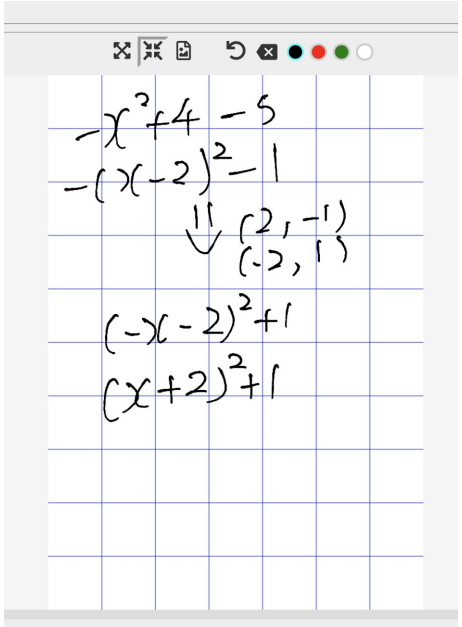
How is BookRoll used in classroom?

- **Learning Maths**
  - Finding stuck points from handwritten answer during problem solving
  - Recommend quizzes from knowledge model
- Language learning (English)
  - Apply active reading strategies with e-book affordances
- Group learning activities
- Supporting self-directed learning
- Extracting evidences through the data and share them

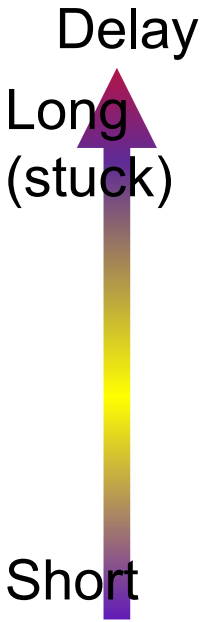
Quiz in BookRoll



Stuck point analysis of hand written answers



Final static answer

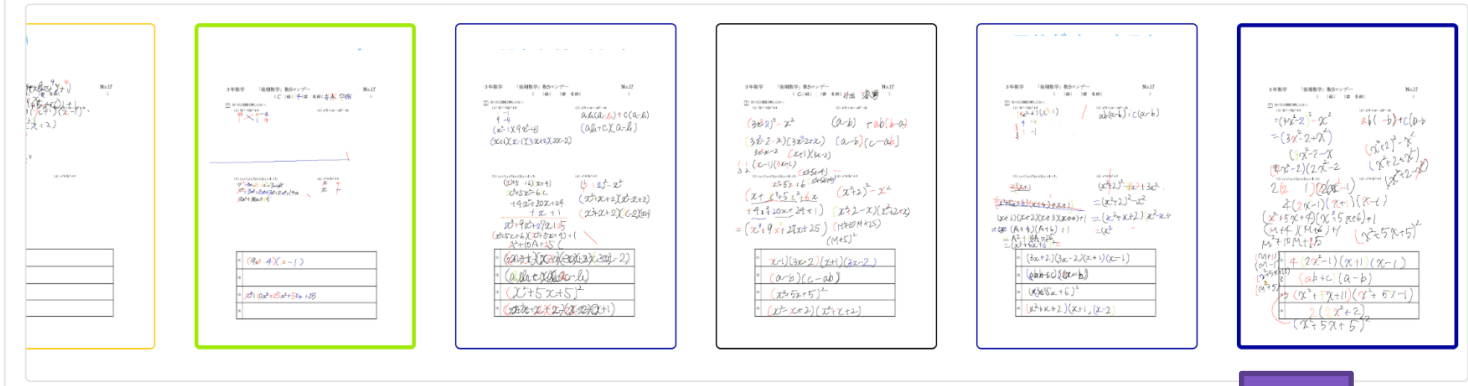


Visualize answering process

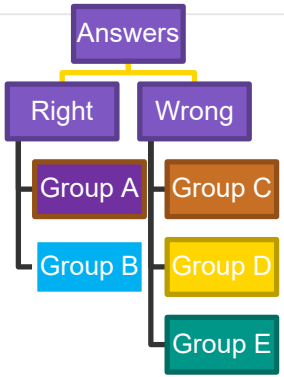
Daichi Yoshitake, Brendan Flanagan, Hiroaki Ogata, Educational Support Using Pen Stroke Data Analytics, 第30回教育学習支援情報システム(CLE)研究発表会, 神戸大学, 2020.3.8-10.

Clustering of stuck points from answers

Group C　　Group D　　Group E

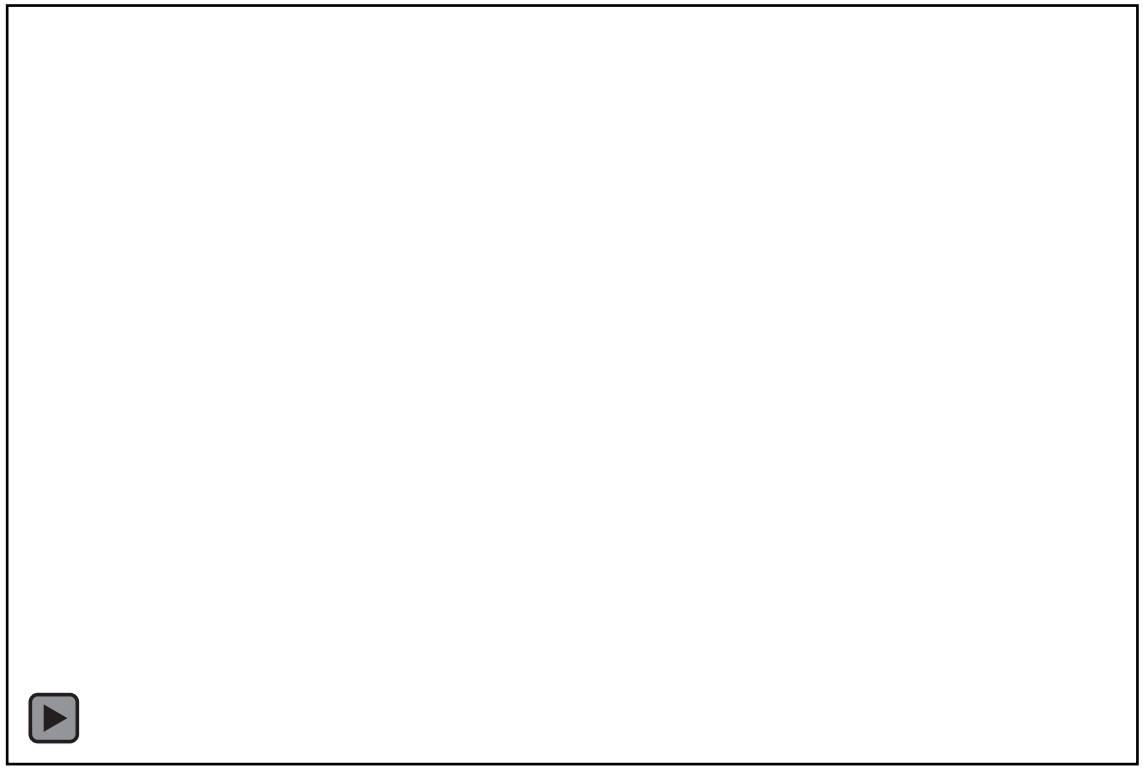


Show the representative of answers in each category.



Daichi Yoshitake, Brendan Flanagan and Hiroaki Ogata, Supporting Group Learning Using Pen Stroke Data Analytics, 28th International Conference on Computers in Education (ICCE2020), Vol.1, pp.634-639, 2020.11.23. (KURENAI, PDF)

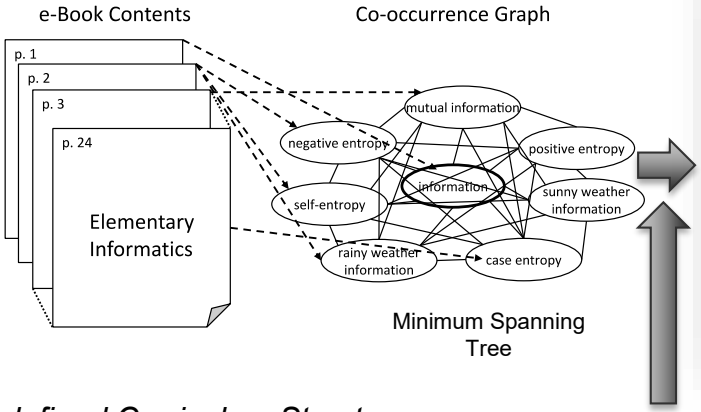
Self explain Video

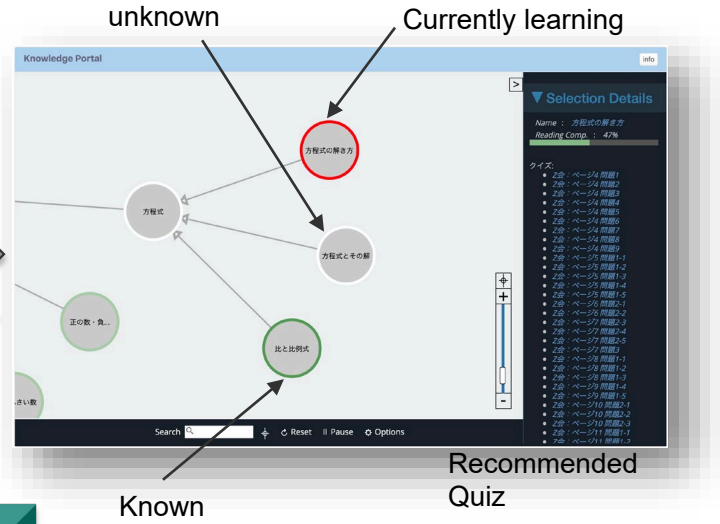


Daichi Yoshitake, Brendan Flanagan and Hiroaki Ogata, Supporting Group Learning Using Pen Stroke Data Analytics, 28th International Conference on Computers in Education (ICCE2020), Vol.1, pp.634-639, 2020.11.23. (KURENAI, PDF)

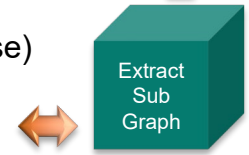
Knowledge and student model for recommendation of text and quiz

It is important to know what knowledge students should know and what knowledge students have already known or not.





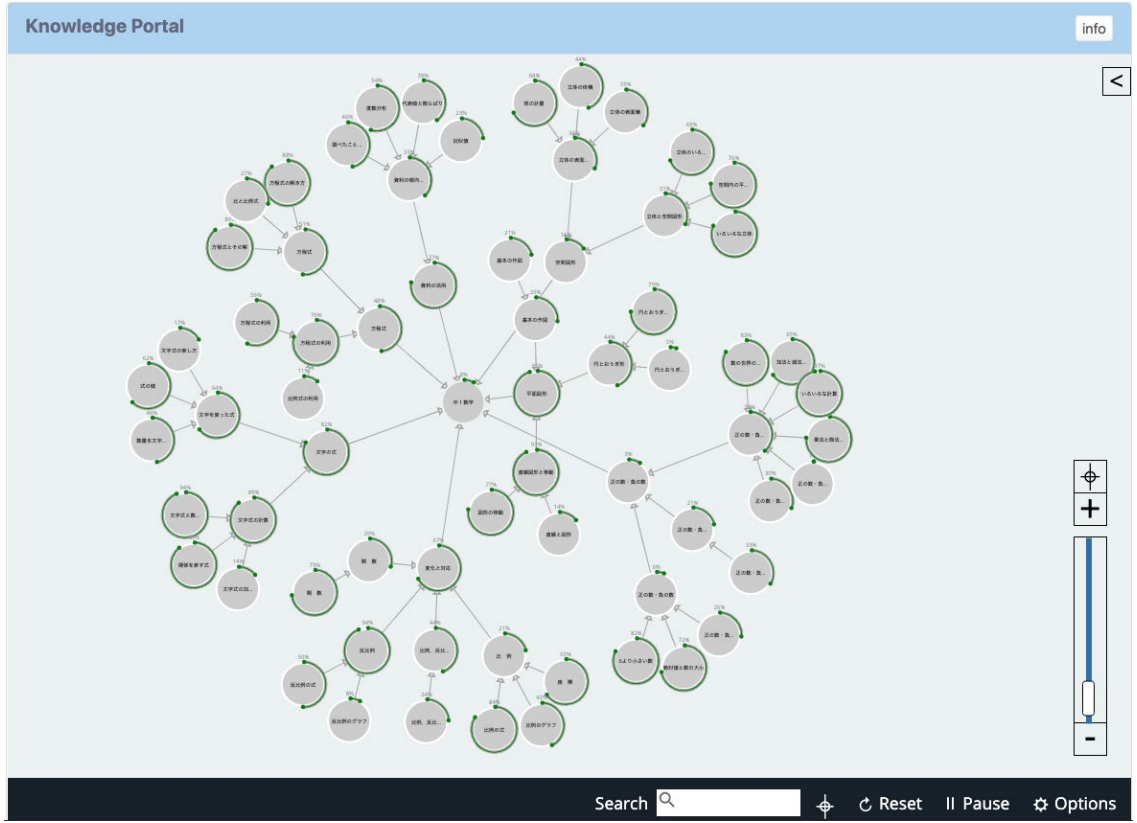
- *Predefined Curriculum Structure*
- JST Thesauruses (English & Japanese)
- Microsoft Academic Graph
- Google Knowledge Graph
- etc…



We have a common national curriculum in Japan.

[Flanagan, Ogata, ICCE 2018]

Student’s comprehension level in Math course

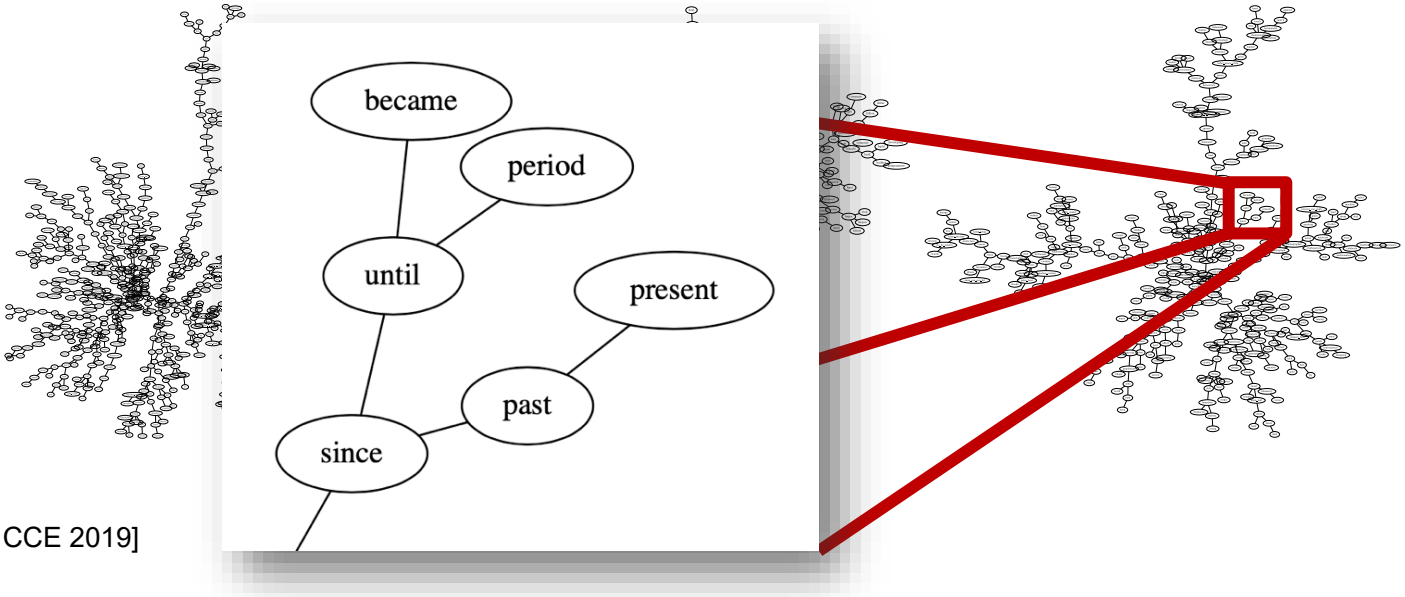


Student's knowledge model in JH 1-3 English courses

New Horizon 1

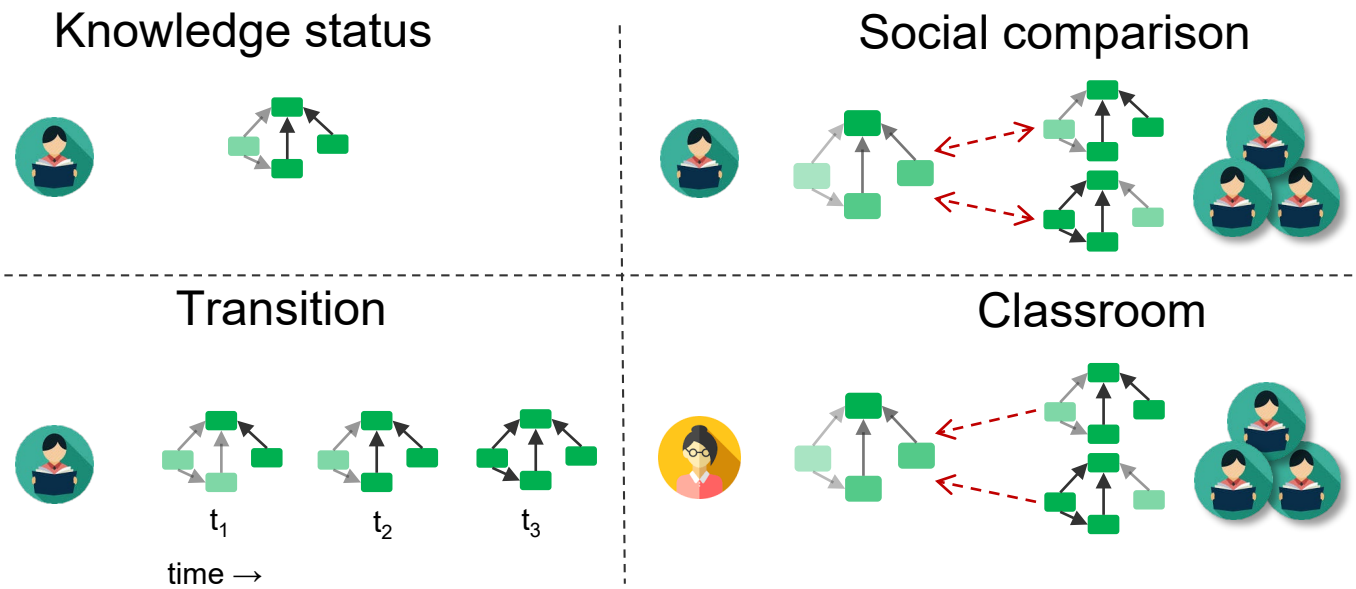
New Horizon 2

New Horizon 3



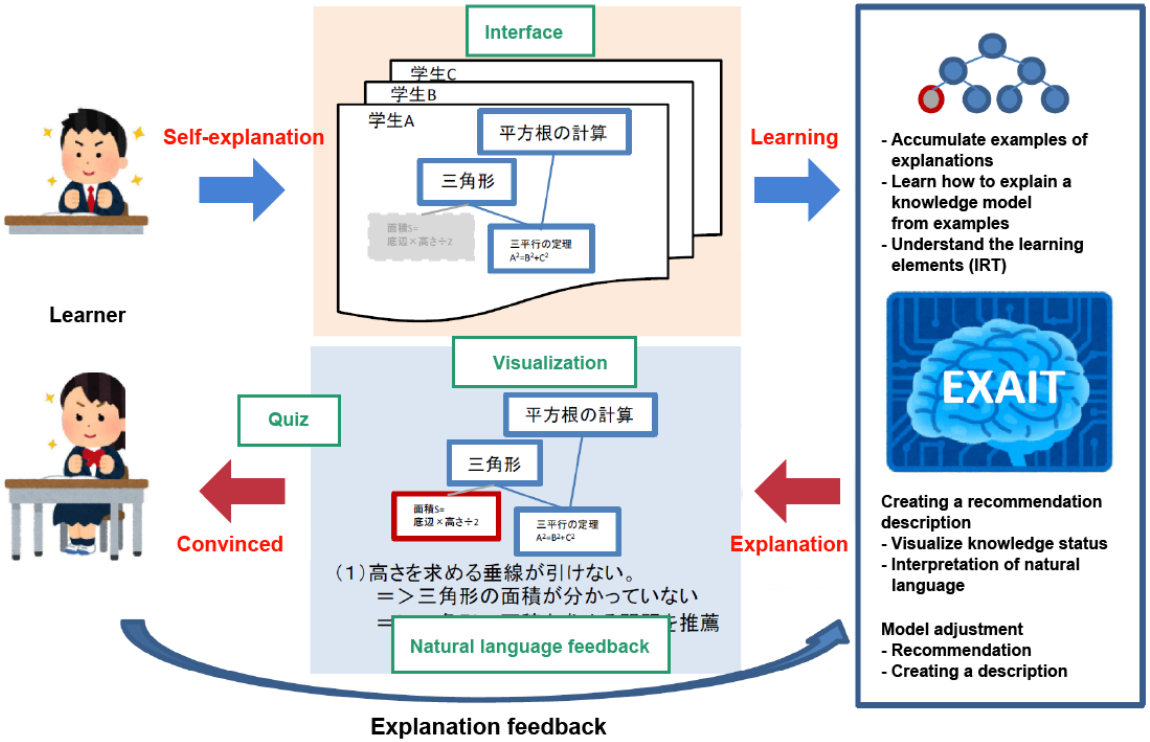
[Flanagan, et al., ICCE 2019]

Use of knowledge and student model



Students don't know what they know or not.
Also, teachers don't know what students know or not.

Explanation of recommendation



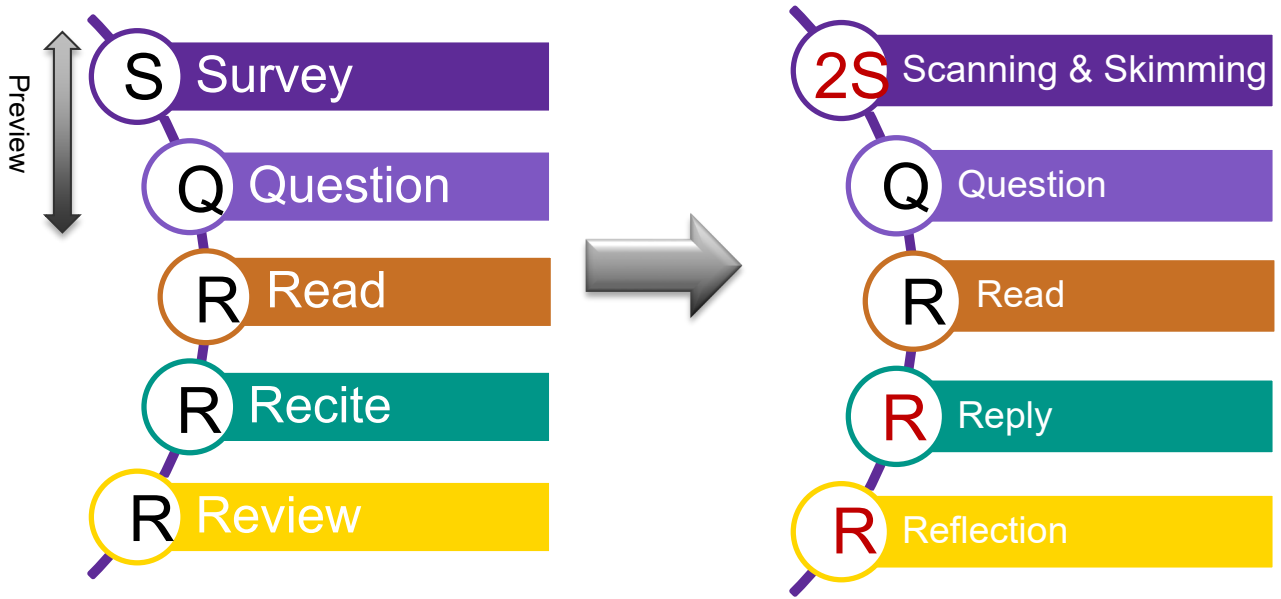
How is BookRoll used in classroom?

- Learning Maths
  - Finding stuck points from handwritten answer during problem solving
  - Recommend quizzes from knowledge model
- **Language learning (English)**
  - Apply active reading strategies with e-book affordances
- Group learning activities
- Supporting self-directed learning

Active reading strategy for e-Book

SQ3R active reading strategy for paper-book [Robinson, 1946]

2SQ3R active reading strategy for e-book [Chen&Ogata, ICCE2019]

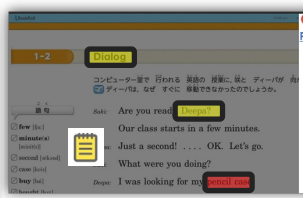


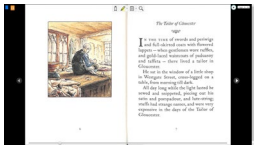
- Mei-Rong Alice CHEN, Hiroaki OGATA, Gwo-Jen HWANG, Gökhan AKÇAPINAR, Brendan FLANAGAN, Yi-hsuan LIN & Hsiao-Ling HSU, Impacts of a knowledge sharing-based e-book system on students' language learning performance and behaviors, 27th International Conference on Computers in Education, Taiwan: Asia-Pacific Society for Computers in Education (ICCE2019), pp.320-325, Kenting, Taiwan, 2019.12.2-6. (PDF)

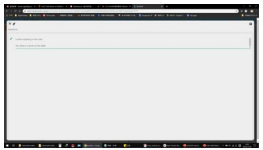
2SQ3R strategy with BookRoll

Scan	Red	look over for important topics such as name, date, and place, and highlight the keywords.
Skim	Yellow	browse through, get an overview, and mark the keywords if don't understand.
Question	memo	raise questions, and bring attention to the main ideas and questions: who, what, where, when, why, or how.
Read	BookRoll	read the contents and find the answer
Reply	memo	answer to the questions
Reflection	memo	think deeply and carefully about the reading, and learn from the topics and the thoughts on the subject.

2SQ3R in English course in High School



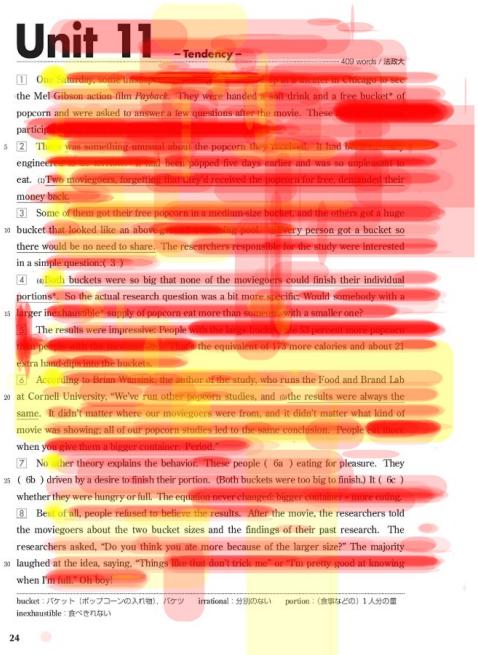




- Mei-Rong Alice Chen, Rwitajit Majumdar, Gwo-Jen Hwang, Yihsuan Diana Lin, Hiroaki Ogata, Gökhan Akcapçnar and Brendan Flanagan, Improving EFL students' learning achievements and behaviors using a learning analytics-based e-book system, 28th International Conference on Computers in Education (ICCE2020), Vol.1, pp.474-483, 2020.11.23.

Markers in Scan + Skim process

October 11



Unit 11 – Tendency –

409 words / 法政大

[1] On a Saturday, some friends and I went to a theater in Chicago to see the Mel Gibson action film *Payback*. They were handed a soft drink and a free bucket* of popcorn and were asked to answer a few questions after the movie. These participi

[2] There was something unusual about the popcorn they received. It had been engineered [illegible] and been popped five days earlier and was so unpleasant to eat. (a)Two moviegoers, forgetting that they'd received the popcorn for free, demanded their money back.

[3] Some of them got their free popcorn in a medium-size bucket, and the others got a huge bucket that looked like an above-[illegible]ing pool. Every person got a bucket so there would be no need to share. The researchers responsible for the study were interested in a simple question:(3)

[4] (b)Both buckets were so big that none of the moviegoers could finish their individual portions*. So the actual research question was a bit more specific: Would somebody with a larger inexhaustible* supply of popcorn eat more than someone with a smaller one?

[5] The results were impressive: People with the large bucket ate 53 percent more popcorn than people with the medium bucket—the equivalent of 173 more calories and about 21 extra hand-flips into the bucket.

[6] According to Brian Wansink, the author of the study, who runs the Food and Brand Lab at Cornell University, "We've run other popcorn studies, and the results were always the same. It didn't matter where our moviegoers were from, and it didn't matter what kind of movie was showing; all of our popcorn studies led to the same conclusion. People eat more when you give them a bigger container. Period."

[7] No other theory explains the behavior. These people (6a) eating for pleasure. They (6b) driven by a desire to finish their portion. (Both buckets were too big to finish.) It (6c) whether they were hungry or full. The equation never changed: bigger container = more eating.

[8] Best of all, people refused to believe the results. After the movie, the researchers told the moviegoers about the two bucket sizes and the findings of their past research. The researchers asked, "Do you think you ate more because of the larger size?" The majority laughed at the idea, saying, "Things like that don't trick me" or "I'm pretty good at knowing when I'm full." Oh boy!

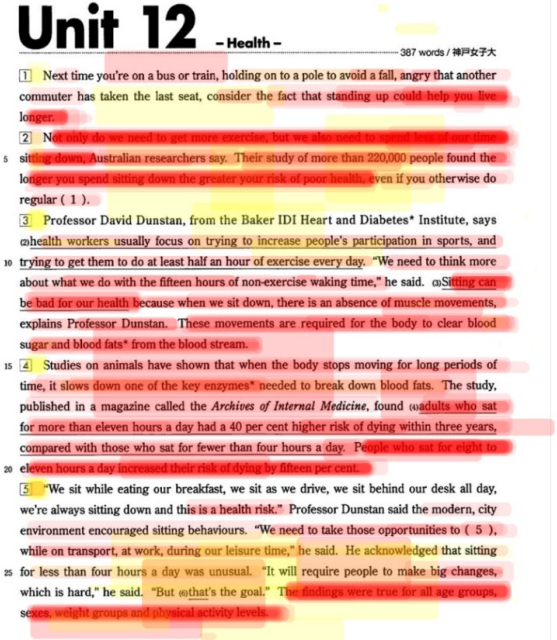
bucket：バケット（ポップコーンの入れ物）, バケツ　irrational：分別のない　portion：（食事などの）1人分の量
inexhaustible：食べきれない

24

+2 weeks

Important keywords became overlapped.

October 25



Unit 12 – Health –

387 words / 神戸女子大

[1] Next time you're on a bus or train, holding on to a pole to avoid a fall, angry that another commuter has taken the last seat, consider the fact that standing up could help you live longer.

[2] Not only do we need to get more exercise, but we also need to spend less of our time sitting down, Australian researchers say. Their study of more than 220,000 people found the longer you spend sitting down the greater your risk of poor health, even if you otherwise do regular (1).

[3] Professor David Dunstan, from the Baker IDI Heart and Diabetes* Institute, says (a)health workers usually focus on trying to increase people's participation in sports, and trying to get them to do at least half an hour of exercise every day. "We need to think more about what we do with the fifteen hours of non-exercise waking time," he said. (b)Sitting can be bad for our health because when we sit down, there is an absence of muscle movements, explains Professor Dunstan. These movements are required for the body to clear blood sugar and blood fats* from the blood stream.

[4] Studies on animals have shown that when the body stops moving for long periods of time, it slows down one of the key enzymes* needed to break down blood fats. The study, published in a magazine called the *Archives of Internal Medicine*, found (a)adults who sat for more than eleven hours a day had a 40 per cent higher risk of dying within three years, compared with those who sat for fewer than four hours a day. People who sat for eight to eleven hours a day increased their risk of dying by fifteen per cent.

[5] "We sit while eating our breakfast, we sit as we drive, we sit behind our desk all day, we're always sitting down and this is a health risk." Professor Dunstan said the modern, city environment encouraged sitting behaviours. "We need to take those opportunities to (5), while on transport, at work, during our leisure time," he said. He acknowledged that sitting for less than four hours a day was unusual. "It will require people to make big changes, which is hard," he said. "But (a)that's the goal." The findings were true for all age groups, sexes, weight groups and physical activity levels.

More markers

Questions from students

October 11	October 25 (+2 weeks)
What does it mean?	What are the findings?
What does it mean?	Who found the study?
何も知らない映画ファン	Who has the highest risk of dying?
who	What is the findings?
who	What study is the reason for this?
	How many hours does sitting down affect our health?
	What does this mean?
	What for example?
	What is ;:::dbquotation:::;big change;:::dbquotation:::;?
	Why does this happen?
	Why standing could help you live longer?
	What do we have to live longer?
	What is able to be bad for our health?
	What is caused increasing our health of dying?

increased the number & quality of questions

2SQ3Rの効果

ARSを活発に行った学生は、成績が高かった

Table 2. *ANOVA result of the learning achievement of the three levels of engagement*

Learning achievement	N	M	S.D.	*F*	Post hoc tests
High-engagement (a)	10	90.70	2.50	39.58**	a > b
Moderate-engagement (b)	20	75.95	8.91		b > c
Low-engagement (c)	10	65.10	6.88		a > c

Note. *p<.001

Chen, A. et al., Improving EFL students' learning achievements and behaviors using a learning analytics-based e-book s, ICCE 2020, pp.1: 474

How is BookRoll used in classroom?

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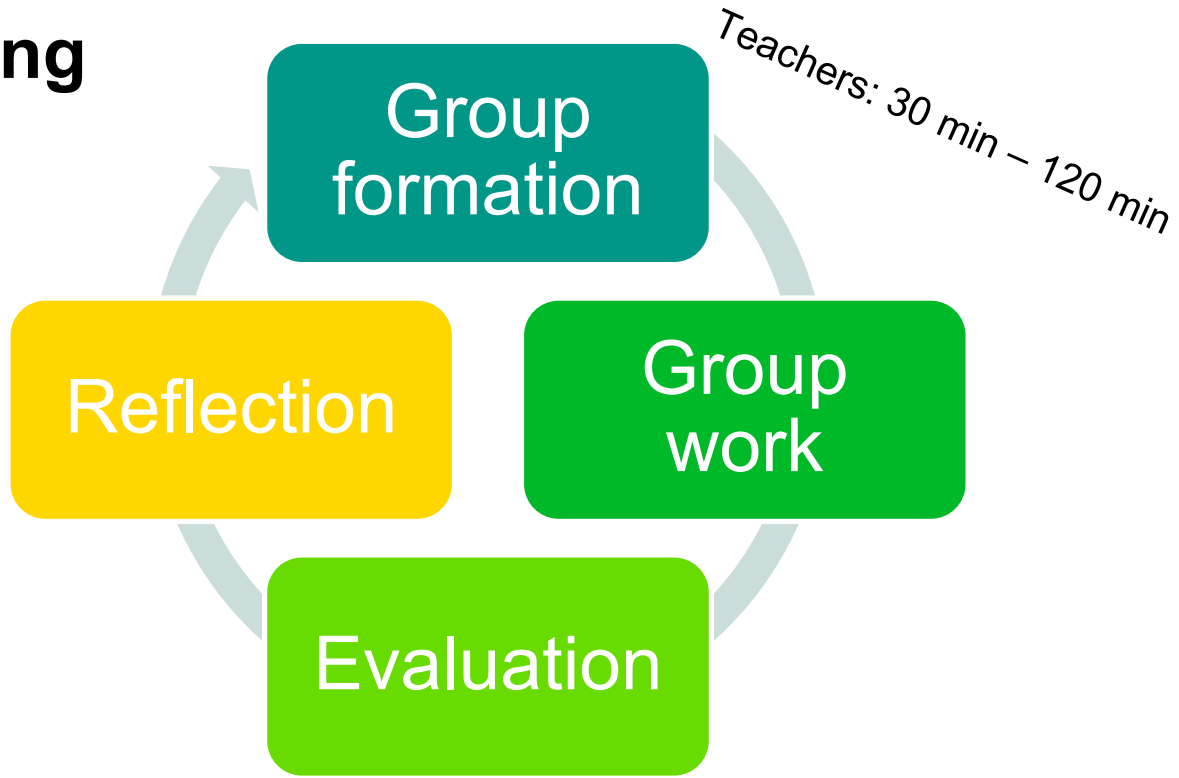
- Supporting self-directed learning

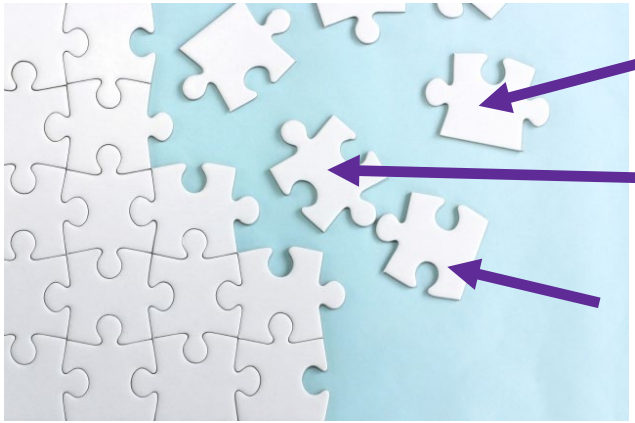
Group learning in class



Group formation

Create the best group according to

1. Learner’s current user model
2. Learner's engagement level of e-book
3. Learner’s performance
4. Friendship among students

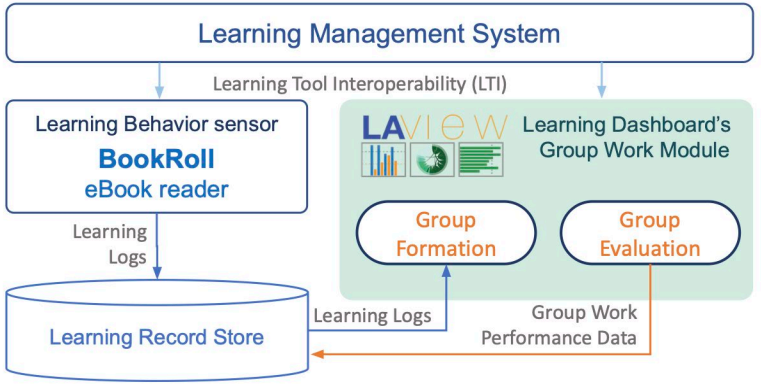


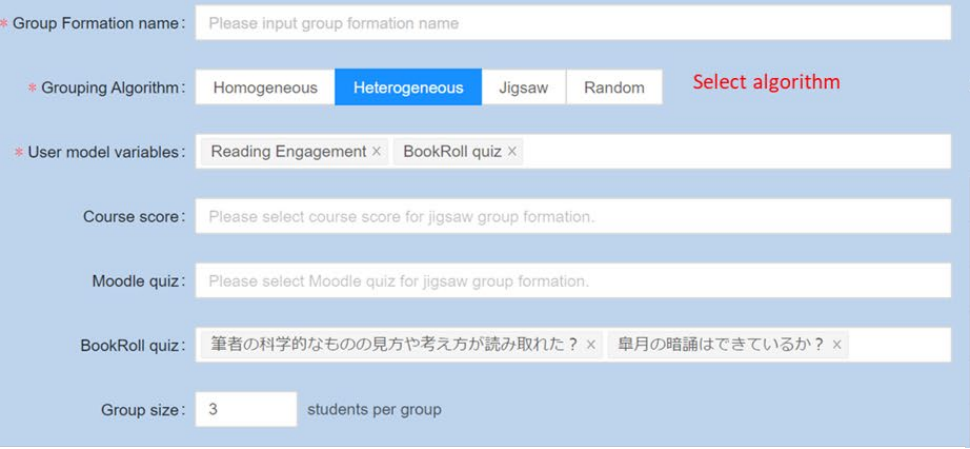
1. Has knowledge C
2. Active
3. Standard performance

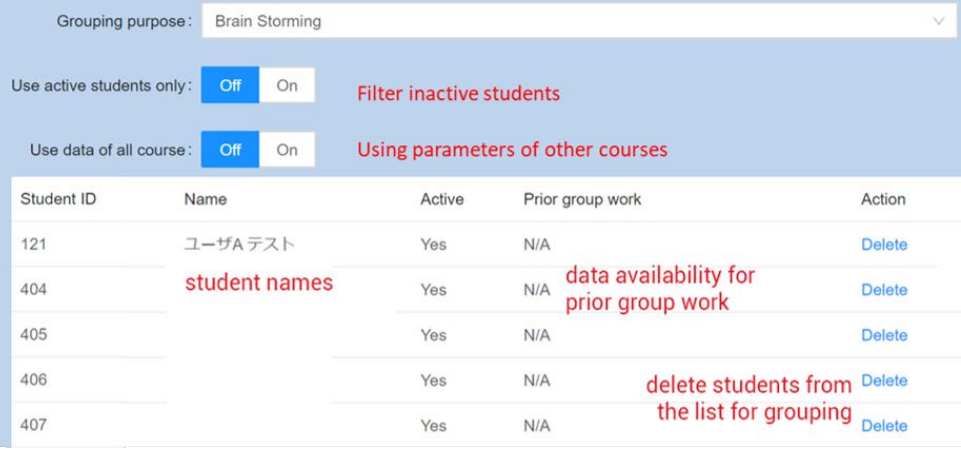
1. Has knowledge A
2. Not active
3. Low performance

1. Has knowledge B
2. Very active
3. High performance

Group formation utilizing learning logs

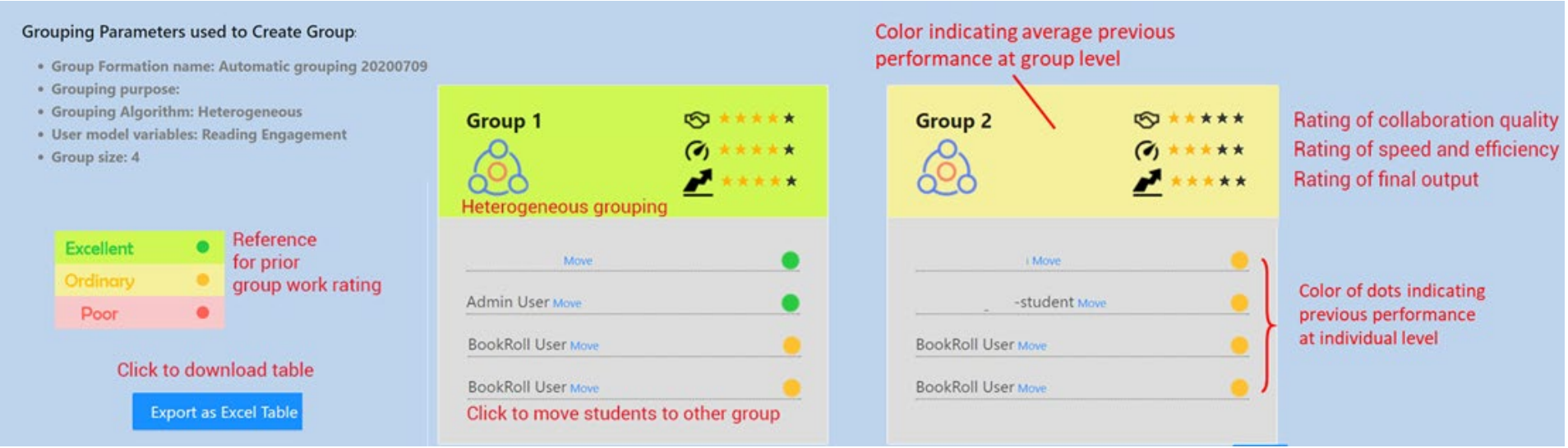






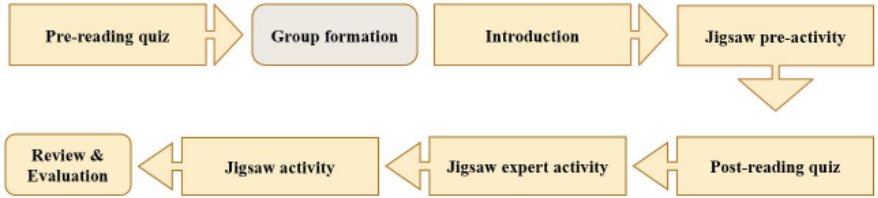
Liang C., Majumdar R., & Ogata H. (2021) Learning Log-based Automatic Group Formation: System Design and Classroom Implementation Study, Research and Practice in Technology Enhanced Learning. (in press)

Resulted groups formed by system and group work evaluation interface

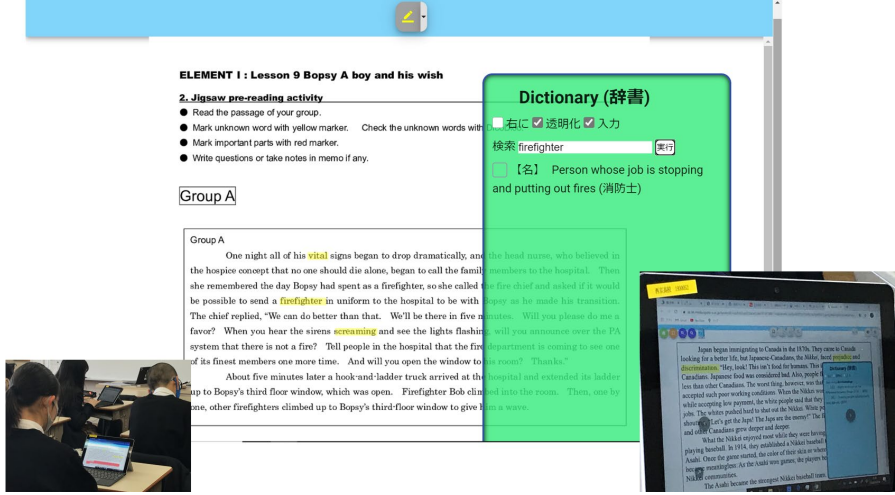


Changhao Liang, Ivica Botički & Hiroaki Ogata, Supporting Teachers in Group Work Formation and Analytics for In-class Group Activities, 27th International Conference on Computers in Education, Taiwan: Asia-Pacific Society for Computers in Education (ICCE2019), pp.744-749, Kenting, Taiwan, 2019.12.2-6

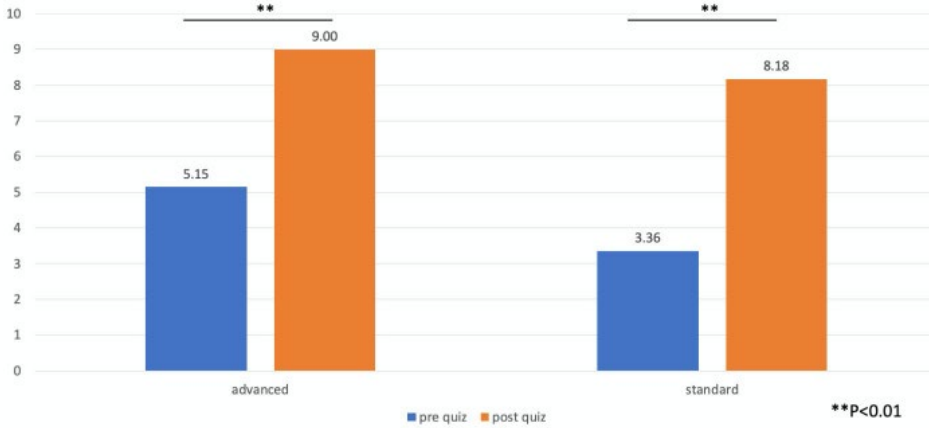
In class jigsaw activity



Jigsaw+ Phase	Platform	SQ4R task
1. Content prediction	BookRoll using memo	Survey / (Question)
2. Jigsaw pre-activity	BookRoll using markers, DicoDico and memo	Read/Record
3. Jigsaw expert activity	BookRoll using memo	Read/Recite/Record
4. Jigsaw activity	BookRoll using memo	Read/Recite/Review
5. Review and Evaluation	In class listening activity	Review



Based on their previous academic records 62 participants were divided in two levels for their English class: standard (n=26) and advanced (n=36).



Yuko Toyokawa, Rwitajit Majumdar, Hiroaki Ogata, Louis Lecailliez, Liang Changhao (2021) Technology Enhanced Jigsaw Activity Design for Active Reading in English, in ICALT 2021

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- **Supporting self-directed learning**

supERpowER

read more, read fast & understand better with GOAL oriented

Extensive Reading!

ER + GOAL

Easy to practice + Easy to monitor = Easy to Aquire!

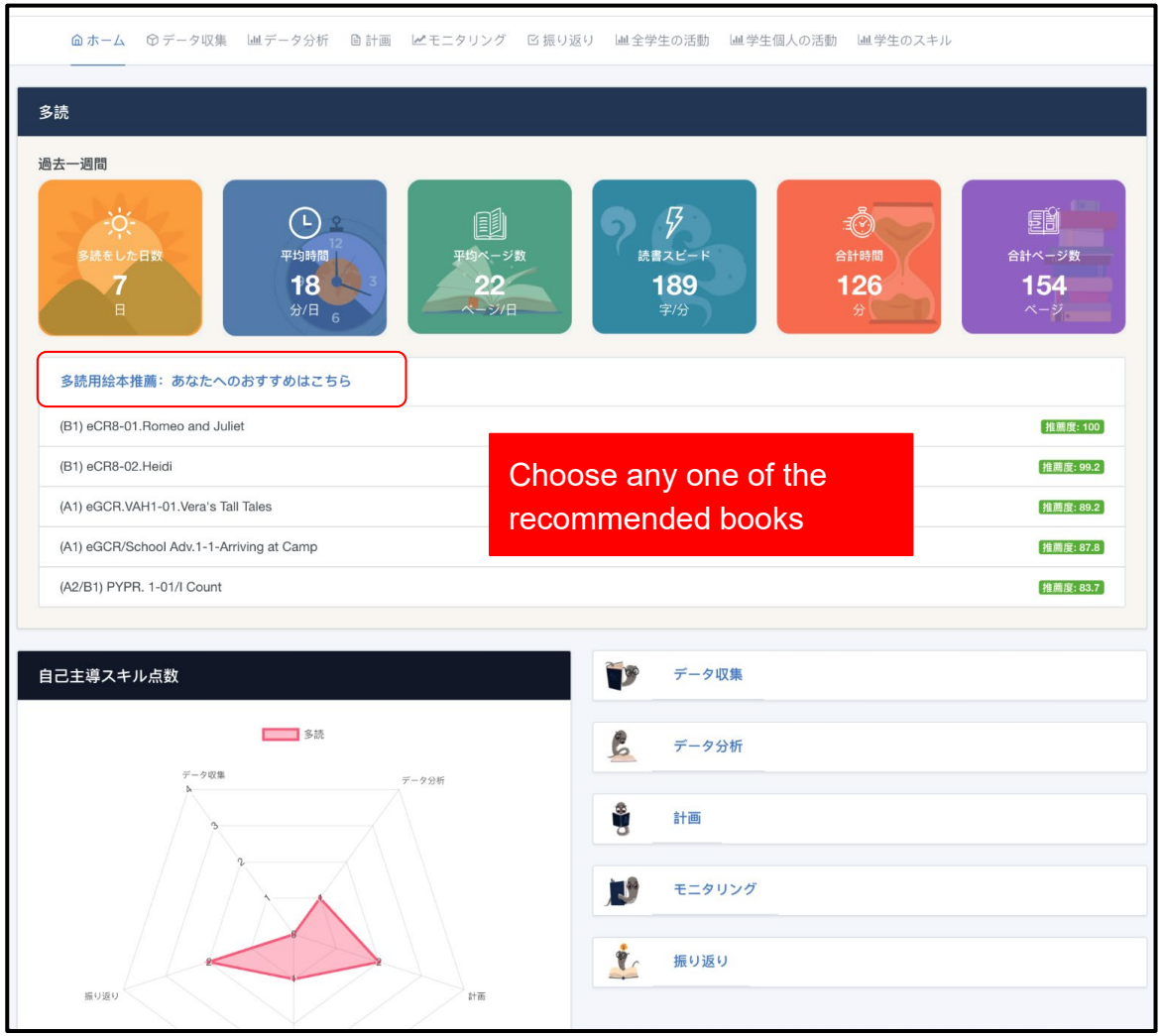
Students have more than 500 books to choose from in BookRoll!

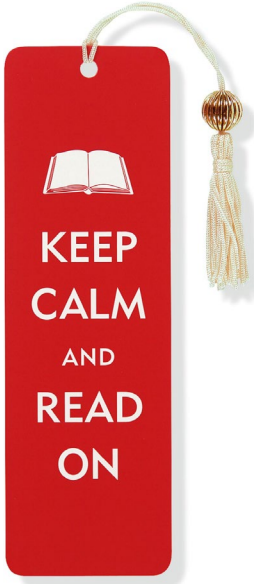
Extensive Reading (ER) is to have fun while choosing and reading many stories while practicing English by your own!

To make it easier to choose books a system recommends you to top 5 books that you can read next!

Open GOAL from Moodle

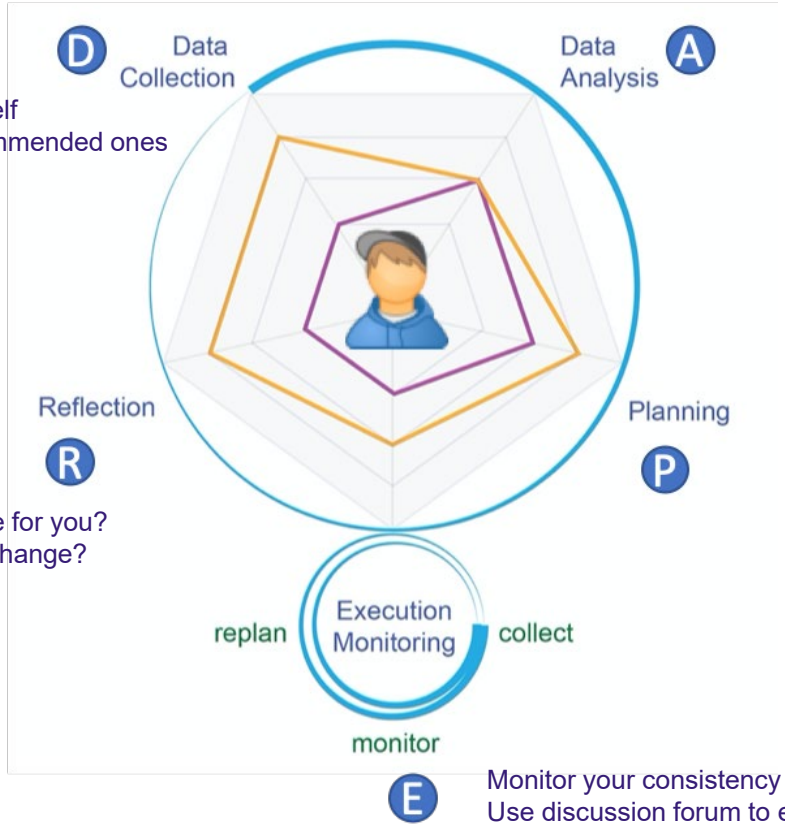
Check ER dashboard





DAPER A DATA INFORMED SELF-DIRECTED ACTIVITY CYCLE

Select book by yourself
Or choose from recommended ones



Check and note your status to decide what to target next.

Set a plan every week.
Take small steps to track improvement.

Was the cycle effective for you?
Write how would you change?

Monitor your consistency while executing a plan
Use discussion forum to engage with friends

Extensive reading of picture books

Extensive Reading

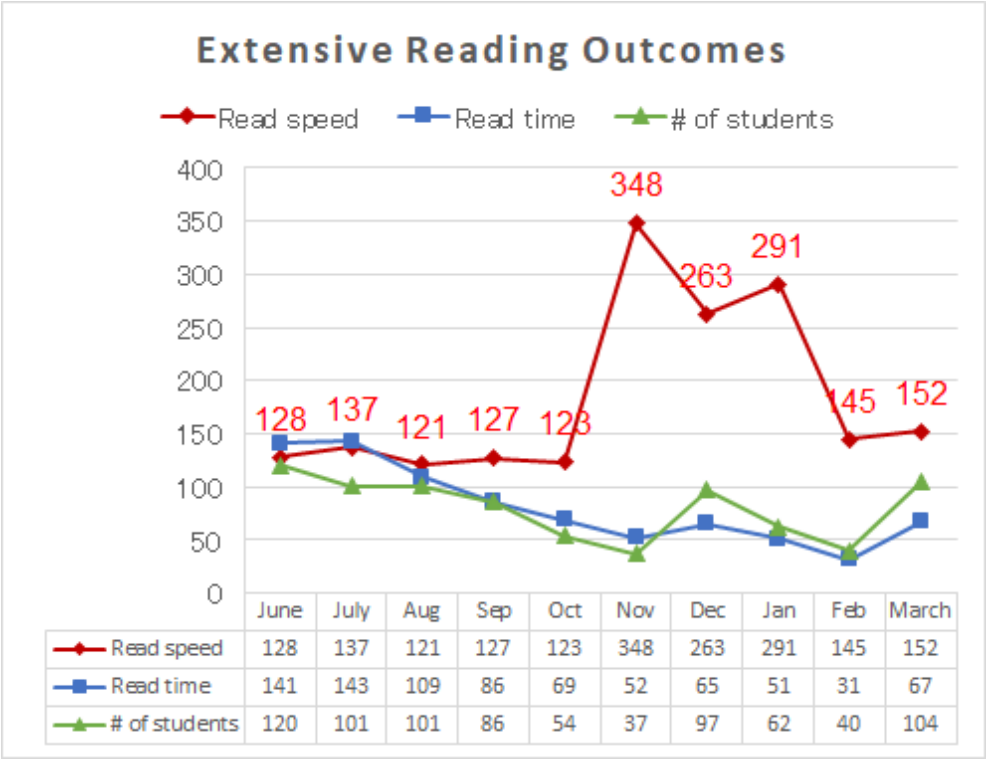
Duration: June 2020 - March 2021
Participants: 120 seven-graders

Total time read: 10.1 hours per student

Total books read: 38 books per student

Total words read: 60,730 per student

Read speed：118 wpm per student
128 wpm ➔ 152 wpm
(18.75% UP)

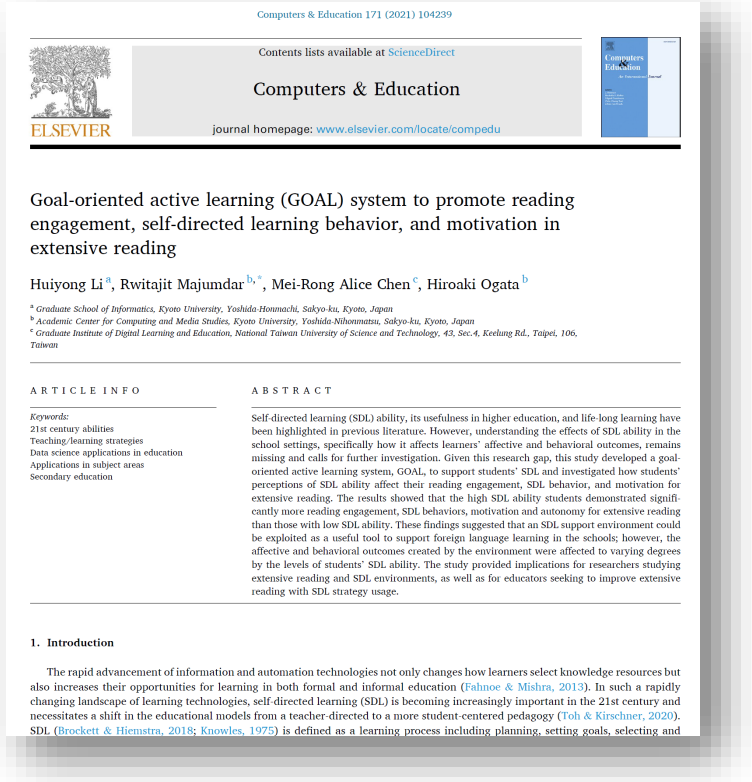


	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
Read speed	128	137	121	127	123	348	263	291	145	152
Read time	141	143	109	86	69	52	65	51	31	67
# of students	120	101	101	86	54	37	97	62	40	104

GOAL study 1

GOAL study 2

Li H., Majumdar R., Chen M.R.A. and Ogata H, Goal-Oriented Active Learning (GOAL) System to Promote Reading Engagement, Self-Directed Learning Behavior, and Motivation in Extensive Reading, Computers and Education (impact factor 5.296), 2021.5.(in press)



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journal homepage: www.elsevier.com/locate/compedu

Goal-oriented active learning (GOAL) system to promote reading engagement, self-directed learning behavior, and motivation in extensive reading

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ABSTRACT

Self-directed learning (SDL) ability, its usefulness in higher education, and life-long learning have been highlighted in previous literature. However, understanding the effects of SDL ability in the school settings, specifically how it affects learners' affective and behavioral outcomes, remains missing and calls for further investigation. Given this research gap, this study developed a goal-oriented active learning system, GOAL, to support students' SDL and investigated how students' perceptions of SDL ability affect their reading engagement, SDL behavior, and motivation for extensive reading. The results showed that the high SDL ability students demonstrated significantly more reading engagement, SDL behaviors, motivation and autonomy for extensive reading than those with low SDL ability. These findings suggested that an SDL support environment could be exploited as a useful tool to support foreign language learning in the schools; however, the affective and behavioral outcomes created by the environment were affected to varying degrees by the levels of students' SDL ability. The study provided implications for researchers studying extensive reading and SDL environments, as well as for educators seeking to improve extensive reading with SDL strategy usage.

1. Introduction

The rapid advancement of information and automation technologies not only changes how learners select knowledge resources but also increases their opportunities for learning in both formal and informal education (Fahnoe & Mishra, 2013). In such a rapidly changing landscape of learning technologies, self-directed learning (SDL) is becoming increasingly important in the 21st century and necessitates a shift in the educational models from a teacher-directed to a more student-centered pedagogy (Toh & Kirschner, 2020). SDL (Brockett & Hiemstra, 2018; Knowles, 1975) is defined as a learning process including planning, setting goals, selecting and

Collecting evidence

- Learning Maths
    - Finding stuck points from handwritten answer during problem solving
    - Recommend quizzes from knowledge model
- Language learning (English)
    - Apply active reading strategies with e-book affordances
- Group learning activities
- Supporting self-directed learning
- Collecting Evidence

Enabling an evidence based educational ecosystem

An evidence is a fact that is scientifically proved with data.

Possible evidence types

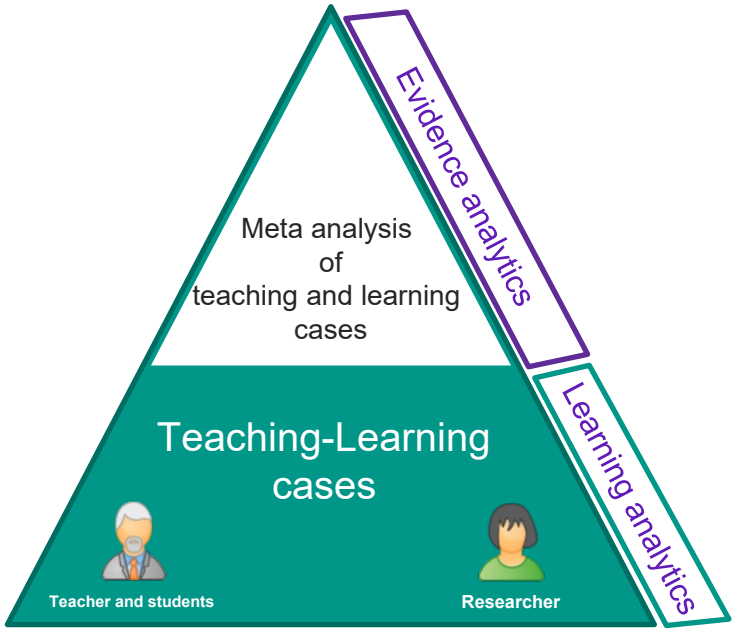
Micro (personal) level	• Results of the feedback for individual student.
Meso (course, institutional) level	• Results of changing a course design or a curriculum
Macro (regional, national) level	• Results of changing a regional /national education policy

Input of evidence data

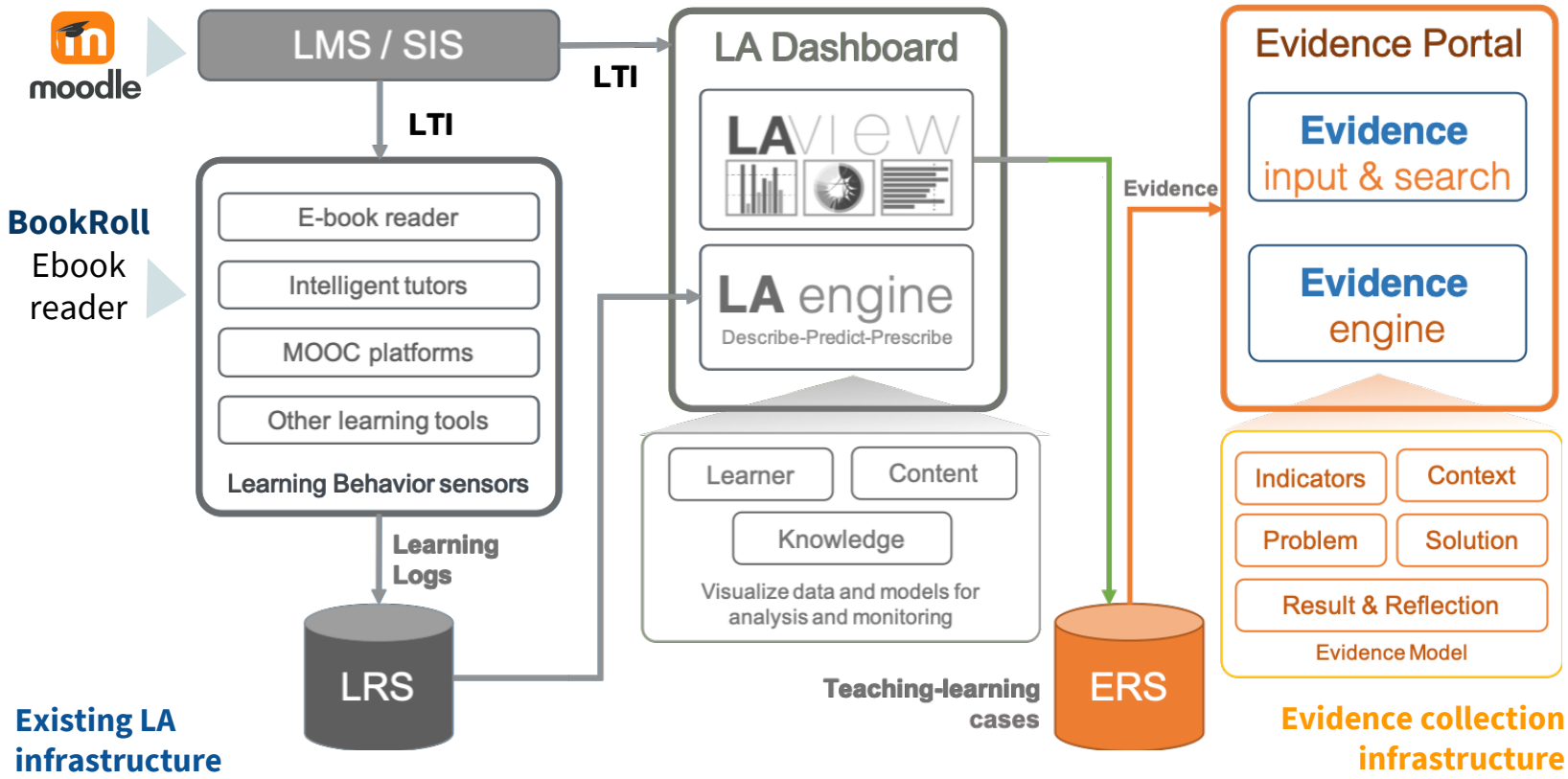
Manual → Automatic

	Source of data	Stakeholders
1	Teaching practice	Teachers
2	Learning practice	Students
3	Published research	Researchers

Researchers input evidences manually for Evidence-based Medicine.

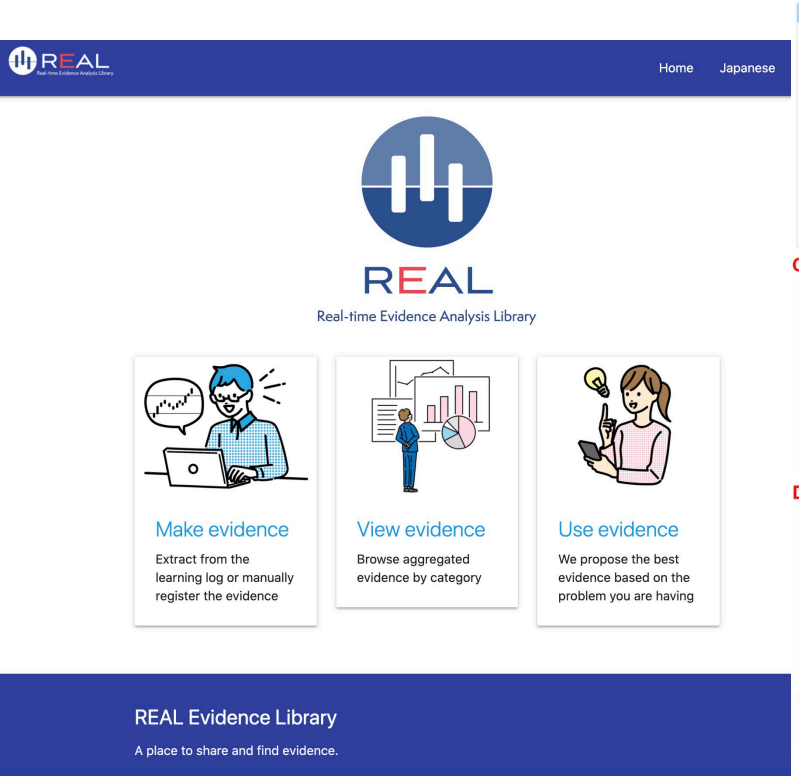


Learning Evidence Analytics framework



Kuromiya, H., Majumdar, R., & Ogata, H.(2020). Fostering Evidence-Based Education with Learning Analytics: Capturing Teaching-Learning Cases from Log Data. Educational Technology & Society, 23(4), 14–29.

Evidence extraction and search



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7 major uni, Hiroshima Uni, Kumamoto Uni, Open Uni and NII
50+ professors joined.

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in order to improve education.
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③Submit SSCI journal papers together

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You can publish Journal papers.

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+30 young professors in 25 different universities

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Chennai, India, 2018

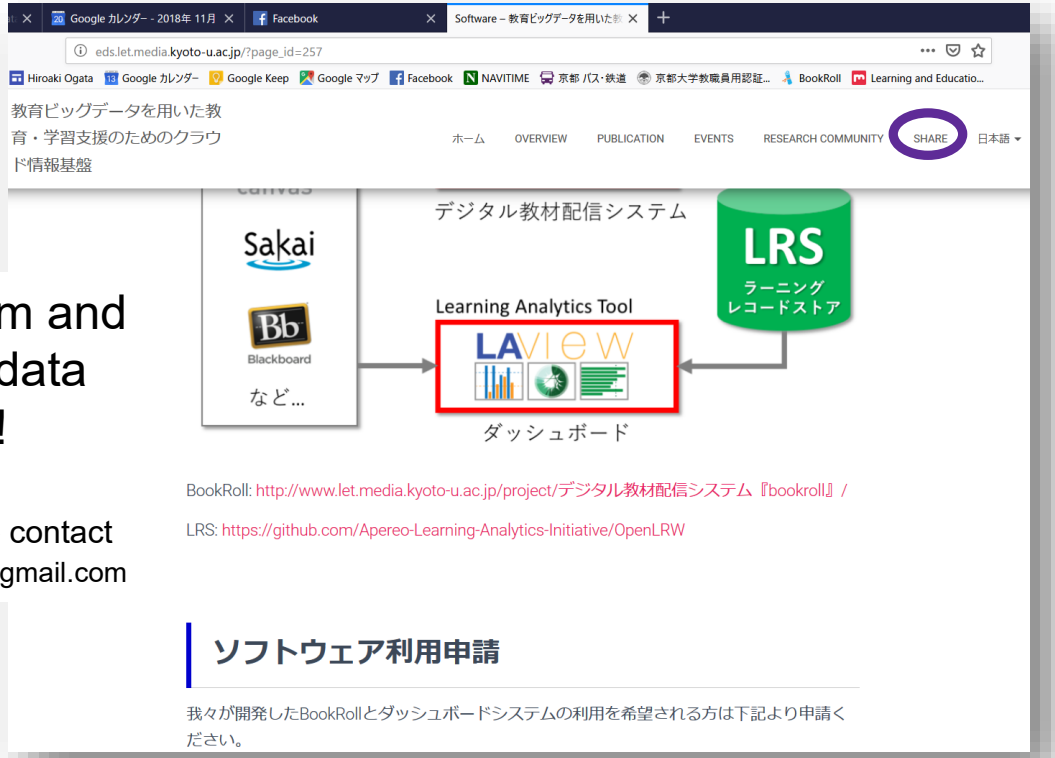
TEEL Workshop with **Researchers** **LAK 2019**

Arizona, USA, 2019

http://eds.let.media.kyoto-u.ac.jp

LEAF Platform and anonymized data are available!

If interested, please contact me at hiroaki.ogata@gmail.com



Thank you!

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