Measuring Student's Utilization of Video Resources and its effect on Academic Performance

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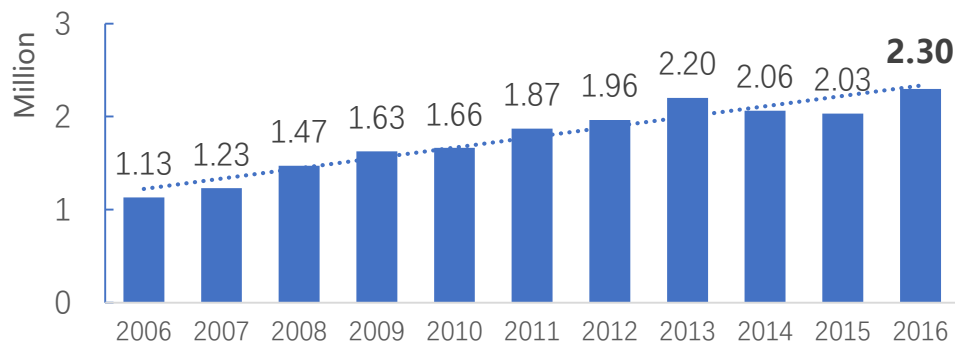{hehuan, qhzheng, dong.bo}@mail.xjtu.edu.cn, yuhongchao@stu.xjtu.edu.cn

Outline

- Background
- Related works
- Methods
- Results
- Summary

Background – Online Distance Education (ODE)

- The ODE in China
  - For the working population
  - Higher education
  - Specialty based
  - Diploma-based or degree-based
  - Authorized by the MOE of China

The national enrollment of ODE in China

- The differences between:

	ODE	**Other Online Learning**
Content:	General education curriculum	Special skills or knowledge
Course:	20~30 courses	One or few courses
Duration:	700~800 hours	Dozens of hours
Time:	2~3 years	Dozens of weeks
Outcome:	Diploma authorized by MOE	Certification by platform

The 66 authorized universities in China

Other online learning platforms

Background – videos in ODE

- Course Resources
  - Textbook
  - Homework
  - Forum threads
  - Quiz and exam
  - **Video**
    - The most important teaching media in online learning, such as open universities and MOOCs
    - Great cost in video production
    - In the ODE of China:
      - More than 1,100 videos per specialty More than 700 hours per specialty
      - In total, more than 20,000 videos were produced in a ODE school
    - Significant difference in number and time

| | ZB Students | | |
Specialty	Courses (Videos)	Video time Total (h)	Mean (m)
Engineering			
CST	23 (1,491)	773	31
PSA	19 (1,224)	808	40
TEP	23 (1,401)	857	37
MEA	21 (1,168)	830	43
CET	23 (1,527)	750	29
CVE	23 (1,160)	707	37
EEN	23 (1,166)	769	40
Law			
LAW	26 (1,499)	770	31
Economics			
ACC	22 (1,229)	734	36
FIN	23 (1,635)	796	29
EFI	22 (1,388)	716	31
Medicine			
NUR	22 (1,332)	648	29
PHA	22 (1,115)	802	43
Management			
BAM	21 (1,764)	785	27
MSB	23 (1,271)	700	33
MSP	21 (1,202)	733	37

The number of courses and videos of each specialty in ODE

Related works

- Indicators based on log data from learning management system (LMS)
  - Amount of interactions
    - Number of visits, page views, video watched, etc.
    - Number of operations on page
  - Time of interactions
    - Time spent on browsing, watching, operating, etc.
    - Intervals between operations
  - Measurements of learning
    - Number of quizzes, posts, submits, sessions, etc.
    - Homework texts

- Limitations of present indicators
  - Too broad value range
  - Incomparable between courses

Course A (Fundamental Course)	Course B (Primary Specialized Course)	Course C (Advanced Specialized Course)
20 videos	50 videos	80 videos
10 hours	20 hours	32 hours
500 learners	100 learners	50 learners

There are significant differences in the number of videos, duration, and number of learners in the courses

- Research questions:
  - How to evaluate the video utilization?
  - How the utilization is related to student's academic performance?

Methods - new indicators for course video

- Attendance Rate (AR)
  - Whether students watched videos or not

  $$ar_{s,c} = \frac{|W_{s,c}|}{|V_c|}$$

  $$ar_s = \frac{1}{|SC_s|} \sum ar_{s,c}$$

- Utilization Rate (UR)
  - Student's utilization of videos

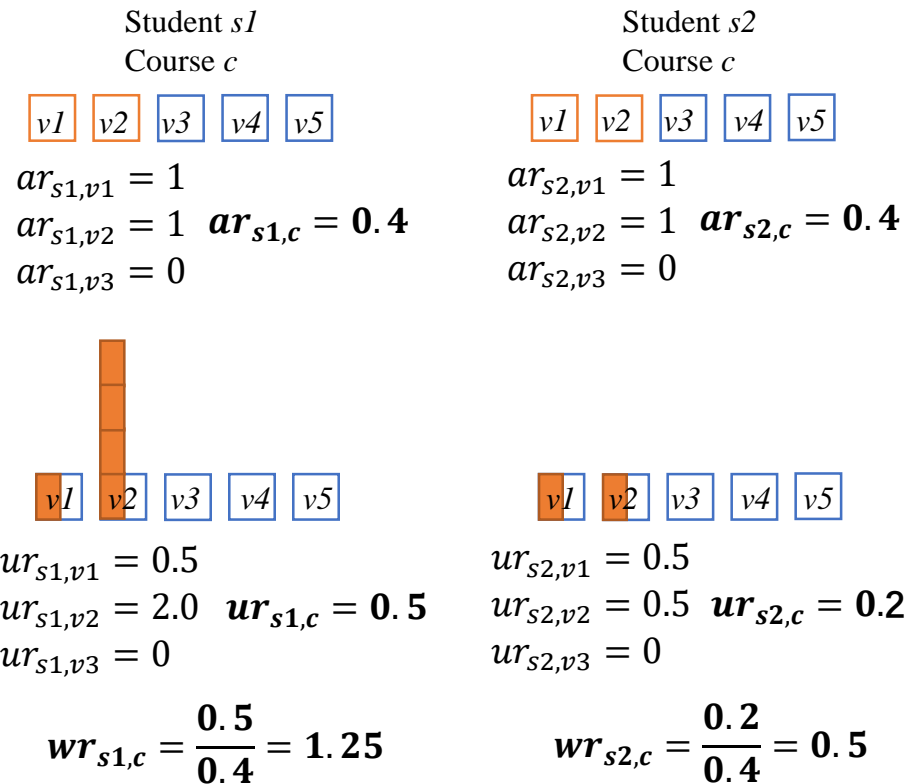 $$ur_{s,c} = \frac{\sum_{wt \in WT_{s,c}} wt}{\sum_{vt \in VT_c} vt}$$

  $$ur_s = \frac{1}{|SC_s|} \sum ur_{s,c}$$

- Watch Ratio (WR)
  - Student's utilization pattern

  $$wr_{s,c} = \frac{ur_{s,c}}{ar_{s,c}}$$

  $$wr_s = \frac{ur_s}{ar_s}$$

Student *s1*
Course *c*

$v1$ $v2$ $v3$ $v4$ $v5$

$ar_{s1,v1} = 1$
$ar_{s1,v2} = 1$ $\boldsymbol{ar_{s1,c} = 0.4}$
$ar_{s1,v3} = 0$

Student *s2*
Course *c*

$v1$ $v2$ $v3$ $v4$ $v5$

$ar_{s2,v1} = 1$
$ar_{s2,v2} = 1$ $\boldsymbol{ar_{s2,c} = 0.4}$
$ar_{s2,v3} = 0$

$v1$ $v2$ $v3$ $v4$ $v5$

$ur_{s1,v1} = 0.5$
$ur_{s1,v2} = 2.0$ $\boldsymbol{ur_{s1,c} = 0.5}$
$ur_{s1,v3} = 0$

$v1$ $v2$ $v3$ $v4$ $v5$

$ur_{s2,v1} = 0.5$
$ur_{s2,v2} = 0.5$ $\boldsymbol{ur_{s2,c} = 0.2}$
$ur_{s2,v3} = 0$

$$\boldsymbol{wr_{s1,c} = \frac{0.5}{0.4} = 1.25}$$

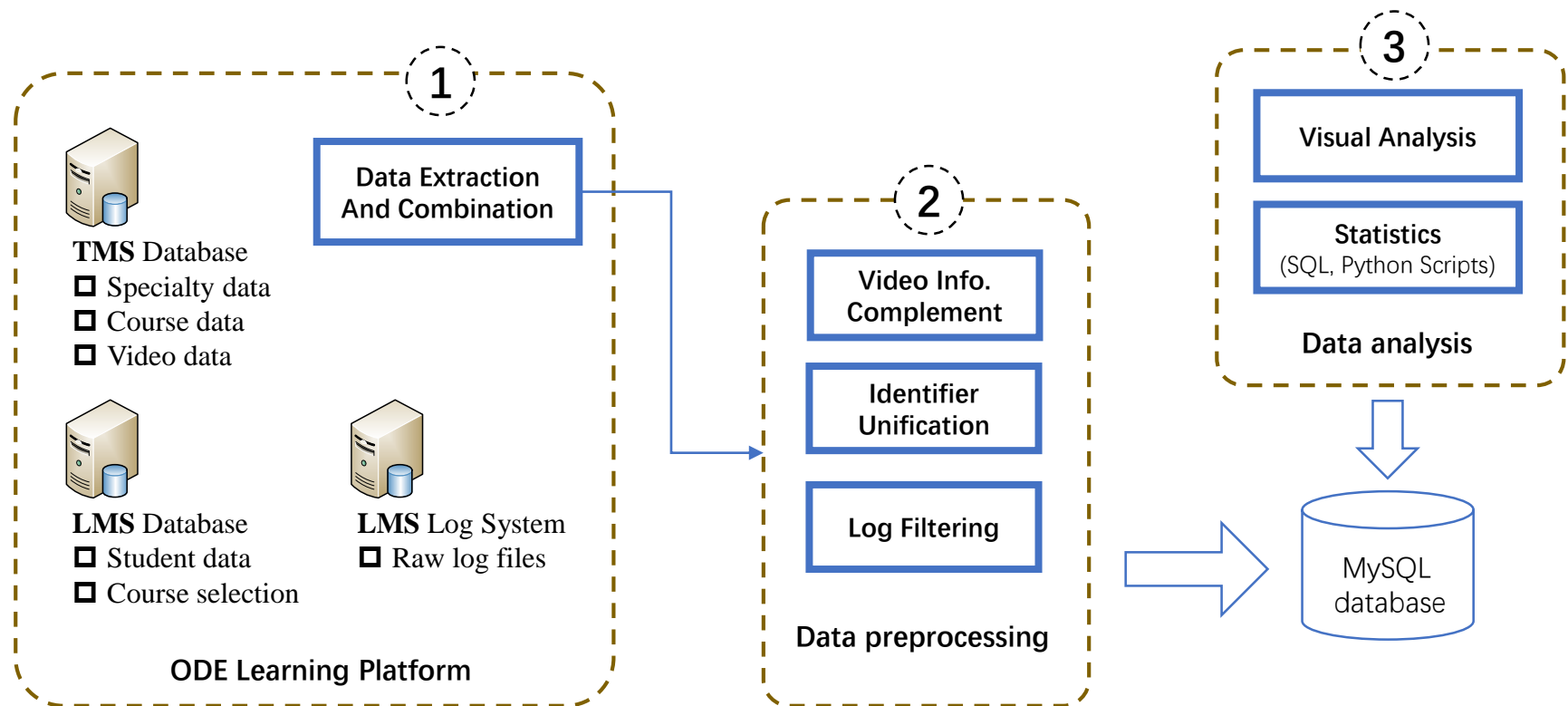$$\boldsymbol{wr_{s2,c} = \frac{0.2}{0.4} = 0.5}$$

Example of AR, UR and WR

# Methods – data collection, preprocessing and analysis

- Data sources
  - TMS: Specialty and course data
  - LMS: student data, academic status, course list, basic personal information, etc.
  - Log System of LMS: learning process data, logs recorded by LMS

The process of data collection, preprocessing, and analysis
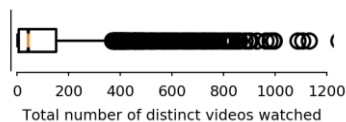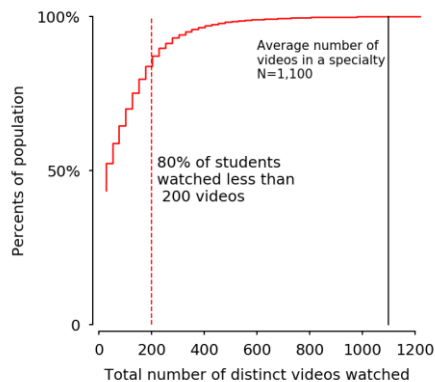
Results – basic indicators
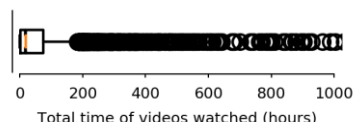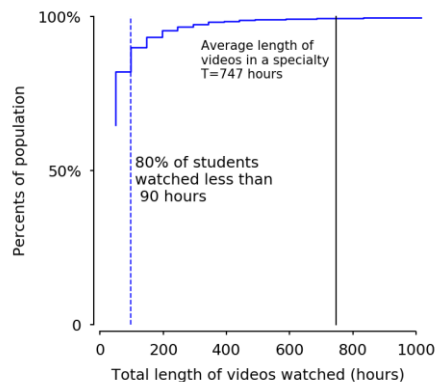
- Descriptive statistics
  - Demographics
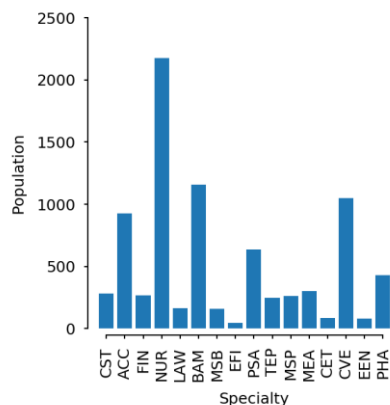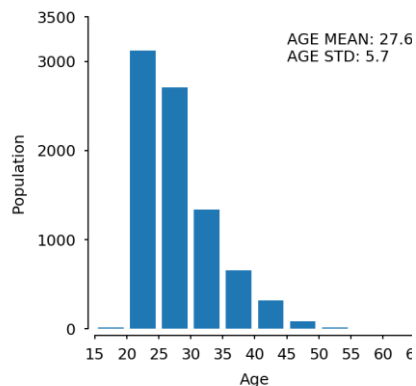
Items	Data
# of Students	8,276
Age	Mean: 27.6 SD: 5.7
Gender	Male: 3,504 Female: 4,772
Specialty	16
Date range	2014.05 – 2017.7

Statistics of students

- Basic indicators

The number of distinct videos watched

The length of videos watched

Indicators	Median	Mean	SD
Total number	43	98	132
Total length	17	61	142
Total operation	831	1,479	2,381
Total online days	90	107	70

Statistics of basic indicators

Results – AR and UR

- AR and UR Scatter Plot
  - each blue dot represents a student
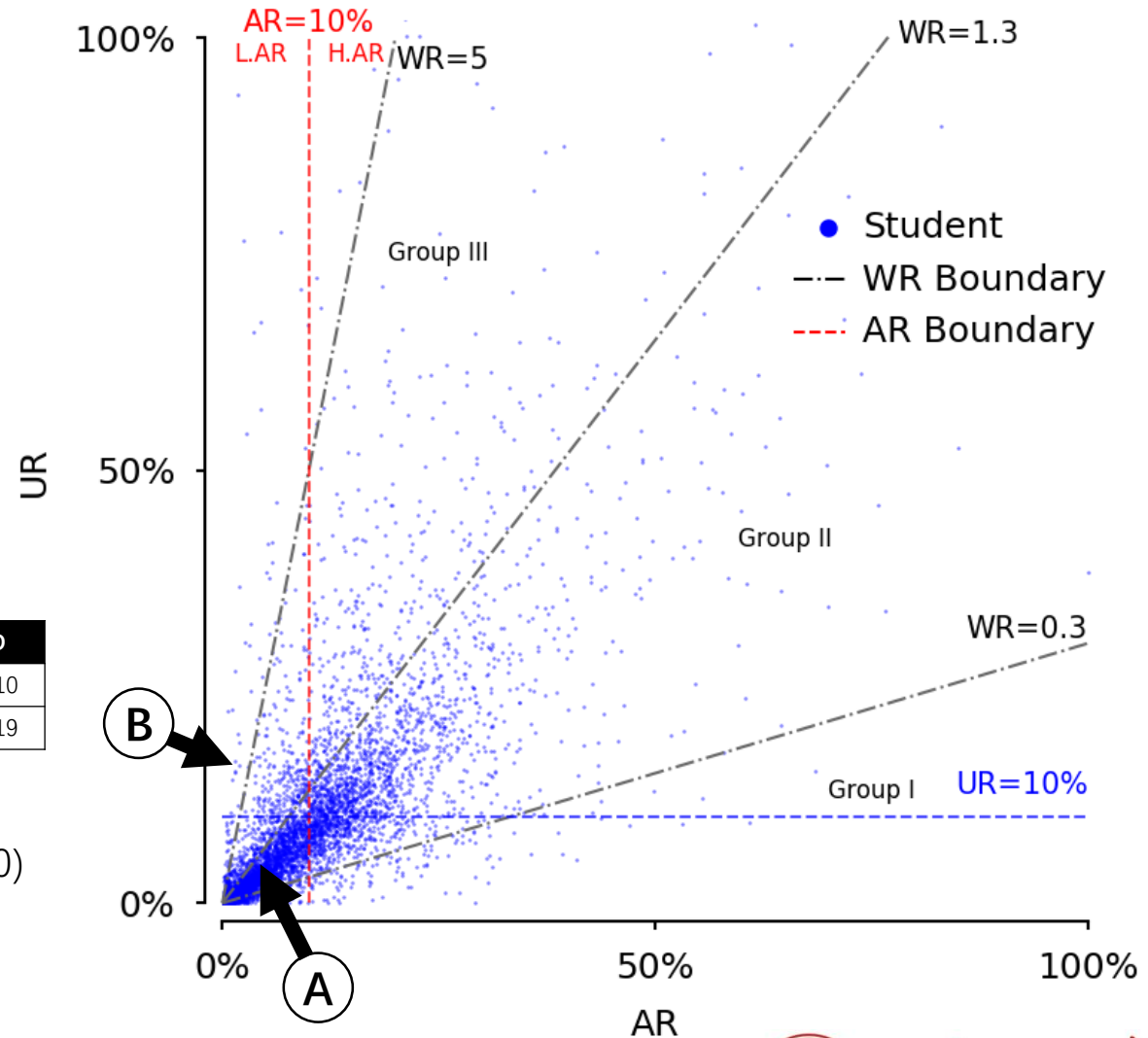 - AR as x-axis coordinate
  - UR as y-axis coordinate

- Findings:
  - Low overall utilization
    - Most students' (70%) AR and UR are less than 0.1 (the dots in area A)

Indicators	Median	Mean	SD
AR	0.03	0.07	0.10
UR	0.02	0.08	0.19

  - Abnormal behaviors
    - Too high WR (e.g., WR>10) (the dots in area B)

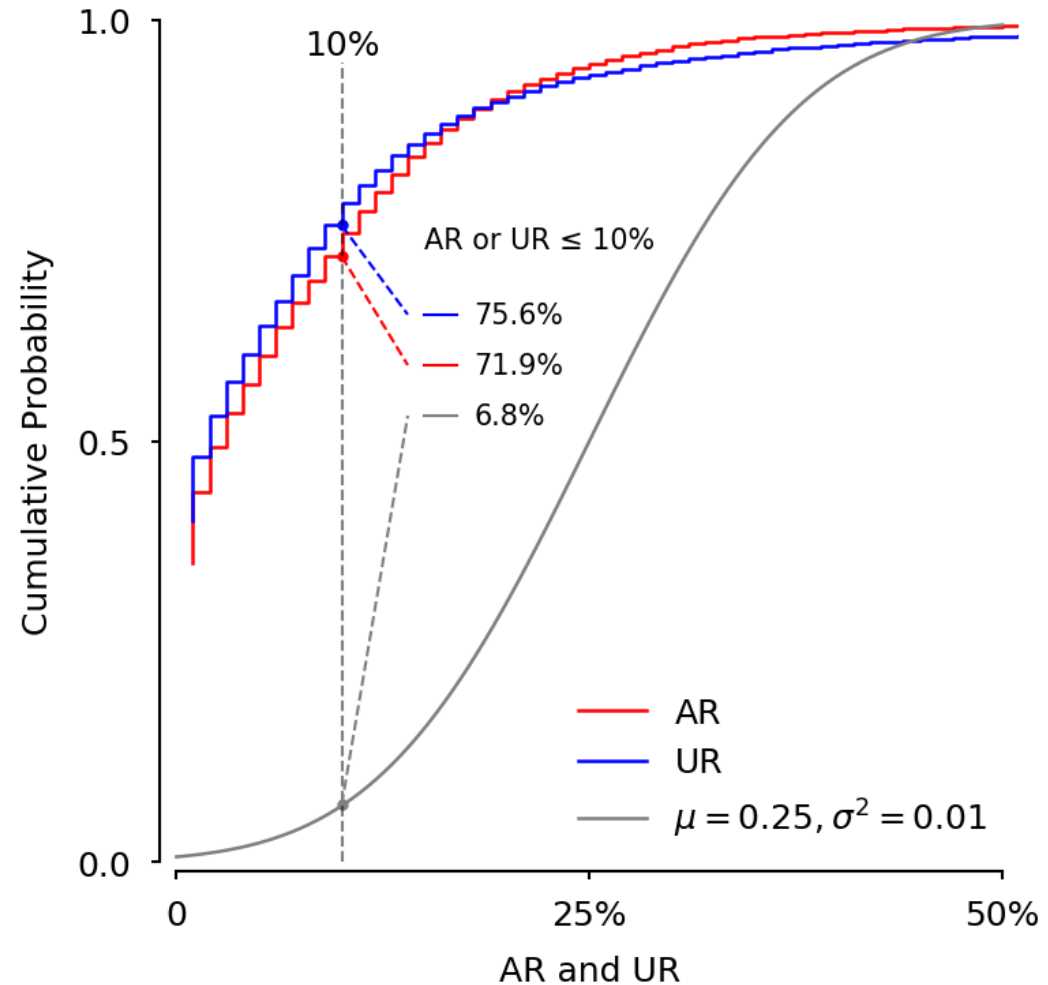# Results – AR and UR

- AR and UR Cumulative Distribution
  - red line represents AR
  - blue line represents UR

- Findings
  - Unbalanced distribution
    - 71.9% students with AR<0.1
    - 75.6% students with UR<0.1

- Discussion
  - Mismatch between current resources and the learning needs of students
  - Abnormal management of student services

Results – WR

- WR distribution
  - black line represents all students
  - red dotted line: AR≤0.1
  - yellow dashed line: AR>0.1

- Findings
  - Two peaks and three groups
  - Peak L
    - just watch beginning part
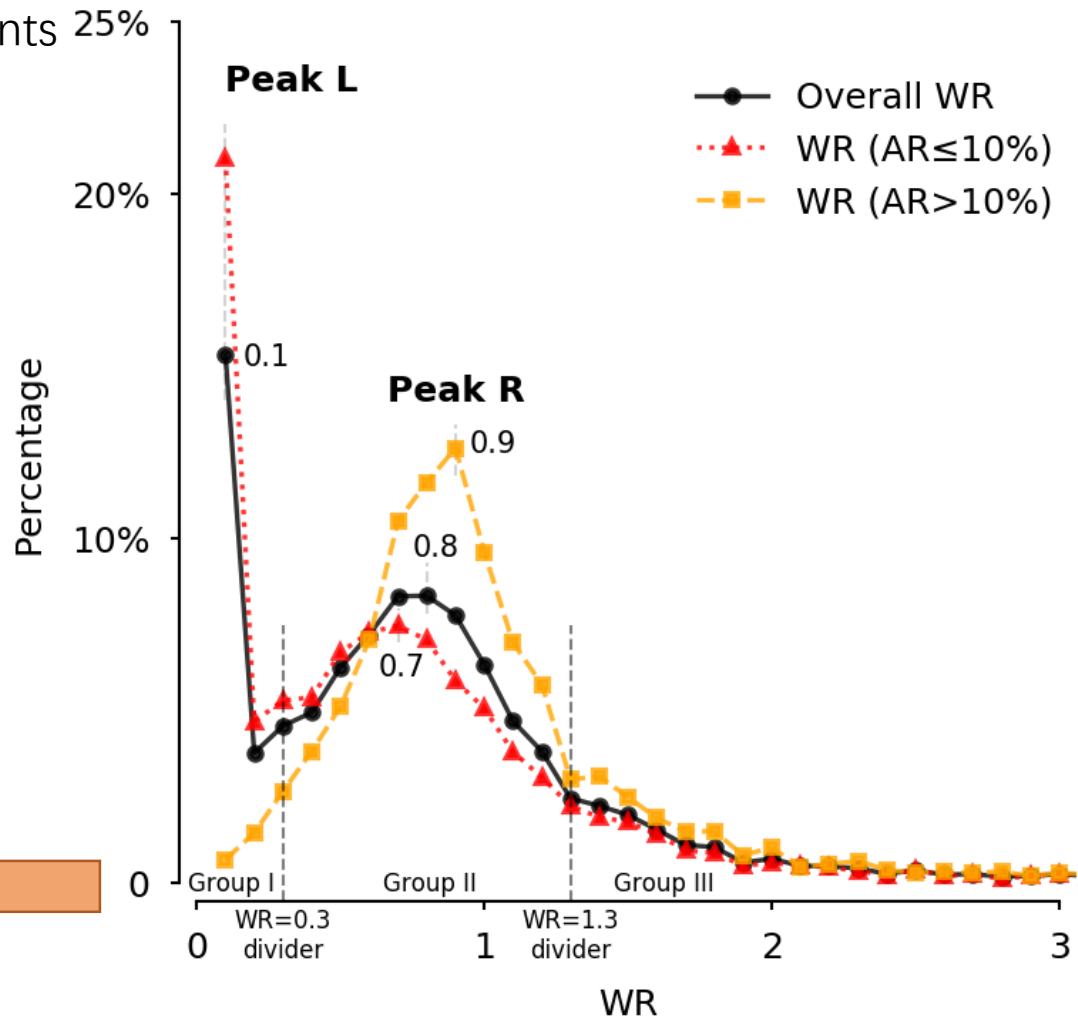
    video | 0.2
  - Peak R
    - watch most of a video

    video | WR≈0.8
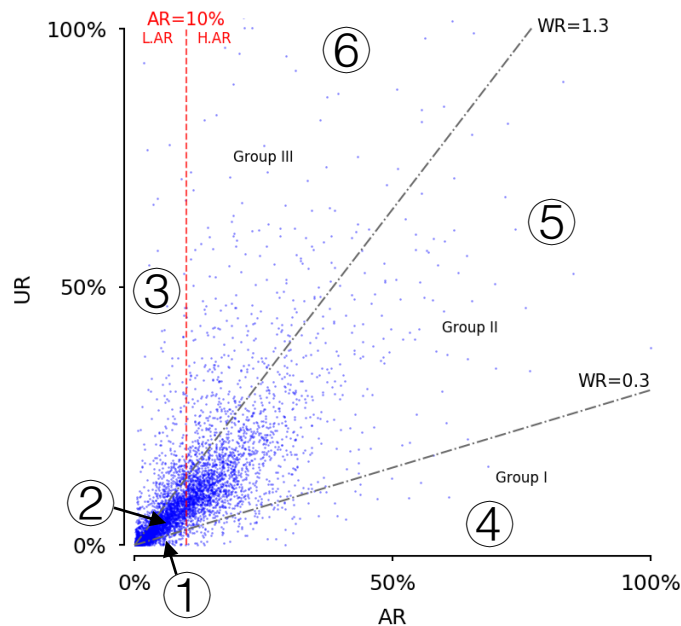 - Far right of Peak R
    - watch a video repeatedly

    video | WR>1.3

Results – learning performance

- Correlation analysis
  - Academic status
    - Studying
    - Graduated on schedule
    - Postponed
  - Groups

AR may have a greater impact on student's academic performance, since student with higher AR had a higher rate of graduation on schedule among groups or in same group.

Table 1. Mutual distribution of academic status and WR groups

WR Group	Ratio	Academic status		
		Studying	*Graduated*	*Postponed*
Group I	P(A|G)	0.24	**0.52**	0.23
	P(G|A)	0.29	0.20	0.31
Group II	P(A|G)	0.18	**0.65**	0.17
	P(G|A)	0.56	0.63	0.56
Group III	P(A|G)	0.17	**0.68**	0.15
	P(G|A)	0.14	0.18	0.13

P(A|G) denotes the ratio of specified status in this group.
P(G|A) denotes the ratio of this group in specified status.

Table 2. Mutual distribution of academic status and AR+WR groups

AR+WR Group		Ratio	Academic status		
			Studying	*Graduated*	*Postponed*
L.AR + Group I	①	P(A|G)	0.25	**0.51**	0.24
		P(G|A)	0.29	0.18	0.29
L.AR + Group II	②	P(A|G)	0.22	**0.59**	0.19
		P(G|A)	0.43	0.37	0.41
L.AR + Group III	③	P(A|G)	0.19	**0.64**	0.16
		P(G|A)	0.11	0.11	0.10
H.AR + Group I	④	P(A|G)	0.08	**0.73**	0.19
		P(G|A)	0.01	0.02	0.01
H.AR + Group II	⑤	P(A|G)	0.12	**0.75**	0.13
		P(G|A)	0.13	0.26	0.16
H.AR + Group III	⑥	P(A|G)	0.13	**0.76**	0.11
		P(G|A)	0.03	0.07	0.03

Summary

- Contributions
  - AR, UR and WR for evaluating video utilization of students and courses in multi-specialty and multi-course context
  - A case study with proposed indicators on real dataset

- Applications
  - Evaluating course design and providing feedbacks to teachers
  - Providing student services based on learning progress

- Limitations
  - Not applicable to other resources (textbooks, posts, etc.)
  - Learning behaviors behind AR and UR are not clear, different viewing processes may result in similar AR and UR

Q & A

- Thank you!