EDUM

EDUM:
Classroom Education Measurements via Large-scale WiFi Networks

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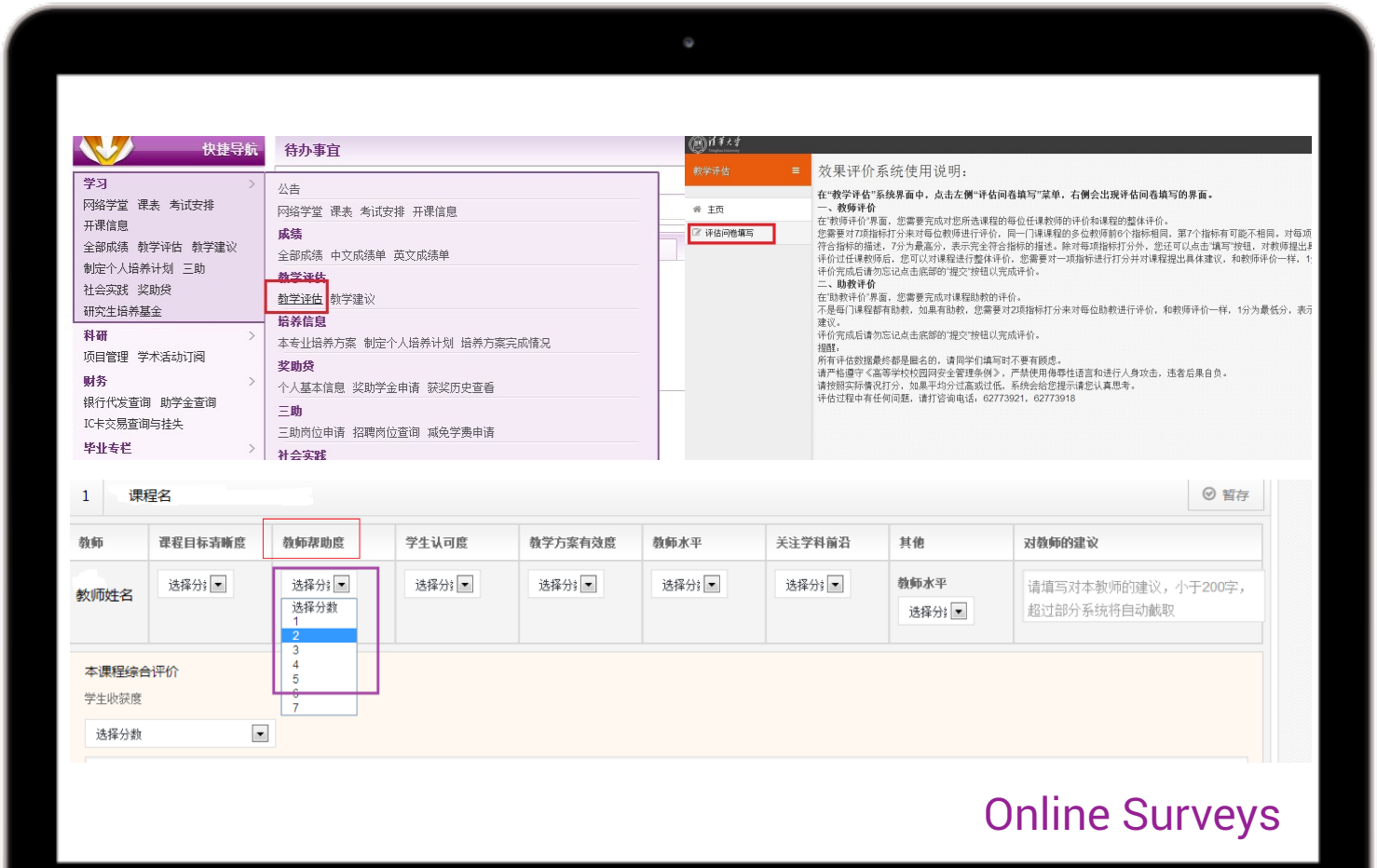
Traditional Ways

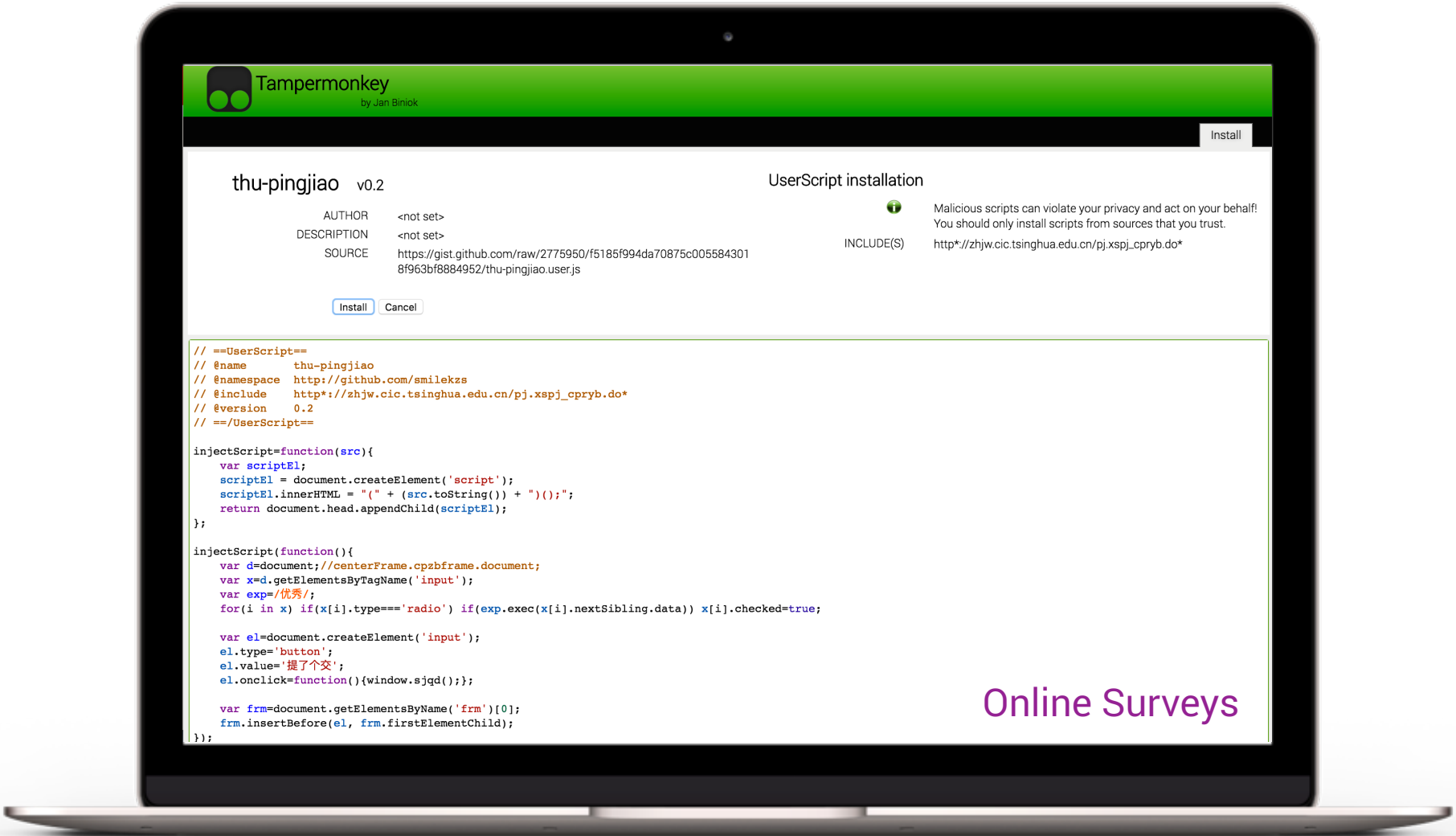
to access Classroom Teaching



Online Surveys

Traditional Ways

to access Classroom Teaching



Traditional Ways

to access Classroom Teaching

Online Surveys

Time-consuming
High costs

Manual Checkins

Subjective
Biases
Obscure scales
Qualitative

Small Experiments

Intrusive
Low diversity
Low coverage

Self Reports

Peer Reviews

Cheat-prone
Ex post

Traditional Ways
to access Classroom Teaching

Low-quality data collected via costly process.

Motivation

MOOC

Large-scale measurements of fine-grained web user behaviors!

Classroom

Large-scale in-situ measurements of accurate behavior?

Large-scale In-situ

Classroom Education Measurements

3 **Accurate**
↑ obscure

2 **Big Data**
↑ small-scale

4 **Objective**
↑ subjective

1 **Automatic**
↑ manual

5 **In-situ**
↑ in memory

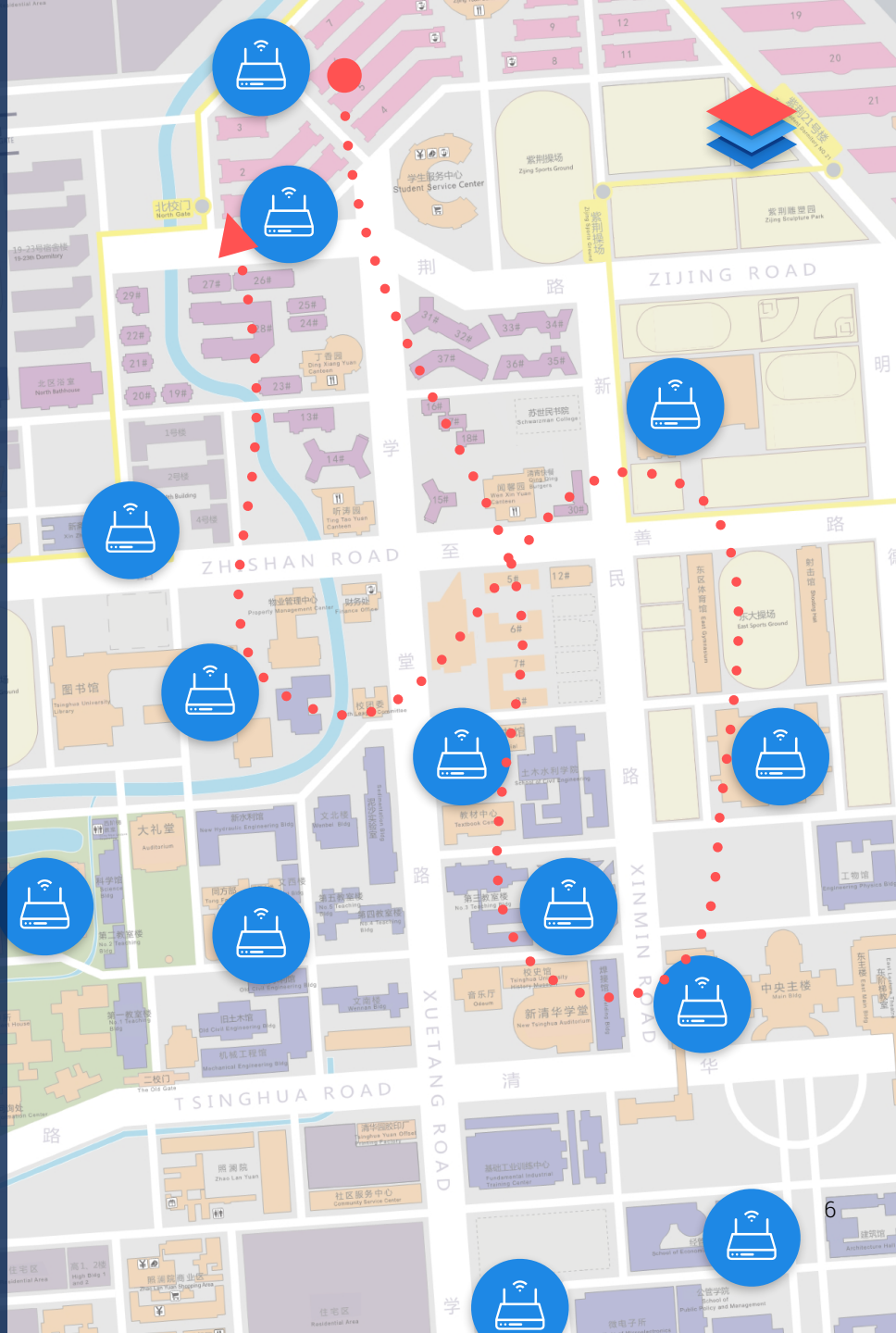
Basic Ideas

Approximate Mobility

Carry-on Mobile Devices
with apps & wireless chips

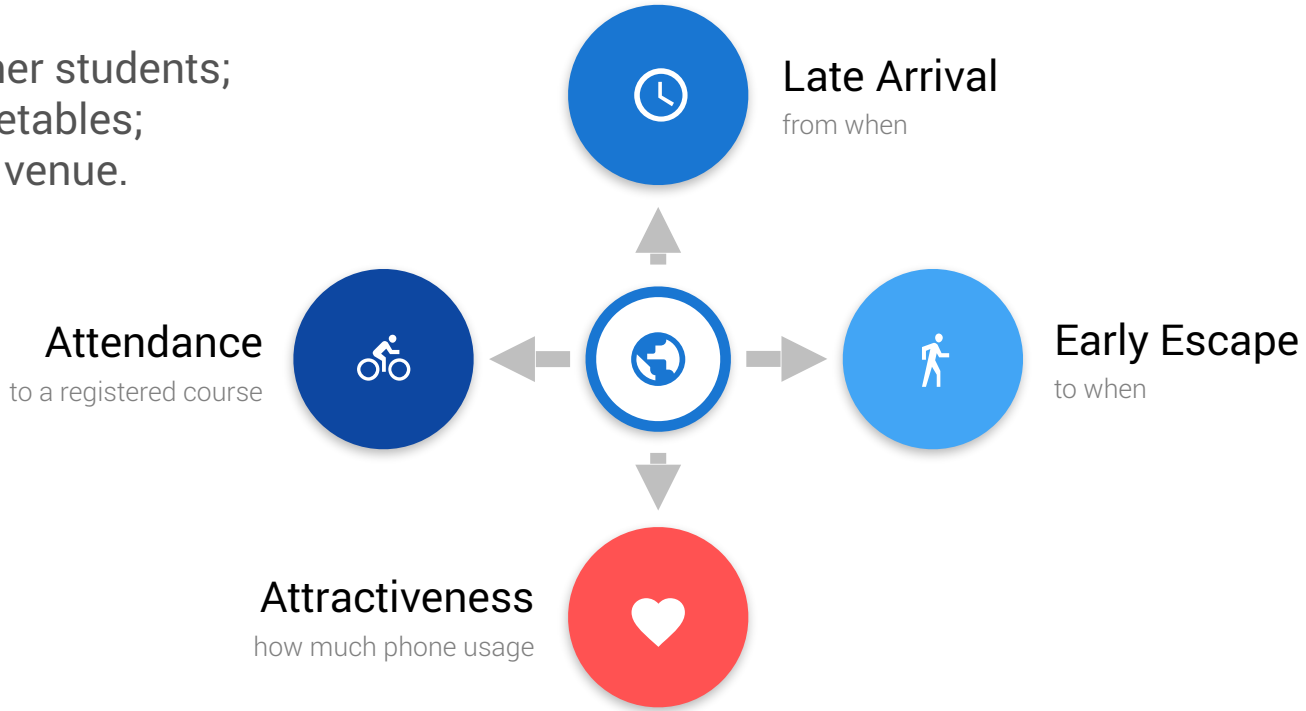
Ubiquitous WLAN
densely deployed on campuses

Mobility
of the devices tracked by WLAN



Punctuality & Attractiveness

- Mobility;
+ Device owner students;
+ Course timetables;
+ Classroom venue.



Challenges

- Registered courses
- Phone usages
- ...

Challenge 1

Educational ground truths are fundamentally hard to collect.

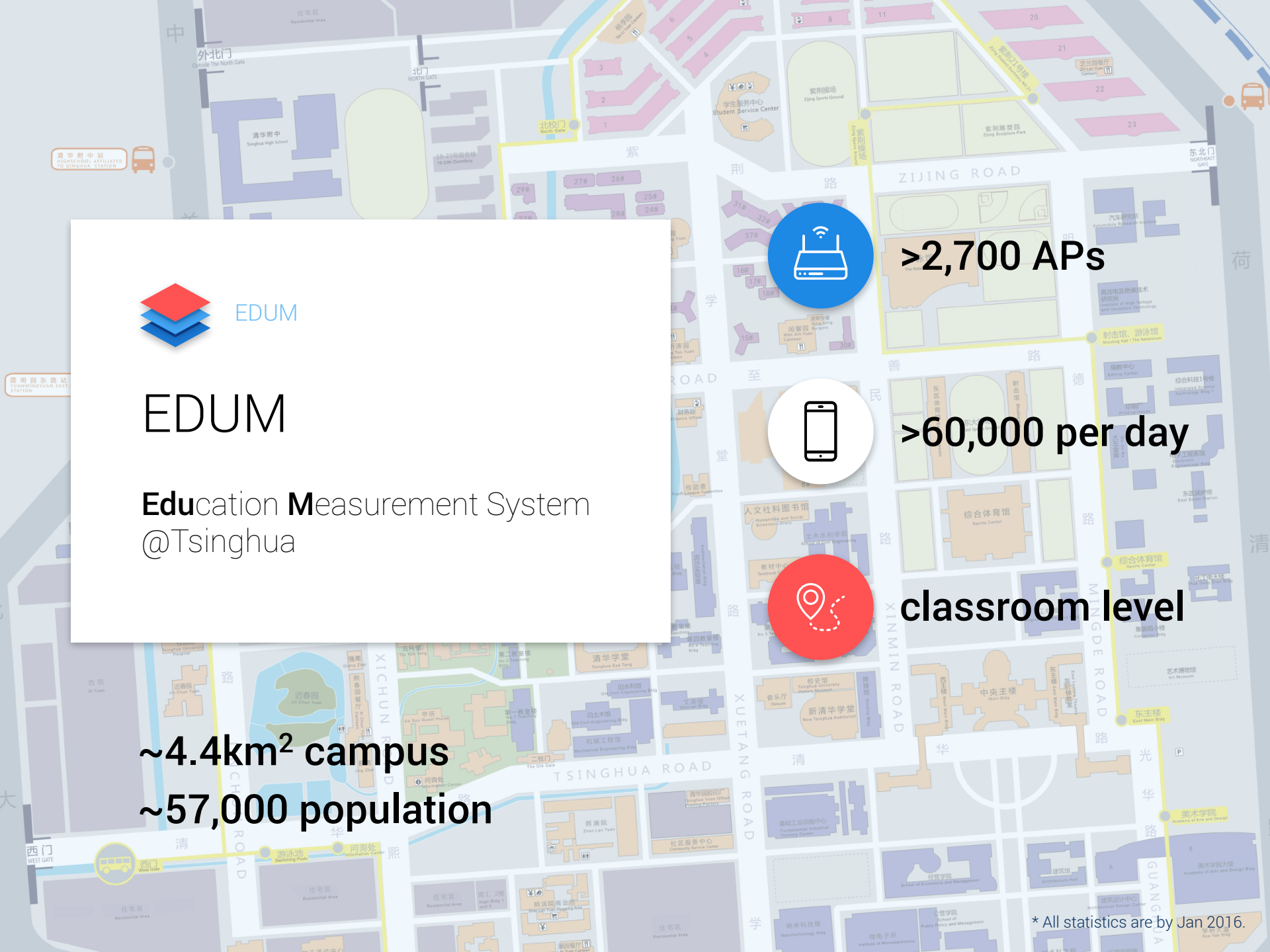
- Not public available
- Privacy concerns
- ...

Challenges

Challenge 2

Using WiFi data to determine course's venue and whether a student is in the classroom.

Classroom <—> WiFi
× Localization services


EDUM
EDUM
Education Measurement System
@Tsinghua
>2,700 APs
>60,000 per day
classroom level
~4.4km² campus
~57,000 population
* All statistics are by Jan 2016.

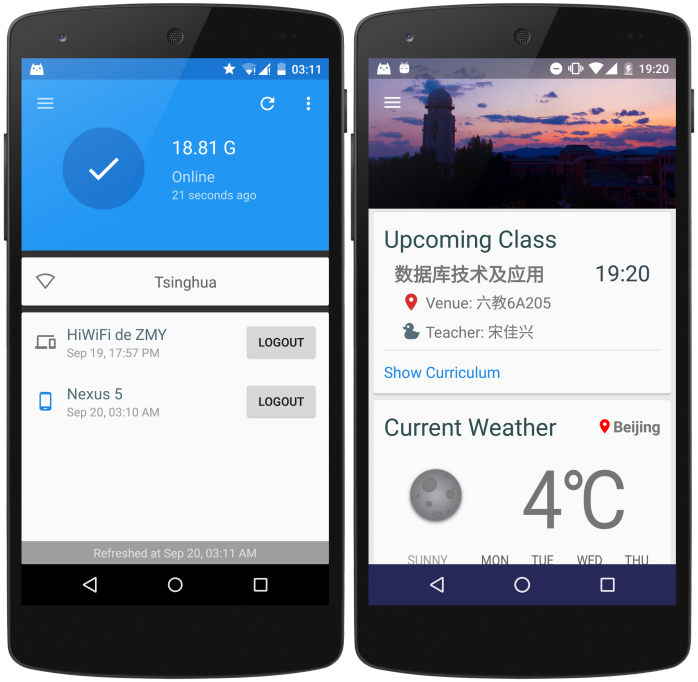
Crowd-sourcing Apps

TUNet
Campus Network Tool

Automatically
Login, protect & manage account

Phone interactive states
with account & MAC mapping

15,000+ users
Both Android and iOS



Tsinghua Now
Campus Life Helper

Prioritized
Information card flow

Registered courses
with account & MAC mapping

1,200+ users
~700 volunteers

Data Processing

Challenge 1

Educational ground truths are fundamentally hard to collect.

Challenge 2

Using WiFi data to determine course's venue and whether a student is in the classroom.

Data Processing

Challenge 1

- Student's devices
- Their registered courses
- How much phone usage

Challenge 2

Using WiFi data to determine course's venue and whether a student is in the classroom.

Data Processing

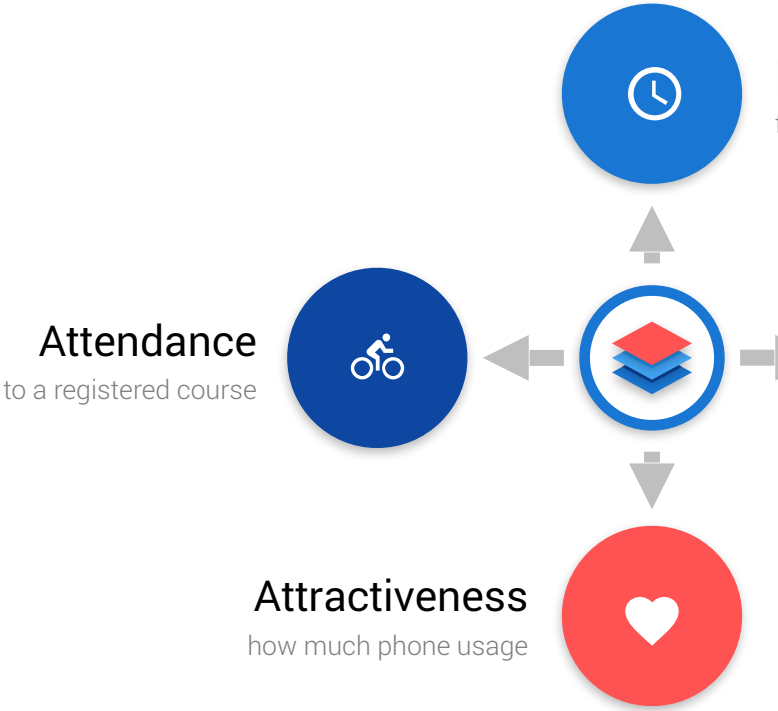
Challenge 1

- Student's devices
- Their registered courses
- How much phone usage

Challenge 2

- Classroom venue (WiFi)
- Accurate ending time
- Students' attendance

Large-scale Measurements



~700 students in
~800 courses

Punctuality

Attendance, late arrival, early escape

Attendance Ratios (for Courses)

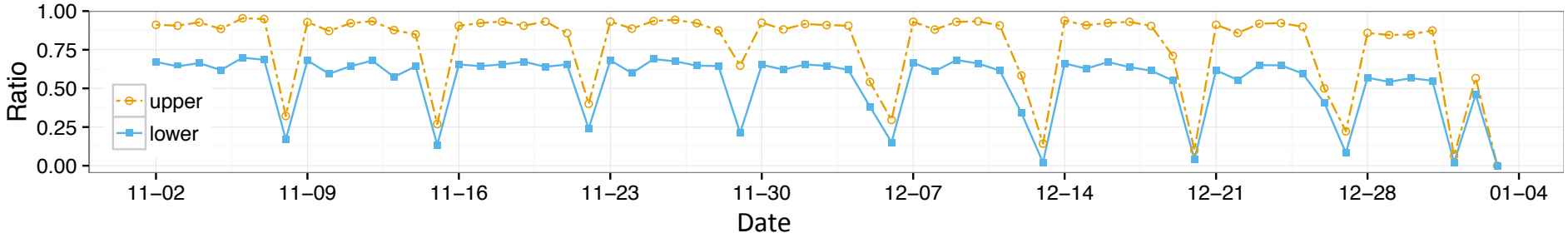
Lecture Attendance Ratio:

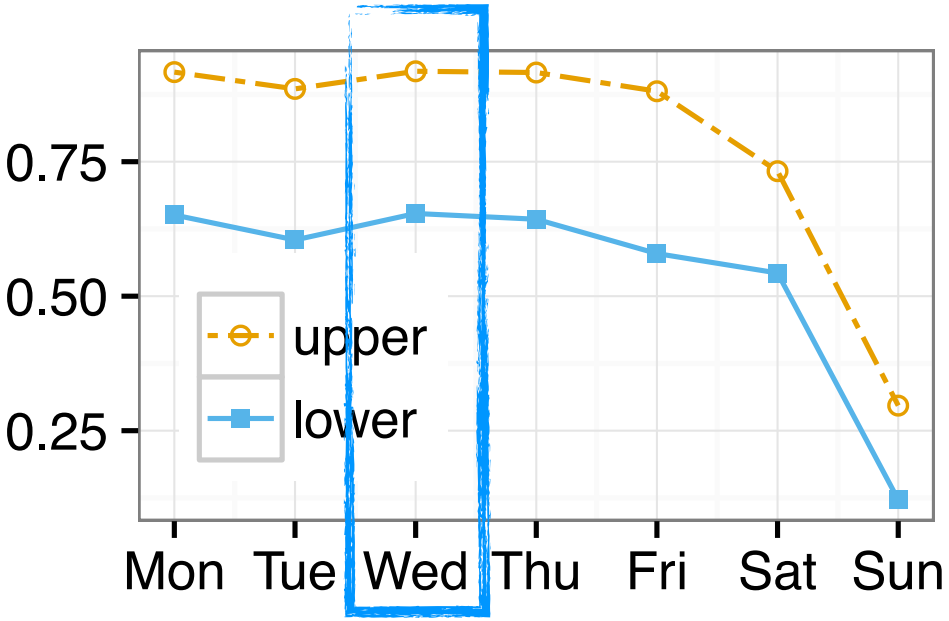
$$\frac{\#(\text{attended students})}{\#(\text{appeared students on campus})}. \quad (1)$$

"**appeared on campus**":

- **upper** bound: during the lecture (smaller #students)
- **lower** bound: during the day (larger #students)

Temporal Patterns of Attendance Ratios

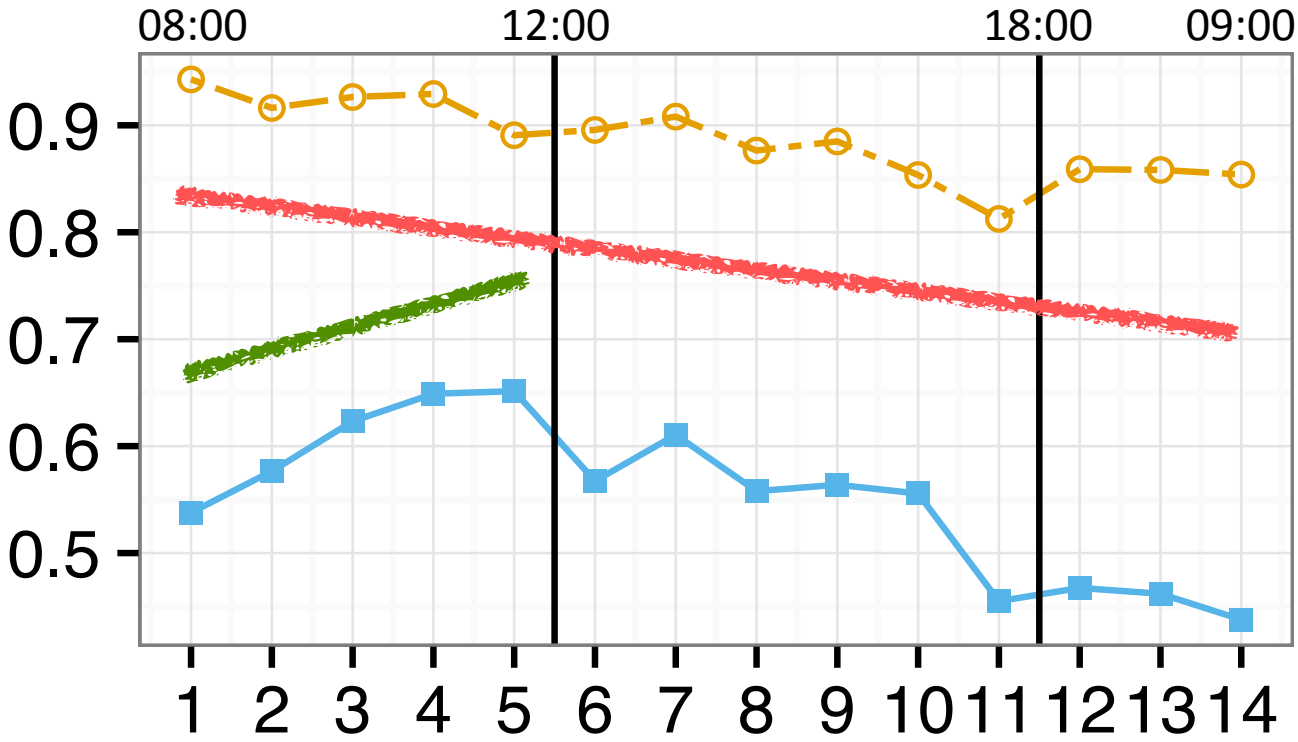




- Wednesday is the most hard-working day.

Temporal Patterns of Attendance Ratios

14 timeslots per day. Each timeslot is 45-min long.



- Attendance ratio decreases from morning to afternoon to evening.
- "Stay-in-bed" effect.

Late Arrival & Early Escape Ratios (for Courses)

$$\text{late ratio} = \frac{\#(\text{late arrived students})}{\#(\text{attended students})} \tag{3}$$

$$\text{escape ratio} = \frac{\#(\text{early escaped students})}{\#(\text{attended students})}. \tag{4}$$

Punctuality Metrics for Students

Student Attendance Ratio:

$$\frac{\#(\text{lectures attended})}{\#(\text{lectures that s/he appeared on campus})}$$

Student Late Arrival Ratio:

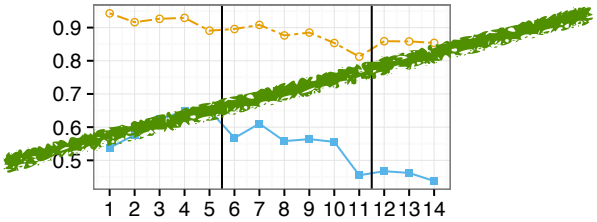
$$\frac{\#(\text{lectures that arrived lately})}{\#(\text{lectures attended})}$$

Student Early Escape Ratio:

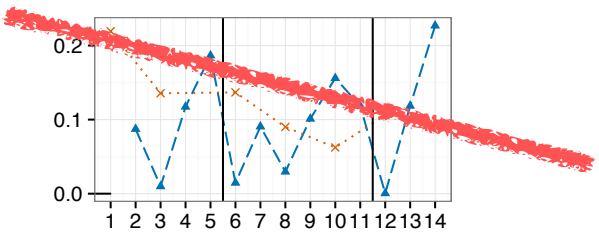
$$\frac{\#(\text{lectures that departured early})}{\#(\text{lectures attended})}$$

Punctuality Metrics for Students

Student Attendance Ratio:

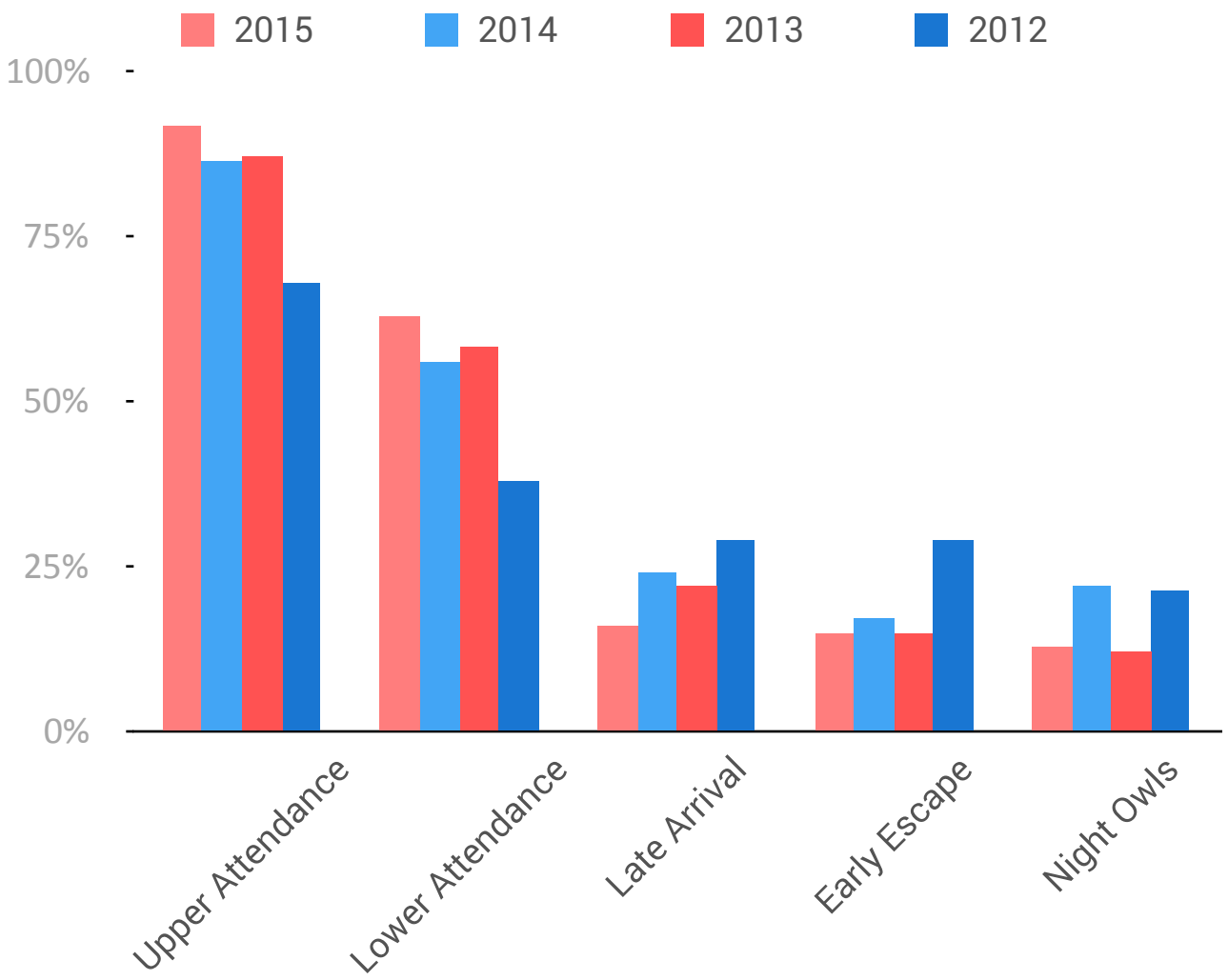


Student Late Arrival Ratio:

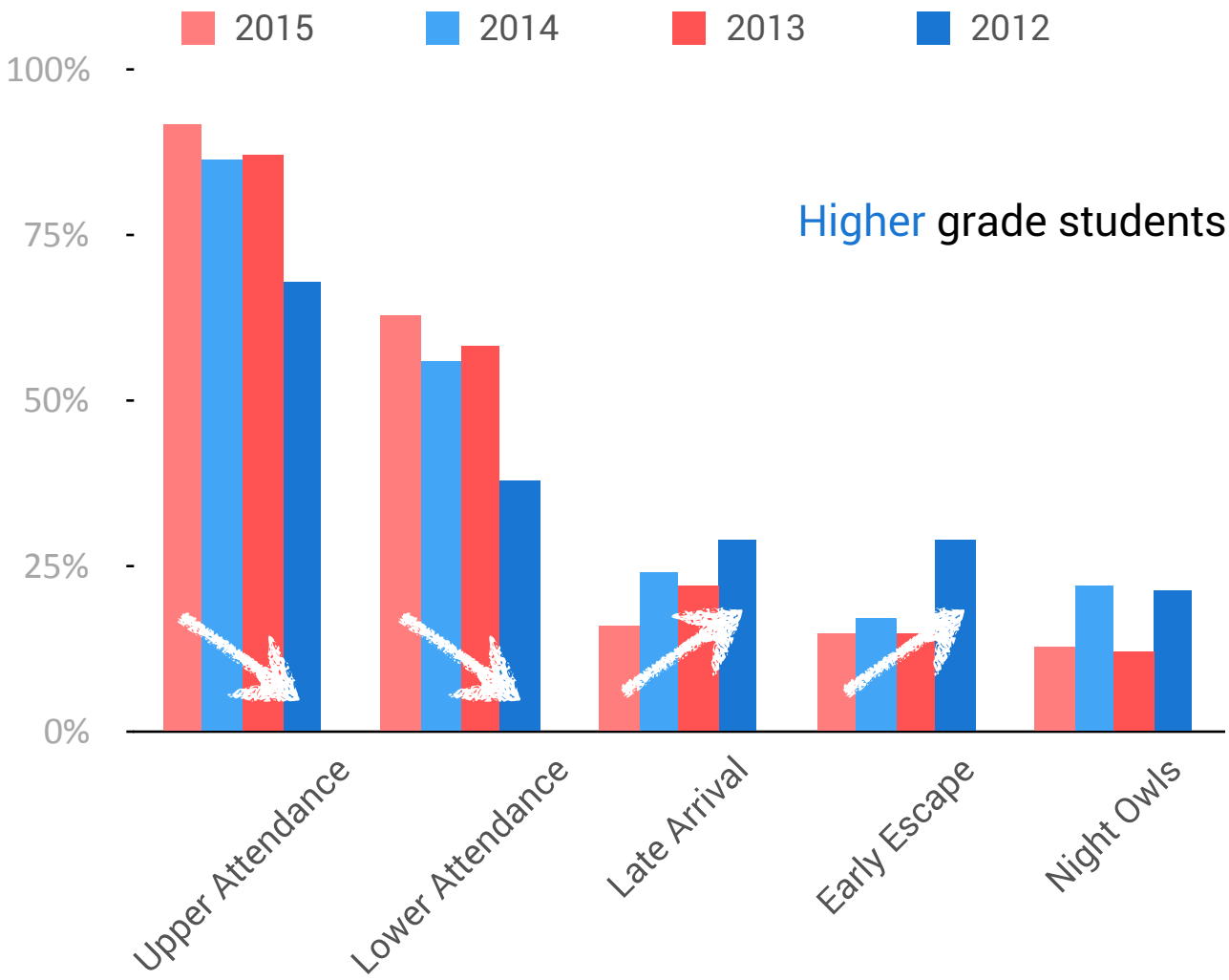


Night Owls:
Increasing attendance &
Decreasing late arrival
over the day

Student Attributes v.s. Punctuality

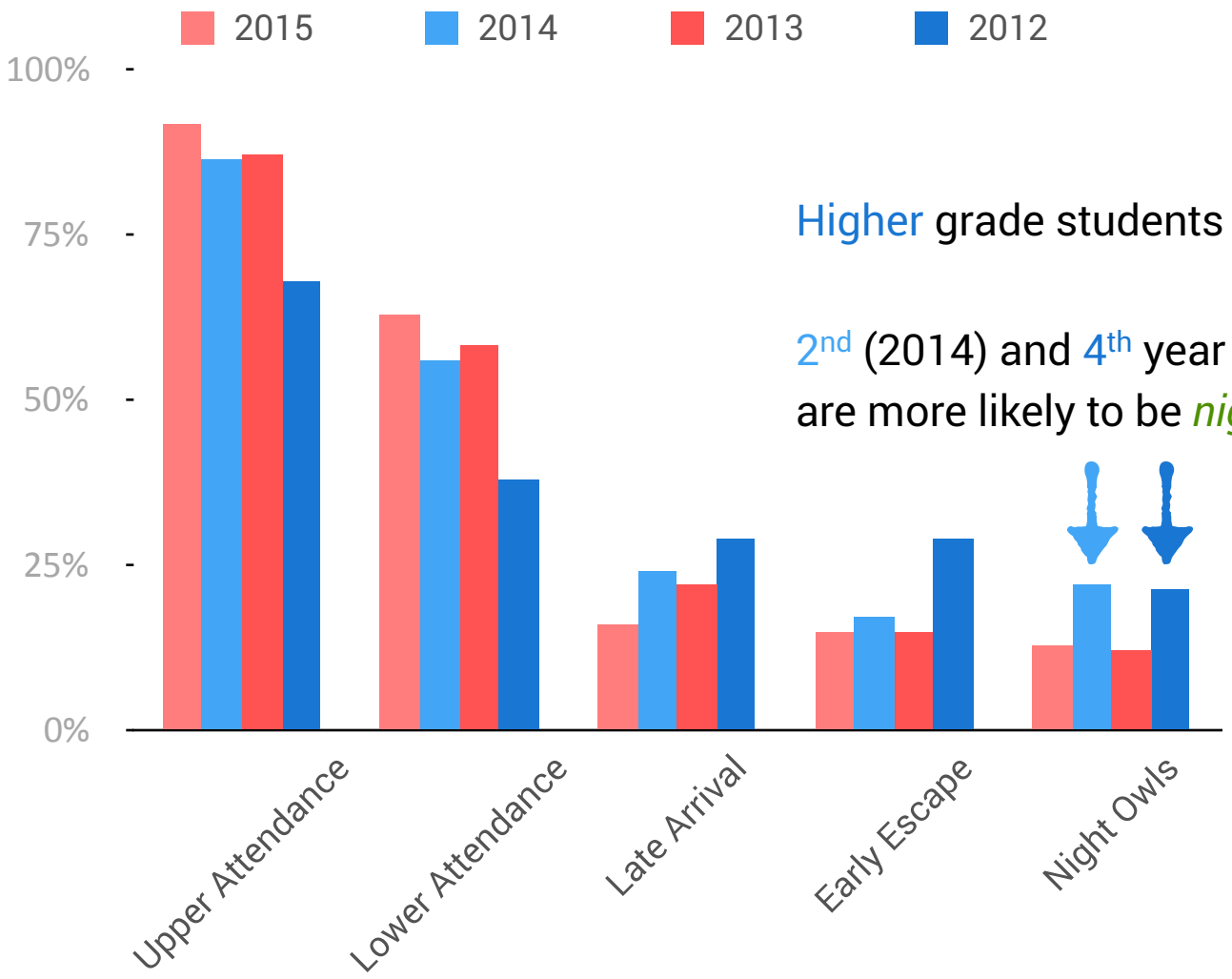


Student Attributes v.s. Punctuality



Higher grade students are *less punctual*.

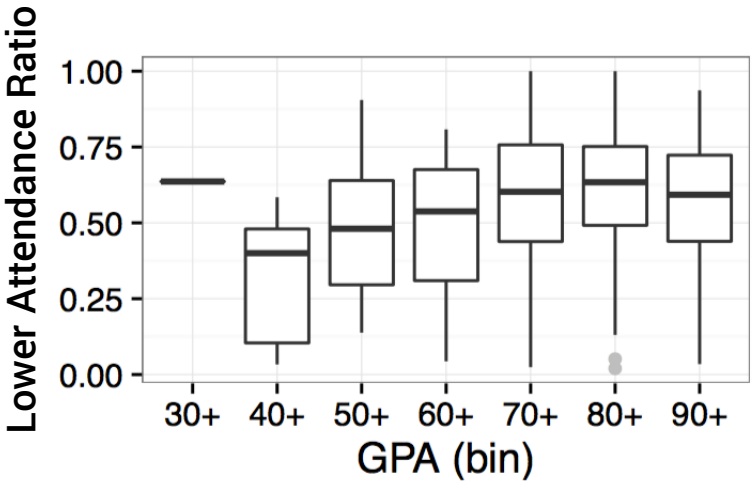
Student Attributes v.s. Punctuality

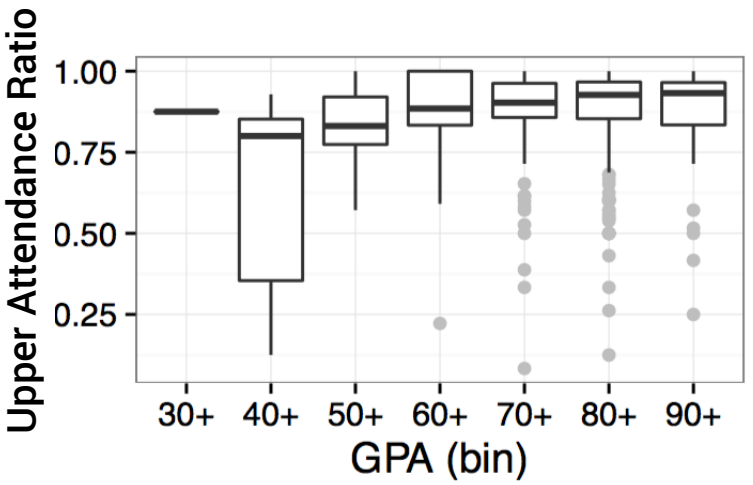


Higher grade students are *less punctual*.

2nd (2014) and 4th year (2012) students are more likely to be *night owls*.

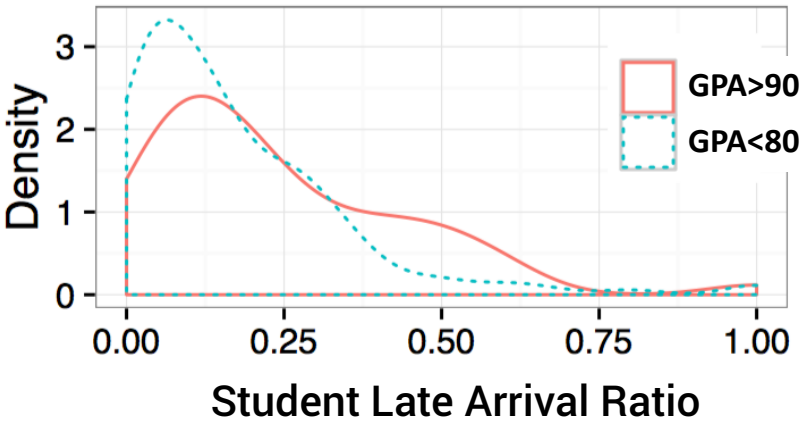
Punctuality v.s. Study Performance

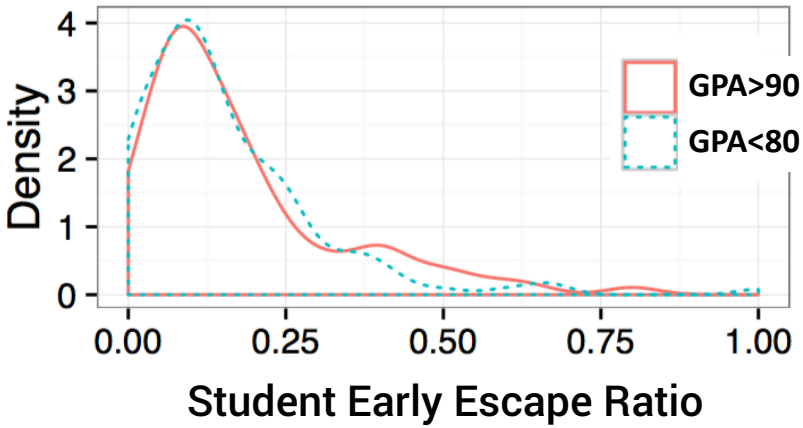




Students with higher GPA attend lectures more.

Punctuality v.s. Study Performance





Students with higher GPA attend lectures more.

High-performance students are more likely to be late than low-performance students.

Attractiveness

Phone distractions

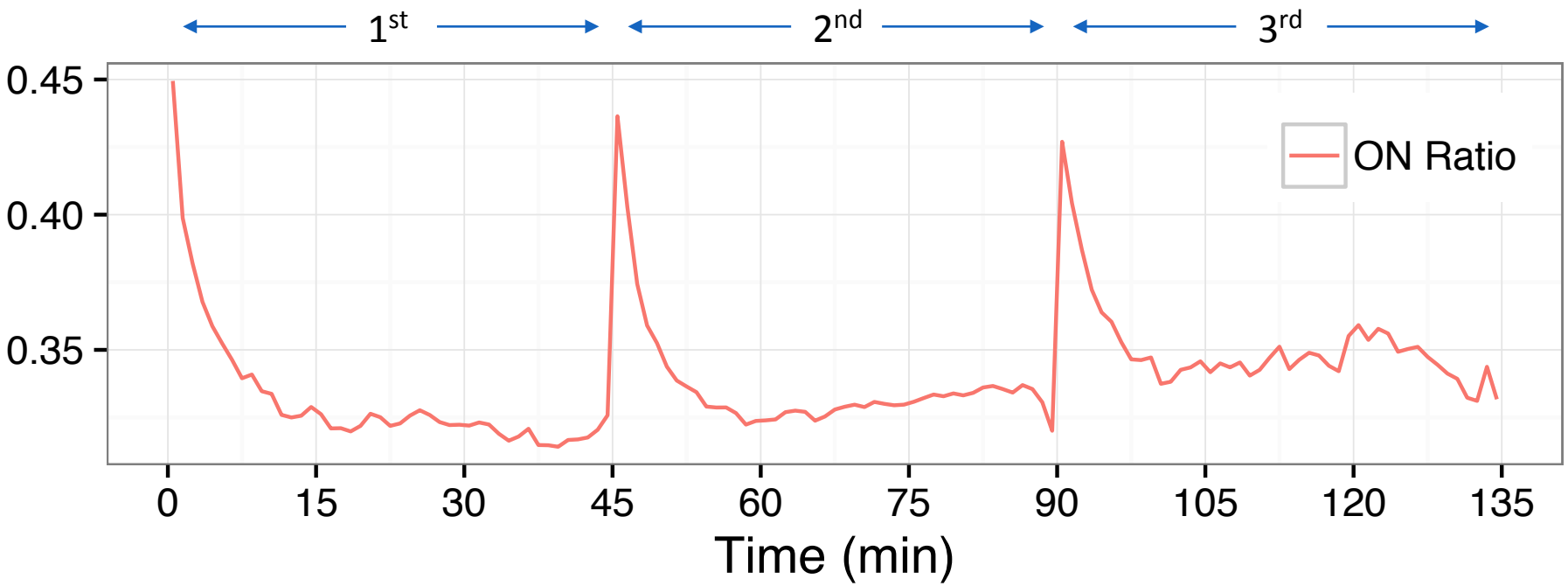
Interactive Distraction Ratio

$$\frac{\text{Total ON duration}}{\text{Total ON duration} + \text{Total OFF duration}} \tag{7}$$

Phone interactive states.

Aggregated Distraction (ON) Ratio

Each timeslot is 45-min long. Break time is cut off.



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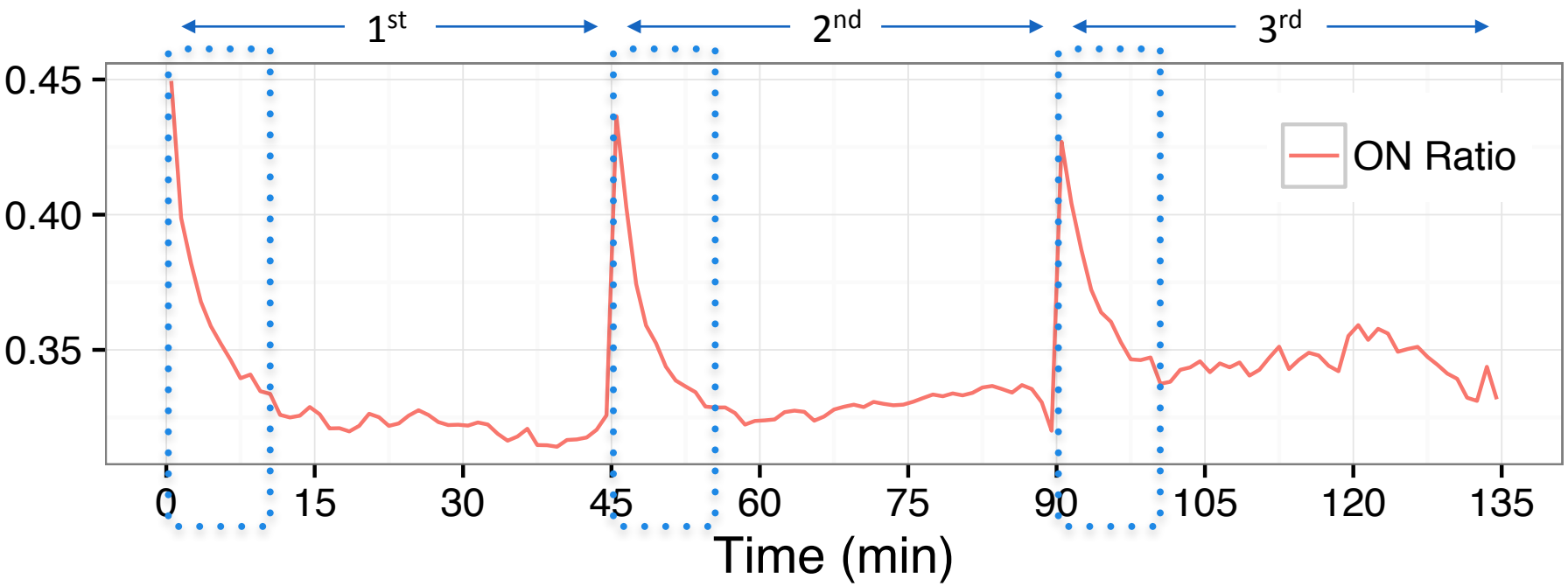

High phone usage quickly drops at the start of each timeslot.

Aggregated Distraction (ON) Ratio

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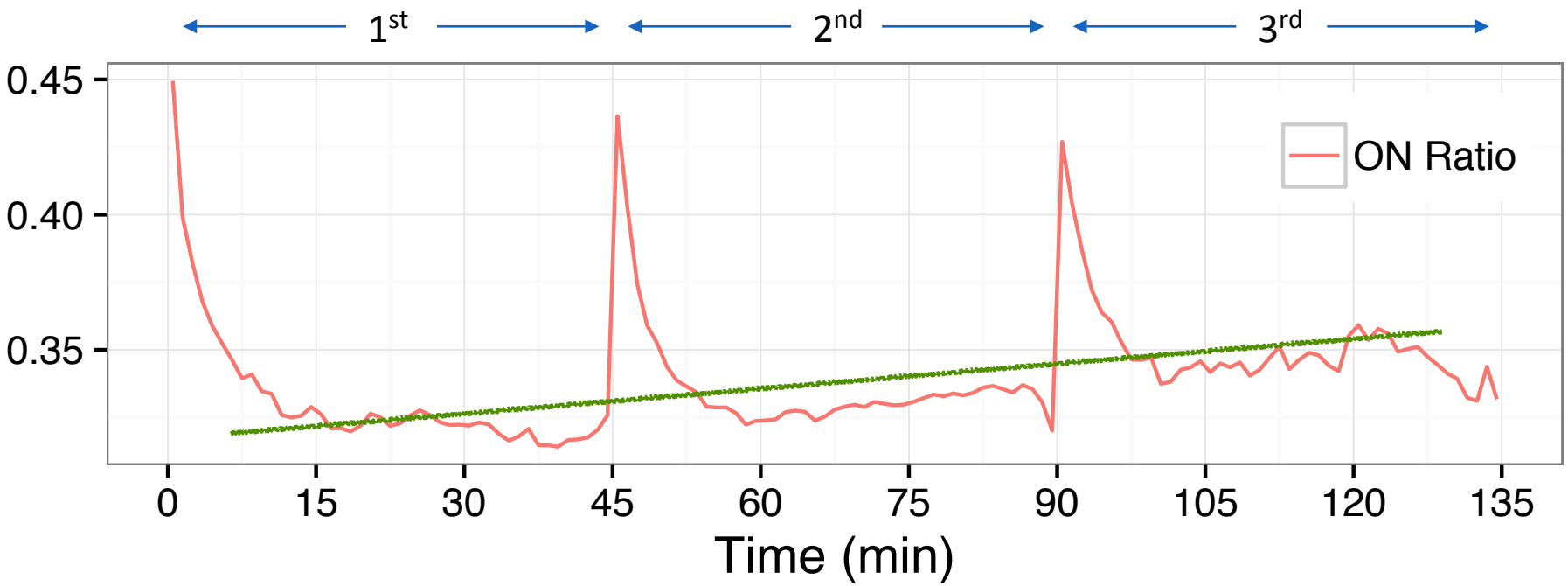

High phone usage quickly drops at the start of each timeslot.

Students gradually lose attention as lecture progresses.

Aggregated Distraction (ON) Ratio

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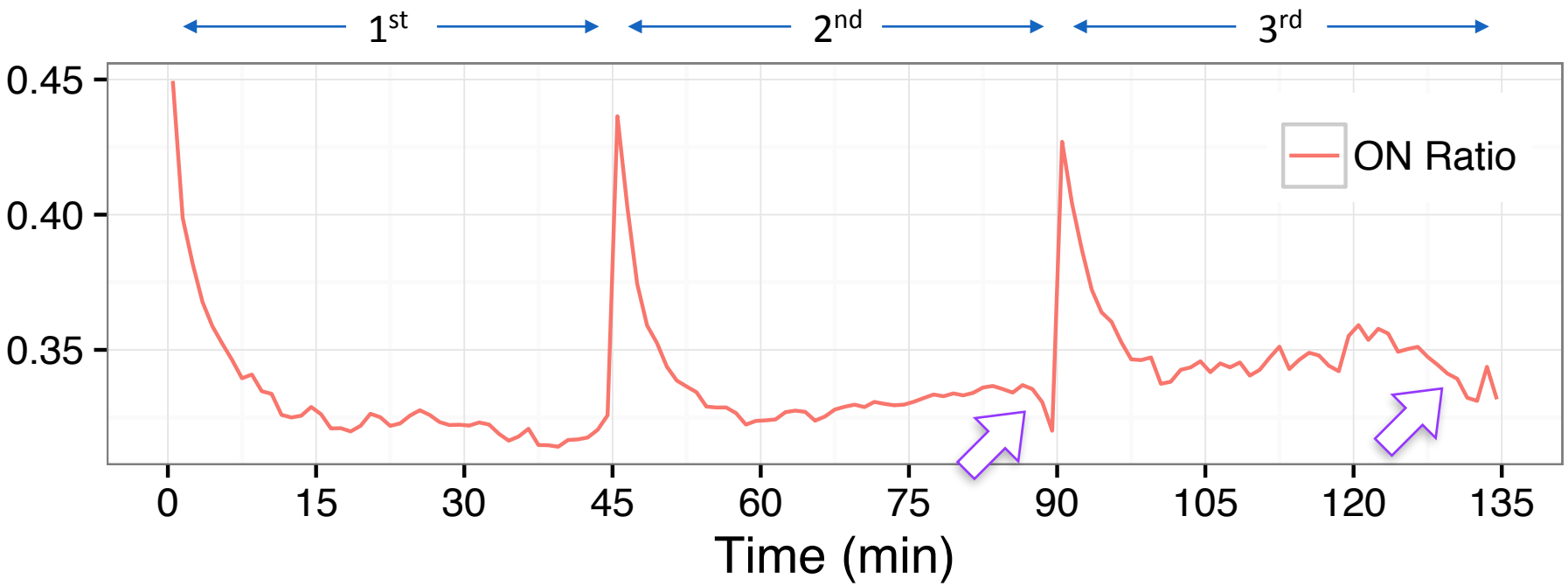


High phone usage quickly drops at the start of each timeslot.

Students gradually lose attention as lecture progresses.

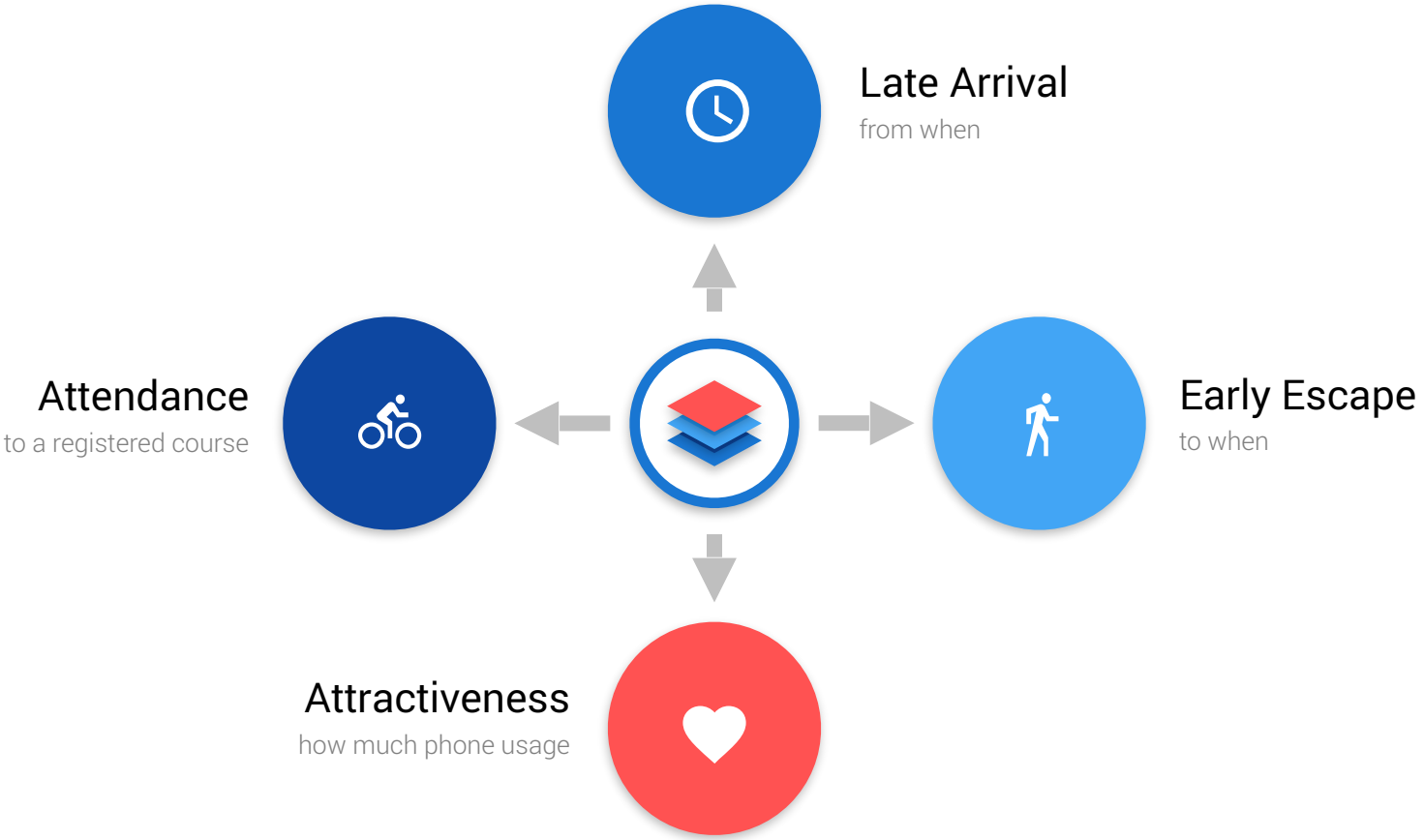
Students stop using phones at the end of lectures.

Recap: Educational Behaviors

1. **Attendance** and **late arrival** ratios to courses both show that Wednesday is the most hard-working day.
2. Class **attendance** is at its highest in the morning, and gradually drops as the day progresses. Meanwhile, fewer students arrive late to classes as the day progresses.
3. Higher grade students are less punctual. The ratio of “night owls” in the 2^{nd} and 4^{th} year is higher than that of the 1^{st} and 3^{rd} year students.
4. Students with higher GPA attend class more. However, they are also more likely to be late compared to low-performance students.
5. Students are more easily distracted as the day progresses.
6. Device usage is highest at the beginning of a lecture, then drops, and then slowly increases as the lecture progresses.

- ……

Recap: Measurements



~4.4km^2 campus
~57,000 population

>2,700 APs
>60,000 devices/day
>15,000 app users

~700 volunteers
~800 courses

EDUM System

for Education Measurements

3 **Accurate**

2 **Big Data**

4 **Objective**

1 **Automatic**

5 **In-situ**

¡Gracias!

¿Preguntas?

 zmoony

 http://zmy.io

 zmoony