



# Innovative Technology in Education: E-book, Sensor, & Electronic-aware Glove

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# Outlines



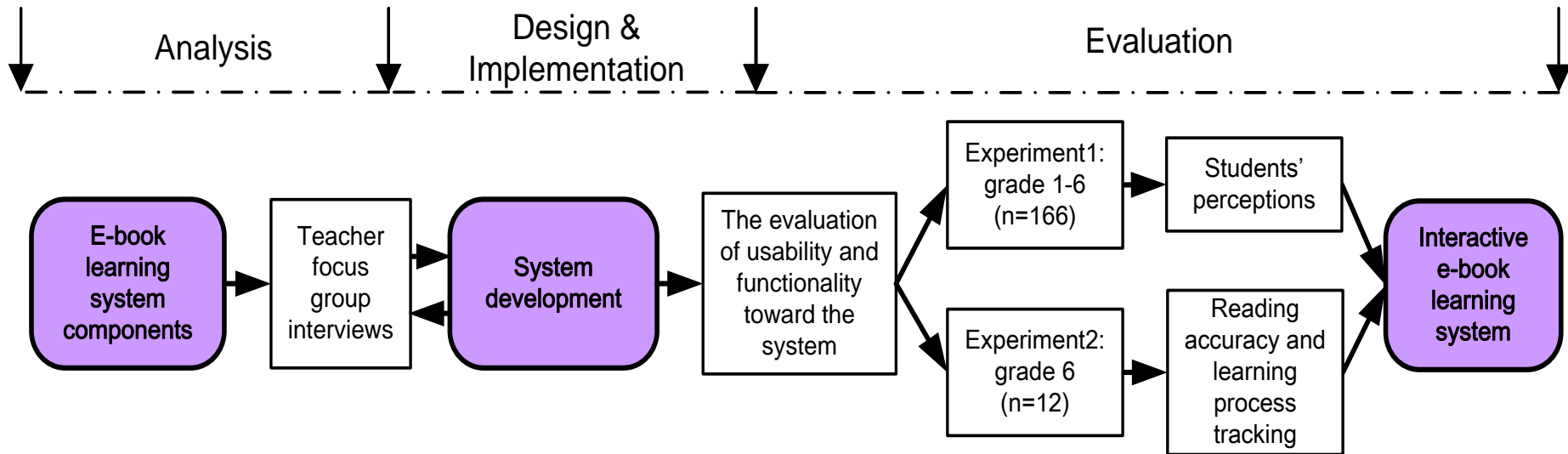
- E-book
  - New design: Interactive e-book learning system
  - Current studies:
    - Formative analysis with reading rate
    - Gender differences in reading e-books
    - Learning diagnosis & reading pattern
  - Future studies:
    - Context aware with sensor technology
- Sensor technology
- Electronic-aware glove



## New design interactive e-book learning system

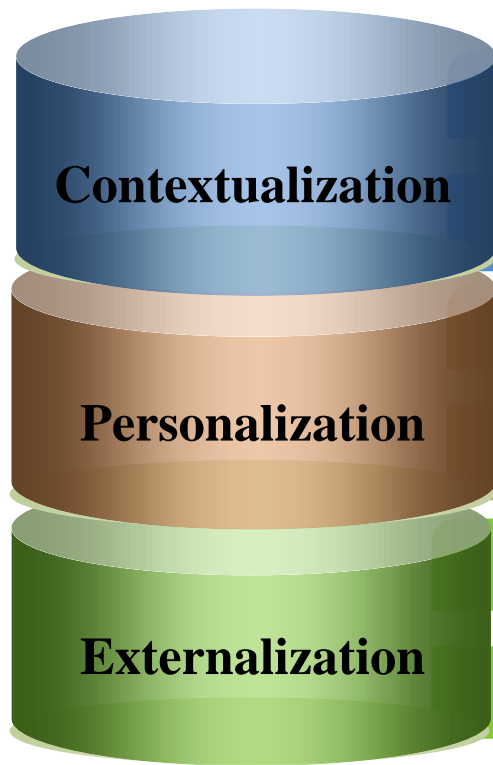


# Research Procedure

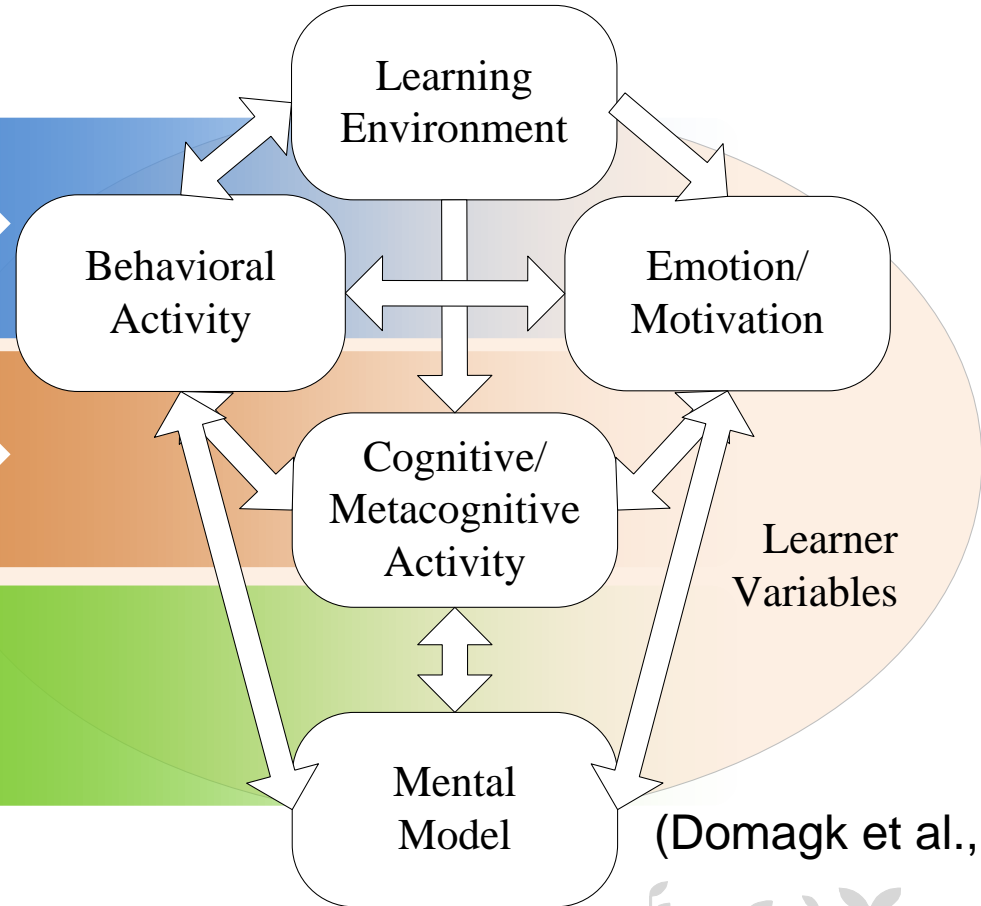




## E-book Learning System Components



## INTERACT Model



# The e-book learning system components



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## Components

## Definitions & examples

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### **Contextualization**

In order to scaffold and enhance students' reading comprehension, the multimedia and interactive controls are developed based on the particular context with regard to the students' needs. (ex. embedded multimedia, spoken text, hotspots, and user control interactivity.)

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### **Personalization**

The students can make personal records during the learning process in order to meet their individual requirements, and these records are context dependent and integrated with the e-book. (ex. e-annotation & bookmarks, content searching, and learning process tracking.)

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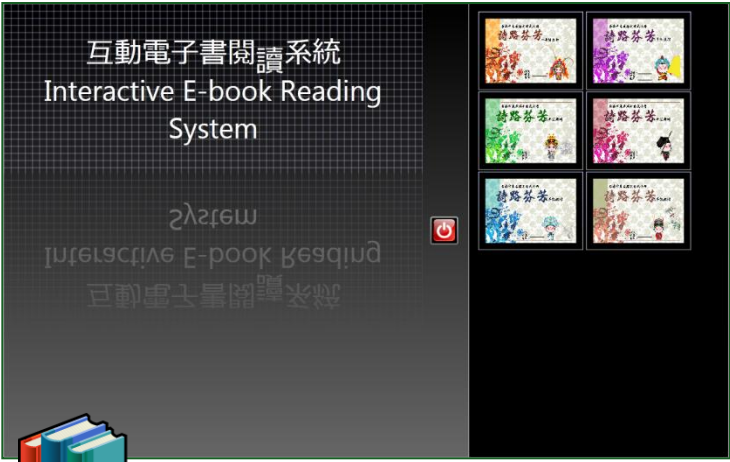
### **Externalization**

The students are able to give external form to what they are thinking and feeling while learning ubiquitously, in order to extend their social interactivity. (ex. notes sharing, home-school links, portability, and ubiquity.)

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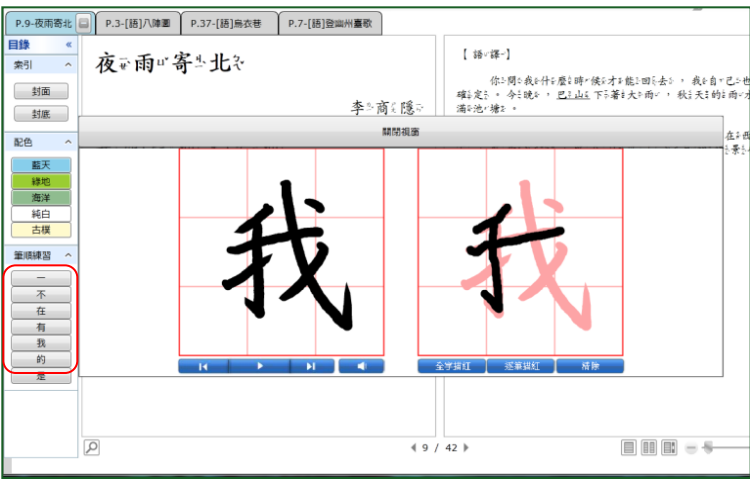
# 電子書櫃及內容元件



(a) E-book shelf



(b) Multimedia embedded



(c) Interactivity: calligraphy



(d) Interactivity: sketch board





# 閱讀輔助工具一

作者：吳瑋琦  
改編自塞維拉媽媽的鏡子

八年華之際，... 腳，差點把門... 詩勤奮篤實的... 直讓外公氣... 逐出方圓百... 面，從此不出... 閣房一步，鎮... 唯一之知己... 橢圓金框的小鏡子，低聲泣訴著她的愛與怨。

最後由於外婆不忍心看女兒如此傷心難... 開，... 定下富... 過，透過友人的協助，讓... 他們在布拉格郊外找到... 來。日子雖然貧苦，媽... 貴，和爸爸 胼手胝足搆起

老家，屋外的圍牆上爬滿... 已久的大門，走進廳堂，... 金框小鏡子，依舊掛在窗... 雖然已經一片模糊，但是媽



(a) Annotation & highlight

華山

只有... 在... 上... 更... 舉... 回首... 白雲... 低。

——宋 五言古詩

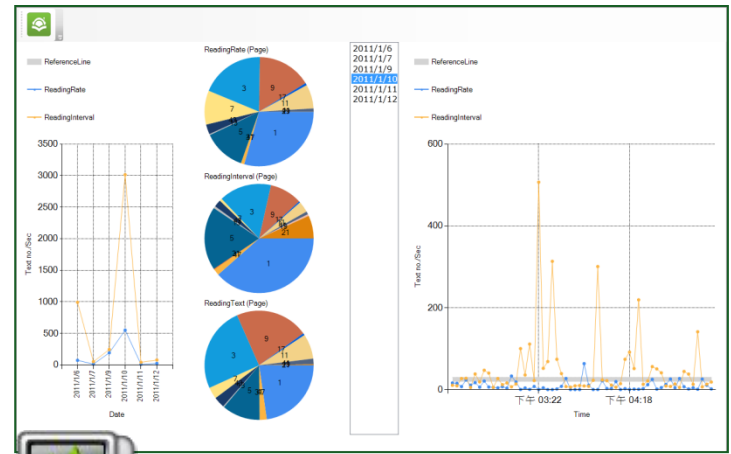


(b) Bookmark (voice)

這是一首詠史詩。詩人藉... 鑄前幽情。鐵戟未... 詩的後兩...

這是... 詩人藉赤壁之戰的遺物，發懷古... 幽情。鐵戟未... 感慨自然深沉。... 詩... 卻不拘泥，大膽假設，出

(c) Search content



(d) Reading process track







# 閱讀輔助工具二

【語譯】  
 瀟瀟的雨聲已停歇。我倚著高樓上的欄杆，想如不盡的國仇家恨，憤怒得頭髮豎起，頂起帽子。  
 我抬頭望向遠方，仰天長聲吟嘯，抒發一腔悲壯的豪情。我已經三十歲，建立的功業卻像塵土不足道，十多年來，日復行軍，奔波了八千多里的路程，尚未消滅敵人。我絕對不能浪費寶貴的高  
 壯年，在還沒洗雪；為  
 破壁題山關口！  
 我絕不能浪費寶貴的高  
 壯年，在還沒洗雪；為  
 破壁題山關口！  
 我絕不能浪費寶貴的高  
 壯年，在還沒洗雪；為  
 破壁題山關口！



(a) Full-screen reading

【語譯】  
 秋天的夜，我深深的懷念你。在涼風的吹拂中，我一面散步，一面吟詠詩歌。  
 你應居空曠寂靜的山裡，這時候應該聽到松子落地的聲音。向來聞雅的你，或許也還沒睡吧！

(b) Annotation Share

【語譯】  
 春天的花朵，秋天的月亮，這樣的良辰美景，不知什麼時候才會終止？那些往事，不知有多少被勾上心頭？  
 昨夜，東風再次吹進我居住的小樓，在明月的月色中，想起故園，心中的痛難以承受。  
 以前宮裡的雕紋欄杆與玉石庭階，應該還保留著，只是那主人的美好容顏已改。我心中有多少哀愁？正像一江的春水不停的向東奔流。

(c) Dynamic viewing modes

【語譯】  
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(d) Index & resources



# The experiments in the evaluation procedure



(a) Experiment 1: paired group students were evaluating the system.



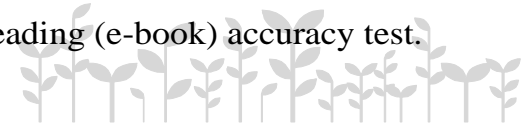
(b) Experiment 1: questionnaire survey.



(c) Experiment 2: the reading (printed book) accuracy test, one student paired with a rater.



(d) Experiment 2: the reading (e-book) accuracy test.



# Experiment 1: perceptions in six grades



## Mean amount of student's perspectives by five dimensions in six grades.

Dimensions	Grade 1 (n=25)		Grade 2 (n=27)		Grade 3 (n=25)		Grade 4 (n=30)		Grade 5 (n=31)		Grade 6 (n=28)		Total (n=166)		ANOVA	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	F	$\eta^2$
	Usefulness	4.60	0.47	4.56	0.46	4.00	0.80	4.05	0.60	3.95	0.86	4.13	1.02	4.20	0.77	4.14**
Ease of use	4.25	0.65	4.45	0.52	3.87	0.87	3.77	0.67	4.05	0.72	4.08	0.84	4.07	0.75	3.31**	0.09
Ease of learning	4.31	0.86	4.44	0.57	3.78	1.34	4.01	0.96	4.37	0.78	4.25	0.97	4.20	0.95	1.88	0.06
Satisfaction	4.69	0.55	4.54	0.50	4.22	0.78	4.30	0.54	4.11	0.80	4.22	0.92	4.34	0.72	2.68*	0.08
Functionality	4.50	0.65	4.60	0.49	4.12	0.84	4.22	0.68	4.14	0.55	4.25	0.89	4.30	0.71	2.26	0.07

# Experiment 1: perceptions in gender



## Mean amount of student's perspectives by five dimensions in gender

Dimensions	Male (n=85)		Female (n=81)		ANOVA	
	M	SD	M	SD	F	$\eta^2$
Usefulness	4.18	0.79	4.23	0.75	0.16	0.00
Ease of use	3.98	0.77	4.17	0.71	2.58	0.02
Ease of learning	4.19	0.87	4.21	1.03	0.03	0.00
Satisfaction	4.20	0.75	4.48	0.66	6.56*	0.04
Functionality	4.20	0.72	4.41	0.68	3.83	0.02



# Experiment 2: reading accuracy

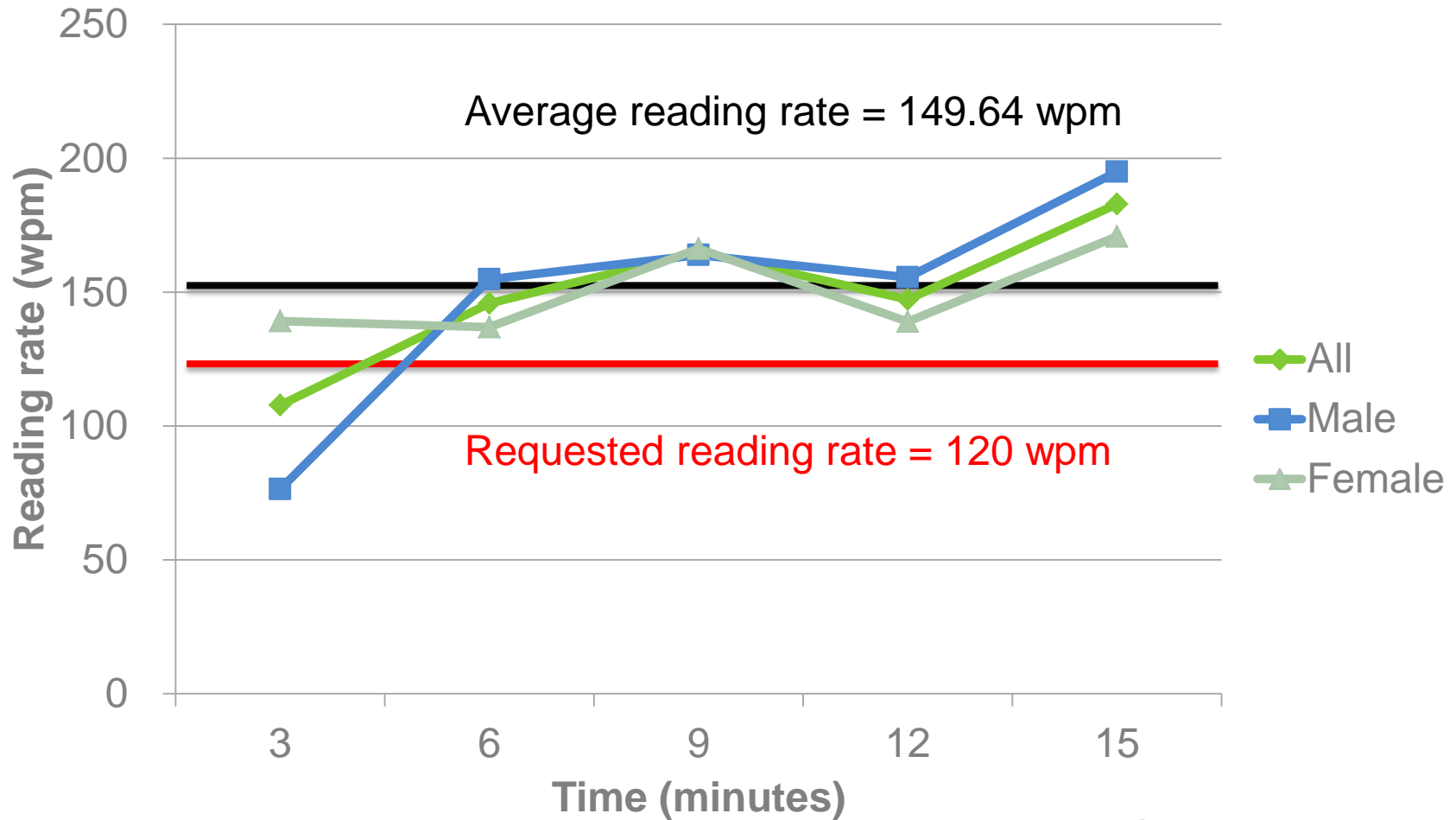


**Oral reading and accuracy rate differences between students who read a printed book and an e-book**

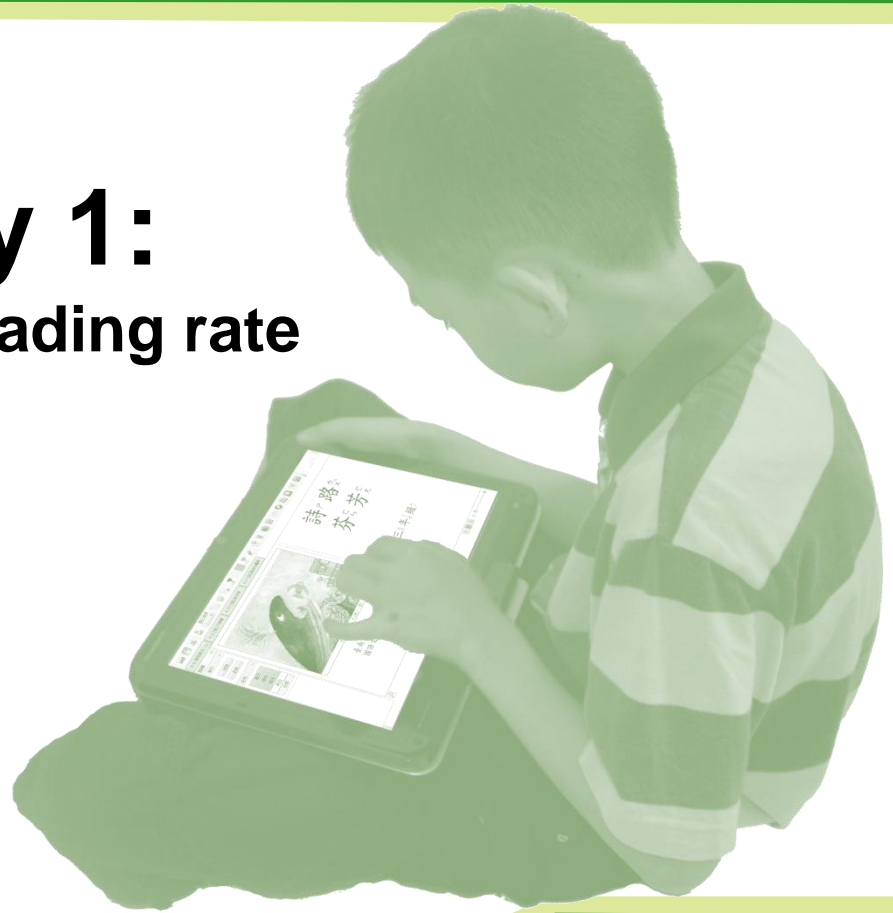
Measure	Printed book (n=12)		E-book (n=12)		df	t
	M	SD	M	SD		
Oral Reading (words)	2,471.83	433.62	2,335.08	294.00	22	.904
Accuracy rate (%)	97.86	1.00	98.12	.86	22	-.687



# The reading rate transformations in the reading process



## Current study 1: Formative analysis with reading rate



# The list of reading statuses associated with reading behaviors

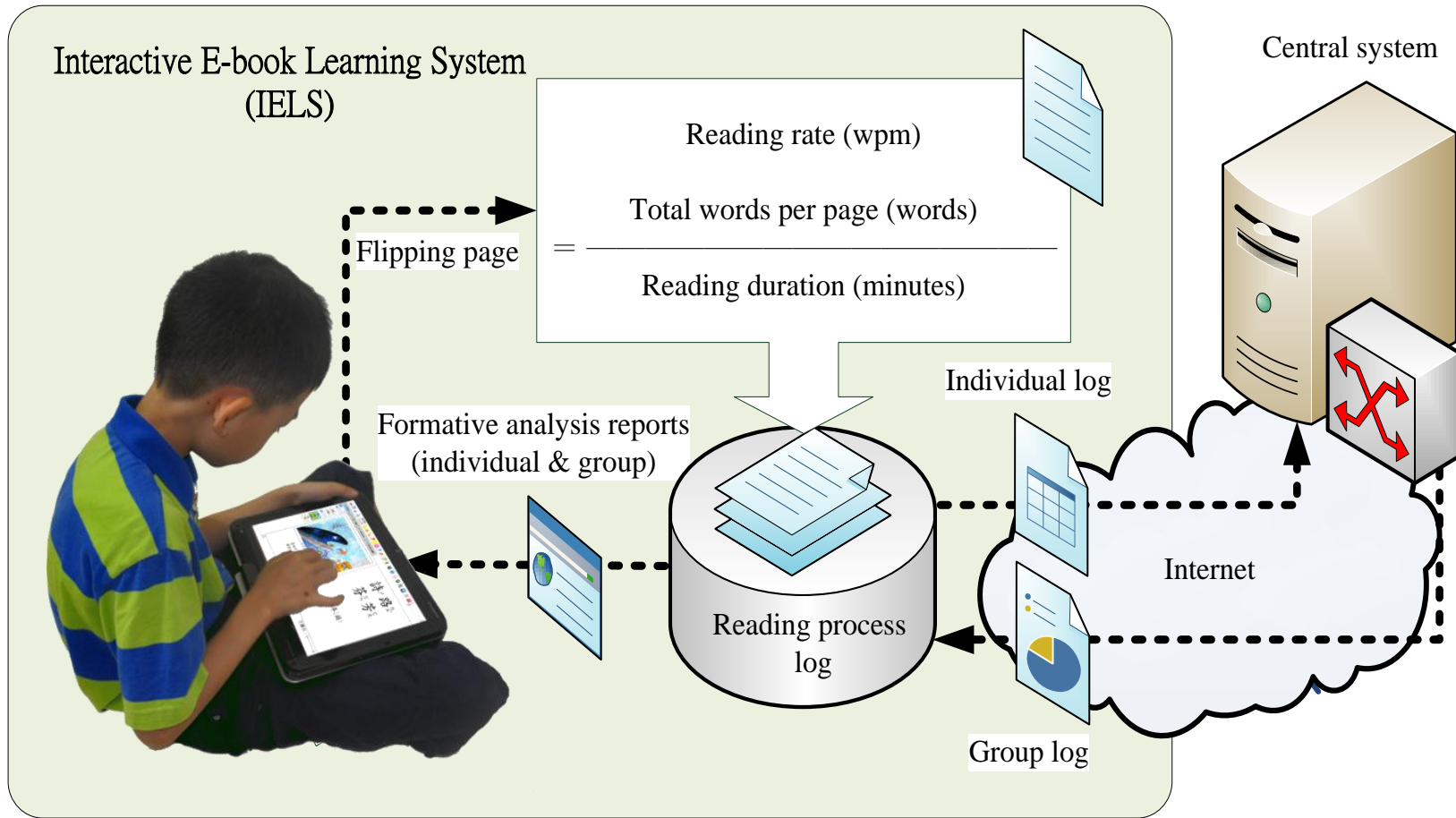


Reading status	Reading rate	Reading behavior
On-reading	0-1,000 wpm	<ul style="list-style-type: none"> <li>Excessively slow</li> <li>Inefficient reading</li> <li>Disfluent</li> <li>Labored</li> <li>Inexpressive</li> <li>Unenthusiastic rendering</li> </ul>
<ul style="list-style-type: none"> <li><i>Slowing</i></li> <li><i>Memorizing</i></li> <li><i>Learning</i></li> </ul>		<ul style="list-style-type: none"> <li>Sustained attention</li> <li>In-depth reading</li> <li>Oral reading</li> <li>Concentrated reading</li> <li>Annotation (highlighting)</li> </ul>
<ul style="list-style-type: none"> <li><i>Rauding</i></li> <li><i>Skimming</i></li> </ul>		<ul style="list-style-type: none"> <li>Keyword spotting</li> <li>Silent reading</li> <li>One-time reading</li> </ul>
<ul style="list-style-type: none"> <li><i>Scanning</i></li> </ul>		<ul style="list-style-type: none"> <li>Reading selectively</li> <li>Browsing and scanning</li> <li>Non-linear reading</li> </ul>
Off-reading	$\geq 1,000$ wpm	<ul style="list-style-type: none"> <li>Flip page</li> <li>Glance and glimpse</li> </ul>

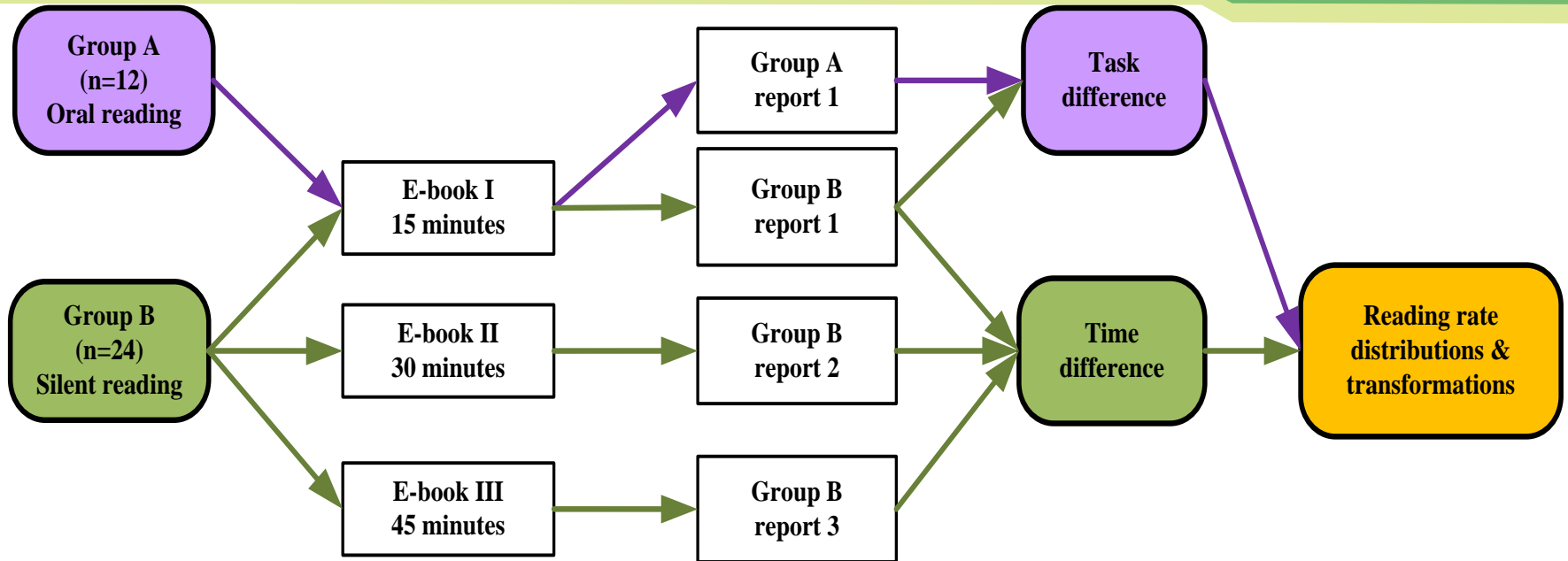




# Reading Process Tracking Technique



# Research procedure



(b) Group A: the oral reading experiment, one student paired with an observer.



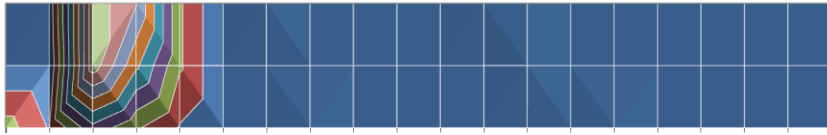
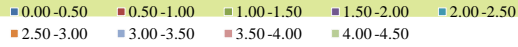
(c) Group B: the silent reading experiment.



# Reading rate distributions



On-reading records



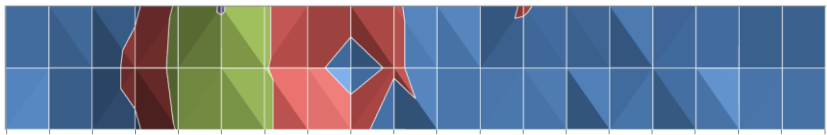
Time (minutes)

Off-reading records



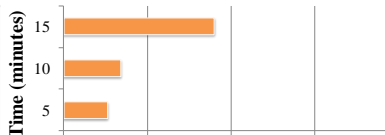
Oral reading (15 minutes)

On-reading records



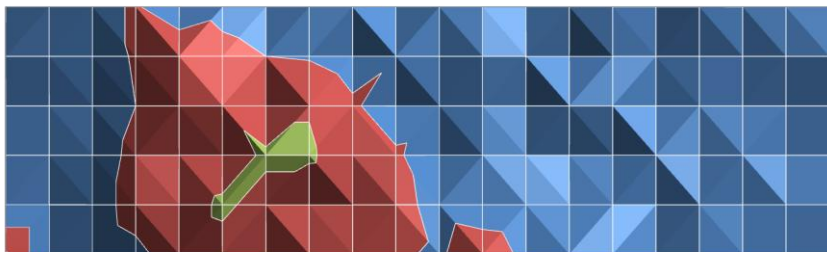
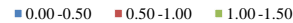
Time (minutes)

Off-reading records

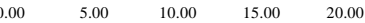


Silent reading (15 minutes)

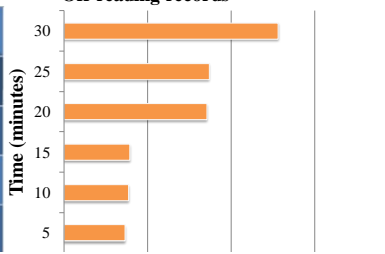
On-reading records



Time (minutes)

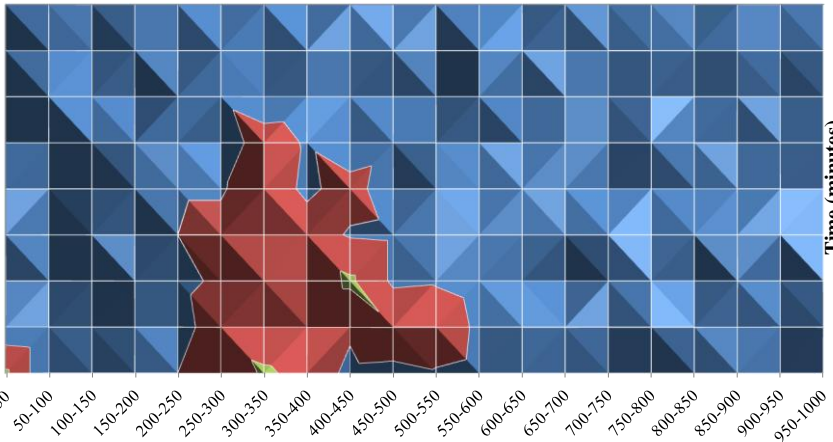
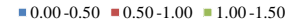


Off-reading records



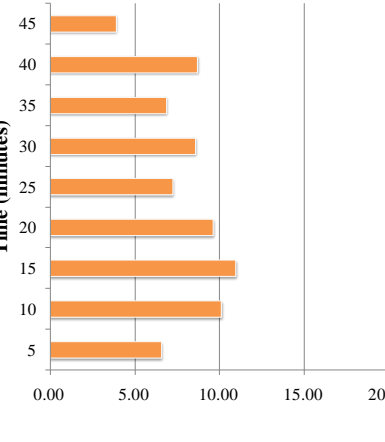
Silent reading (30 minutes)

On-reading records



Time (minutes)

Off-reading records



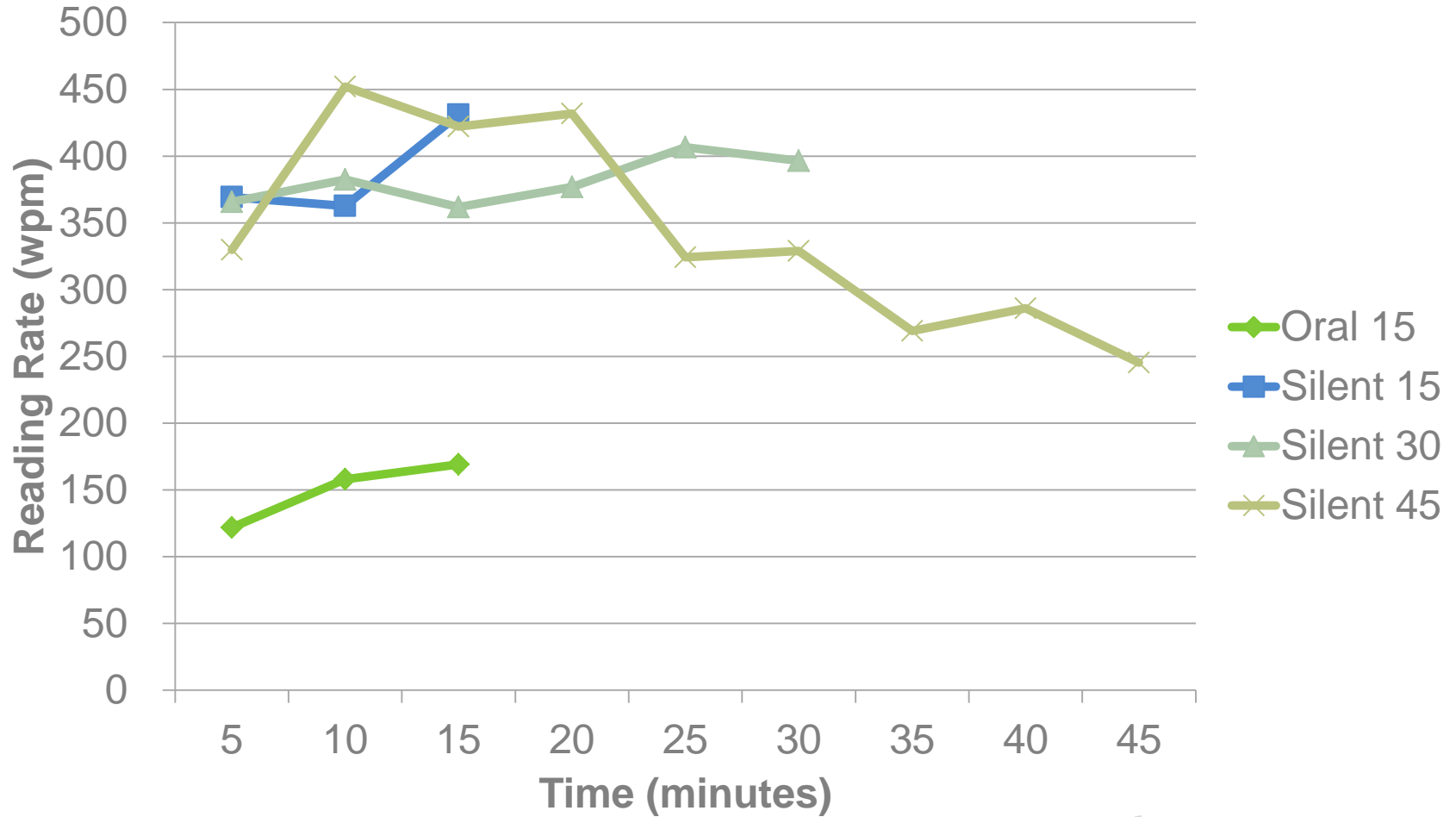
Silent reading (45 minutes)

Reading rate (wpm)

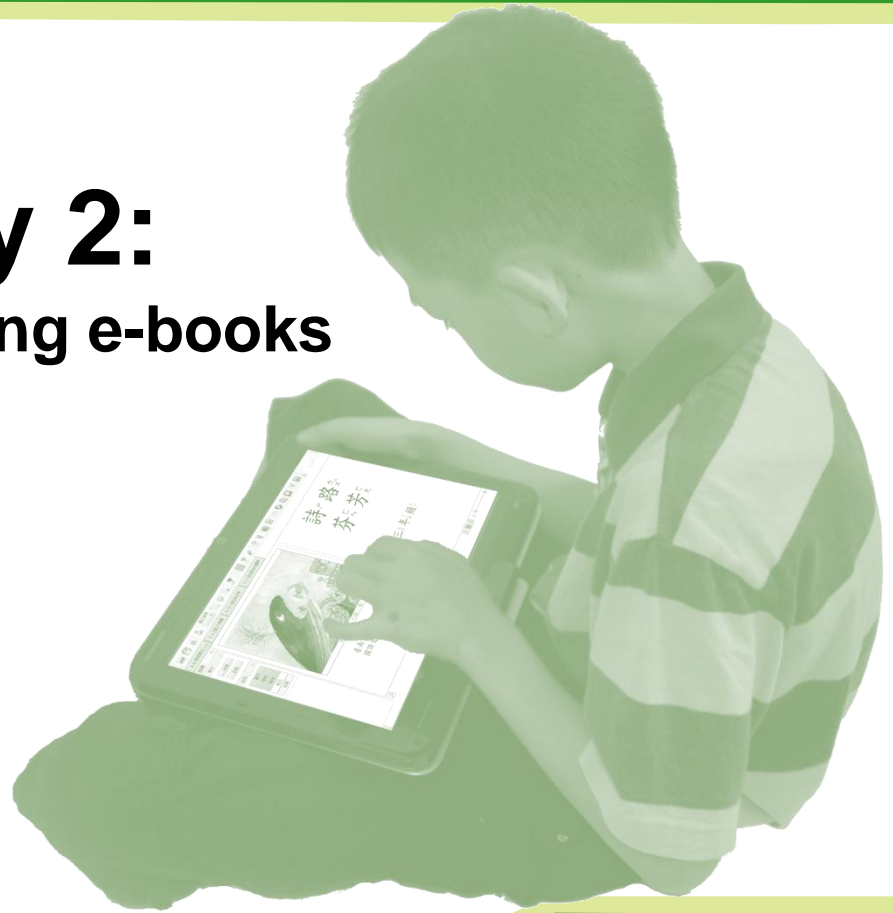
Records



# Reading rate changes



## Current study 2: Gender differences in reading e-books

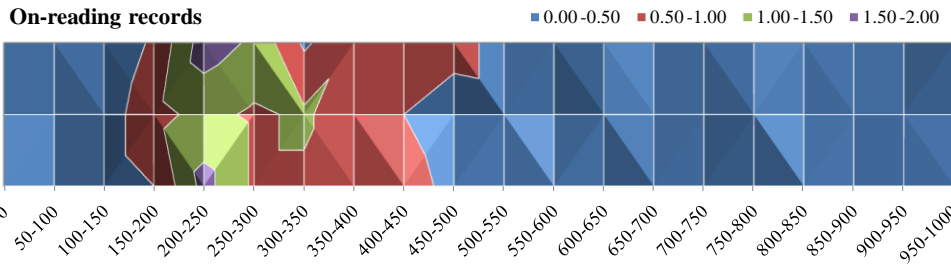


# Reading rate distributions between genders (1/3)



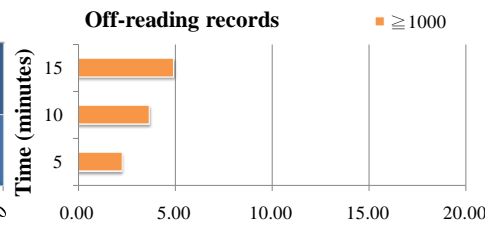
## Silent reading (15 minutes)

On-reading records



Reading rate (wpm)

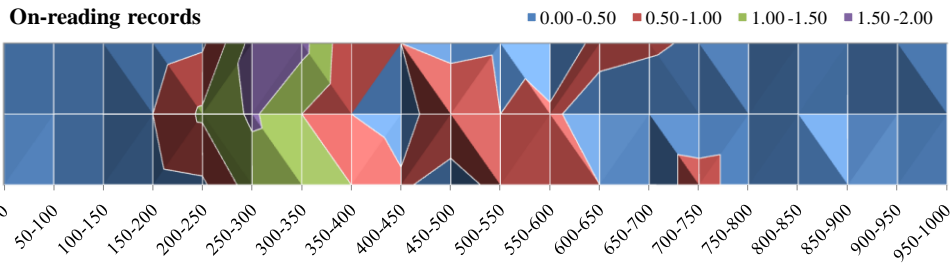
Off-reading records



Records

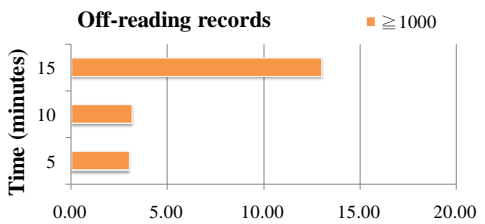
Male students

On-reading records



Reading rate (wpm)

Off-reading records



Records

Female students



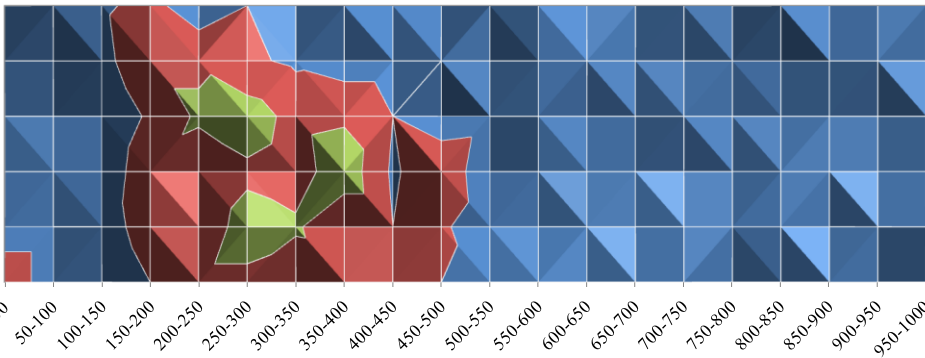
# Reading rate distributions between genders (2/3)



## Silent reading (30 minutes)

On-reading records

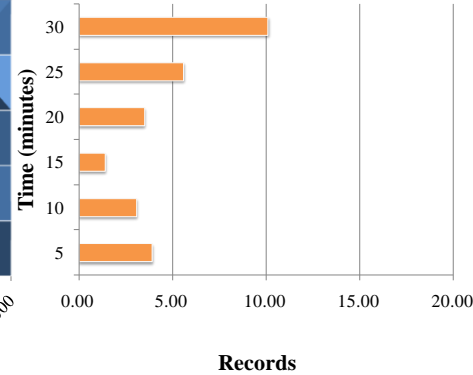
0.00-0.50 0.50-1.00 1.00-1.50



Reading rate (wpm)

Off-reading records

≥ 1000

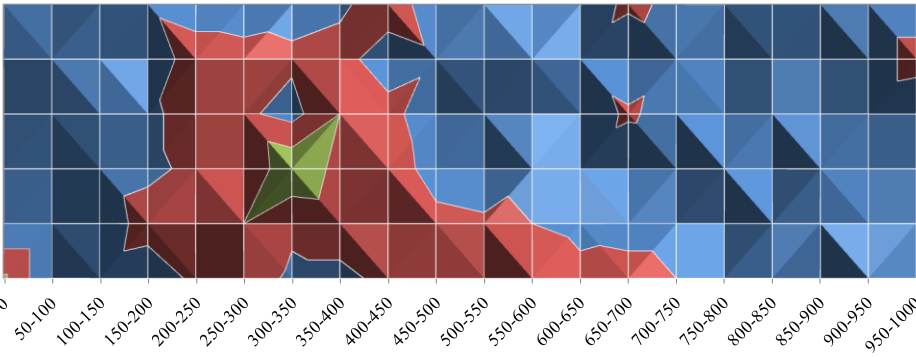


Records

Male students

On-reading records

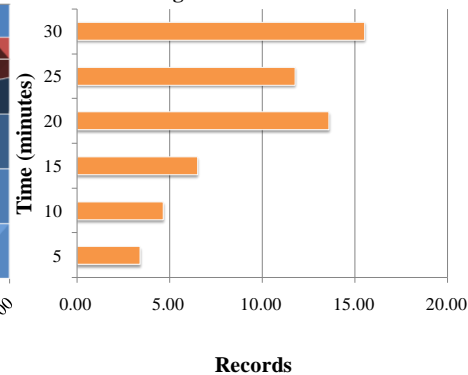
0.00-0.50 0.50-1.00 1.00-1.50



Reading rate (wpm)

Off-reading records

≥ 1000



Records

Female students



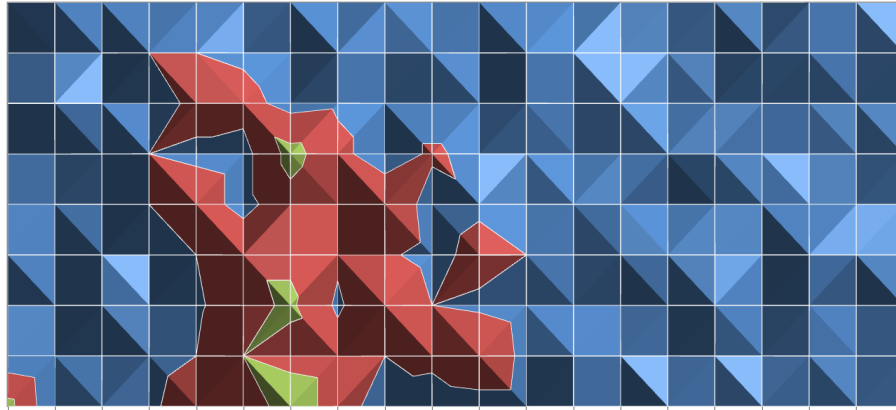
# Reading rate distributions between genders (3/3)



## Silent reading (45 minutes)

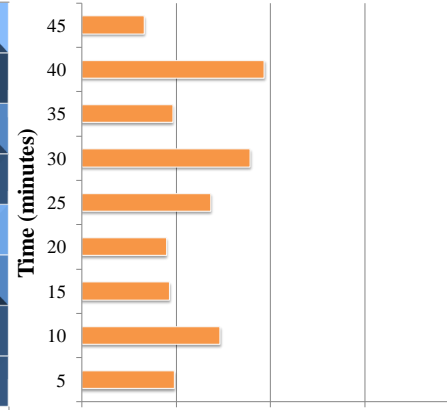
On-reading records

■ 0.00-0.50 ■ 0.50-1.00 ■ 1.00-1.50



Off-reading records

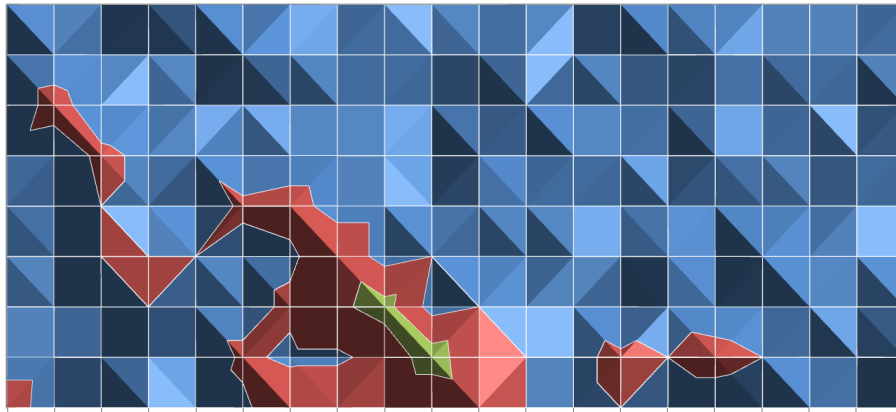
■  $\geq 1000$



Male students

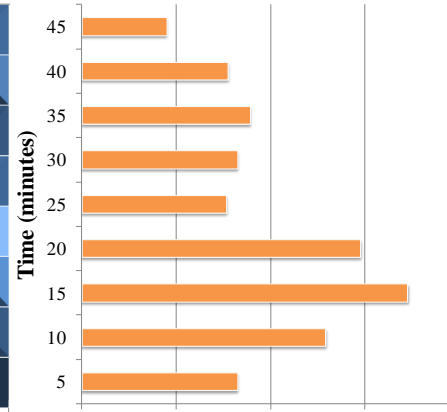
On-reading records

■ 0.00-0.50 ■ 0.50-1.00 ■ 1.00-1.50



Off-reading records

■  $\geq 1000$



Female students

Reading rate (wpm)

Records



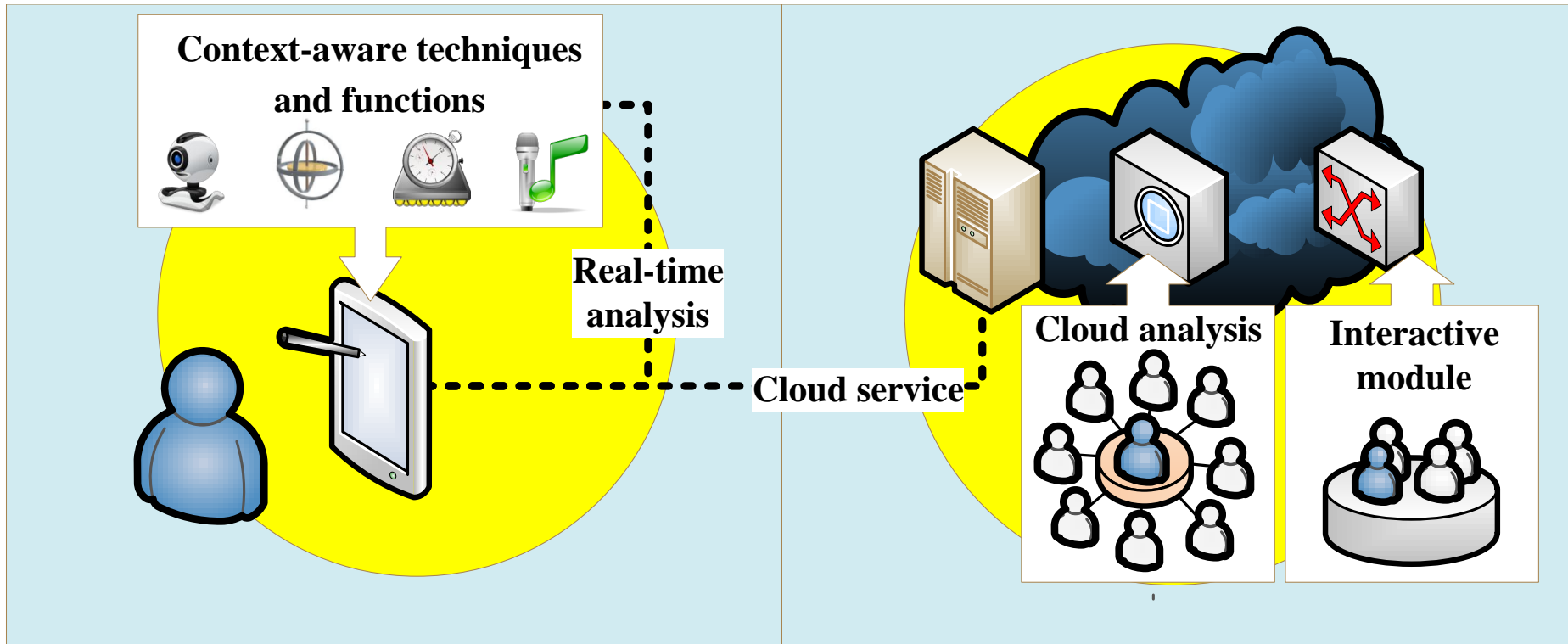


## Future Studies

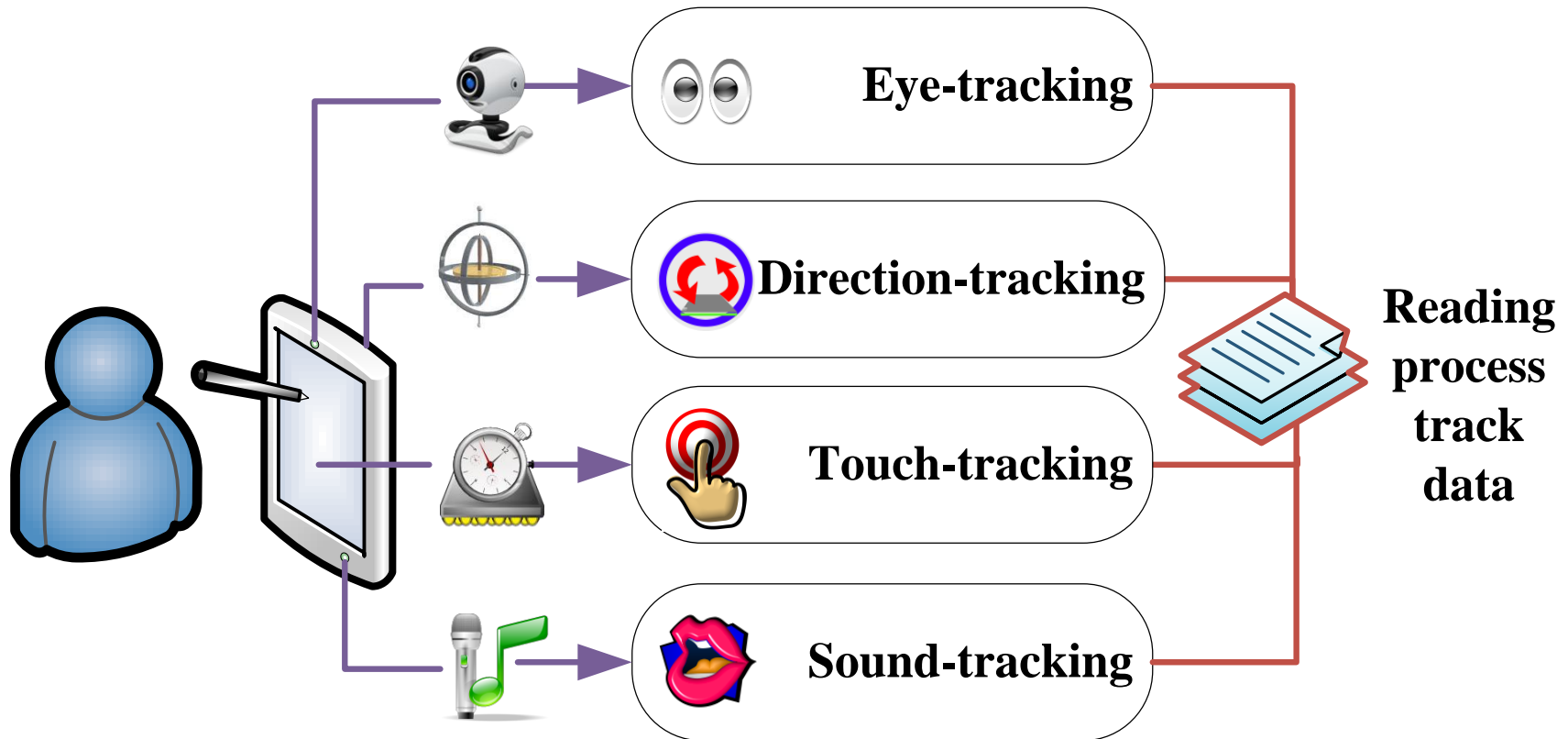
Context aware with sensor technology



# Learning process research framework



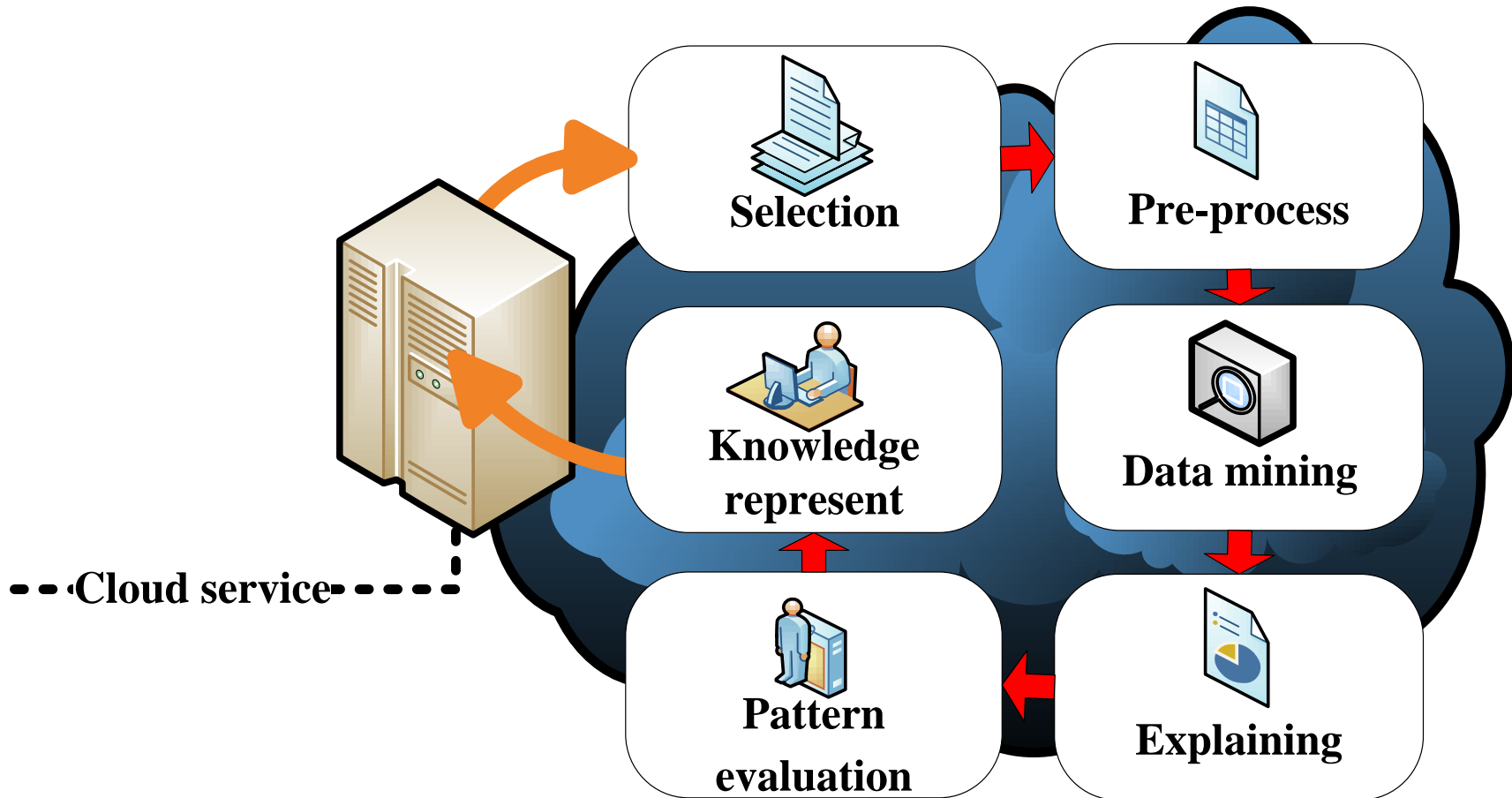
# Context-aware techniques



Options: GPS sensor, ambient-light sensor



# Reading process- student modeling



## Sensor technology



# 學習狀態測量系統



- 影像元件
  - 攝影機
- 感測元件
  - 血氧脈搏感測器
  - 壓力坐墊感測器
- 雲端元件
  - 雲端伺服器



# 影像元件





- 功能

- 特徵偵測

- 臉、雙眼、瞳孔、鼻子

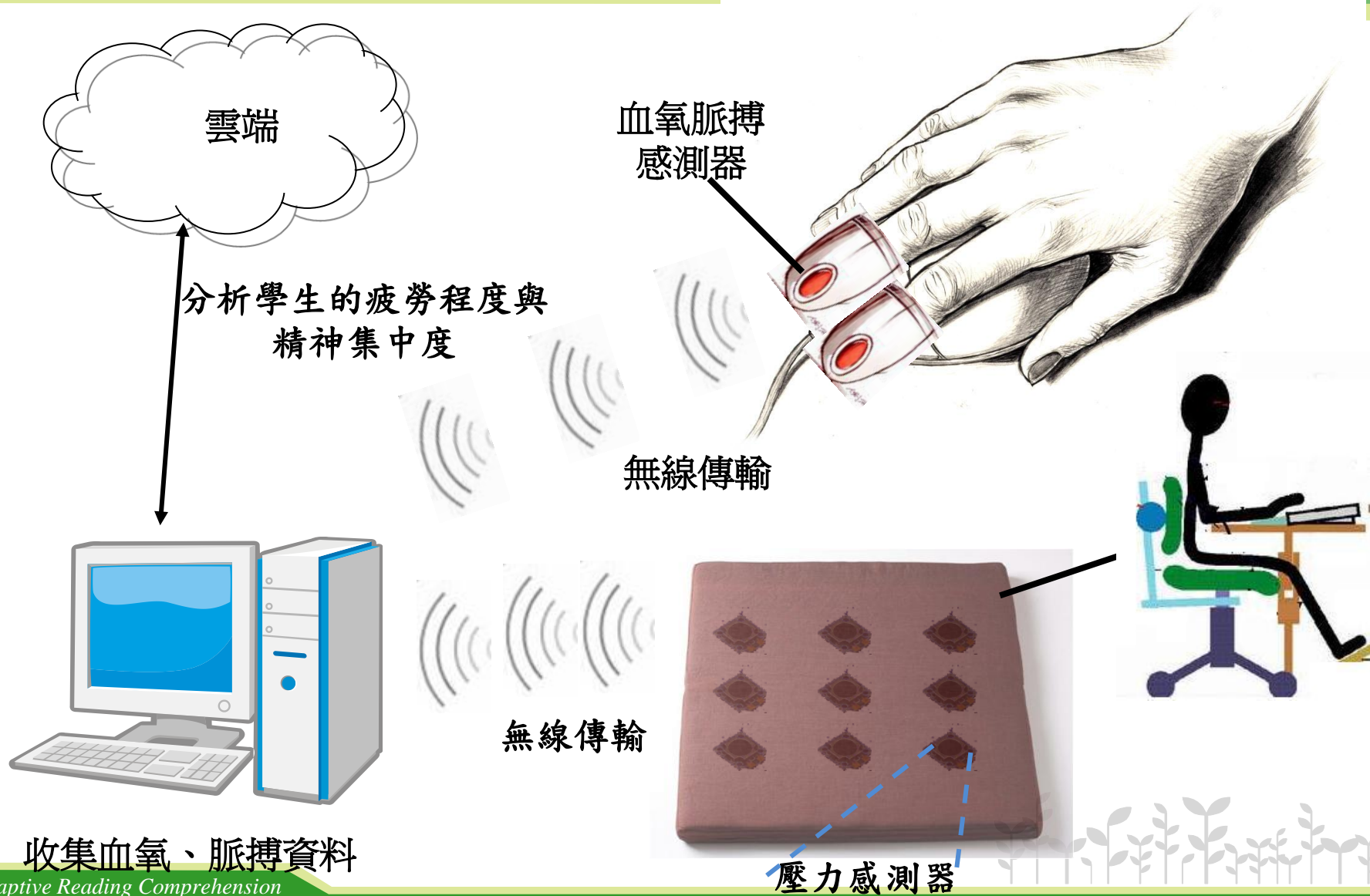
- 非專注力判斷條件

- 臉部偵測失敗(離開座位)
    - 視線偏離螢幕(上下左右)
    - 閉眼(單眼或雙眼)





# 感測元件



# 感測元件：血氧脈搏感測器



- 設備
  - Pulse-Oximater: HBE-Ubi-nanoLoc M100i0404
- 紅外線偵測
  - 心跳反應學習情緒
    - 平靜、激昂
  - 血氧反應學習狀態
    - 是否疲勞



# 感測元件：血氧脈搏感測器



# 感測元件：壓力感測器

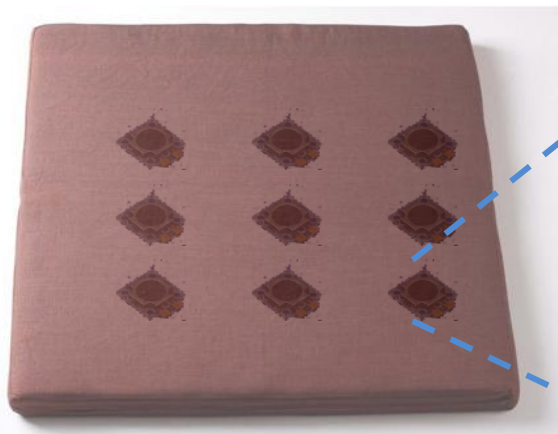


- 設備

- FlexiForce Sensor Model A201

壓力感測器規格

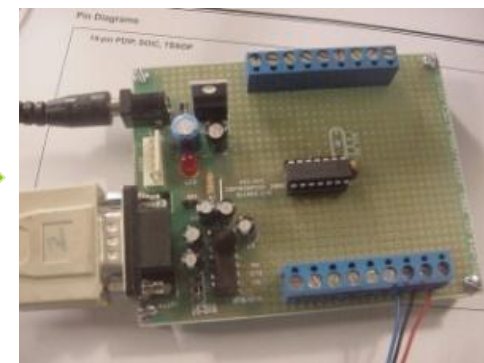
連結器	電路板 (RS232)
元件大小	1cm*1cm
測量範圍	1cm <sup>2</sup>
測重區間	0~60kg



坐墊示意圖



電壓式壓力感測器



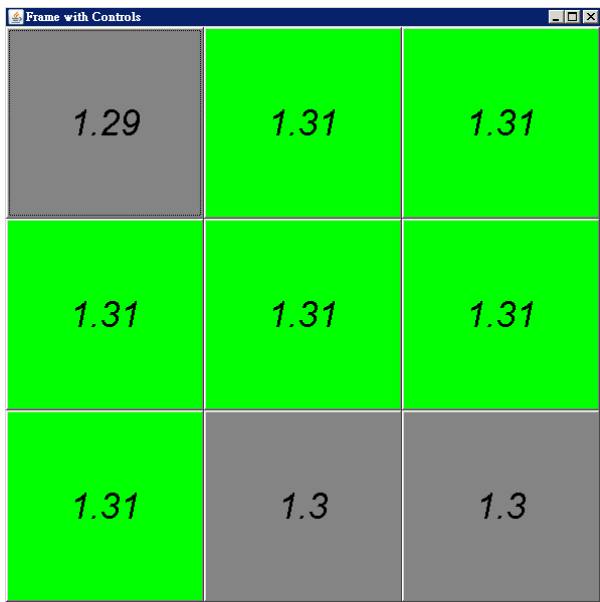
類比數位連結器



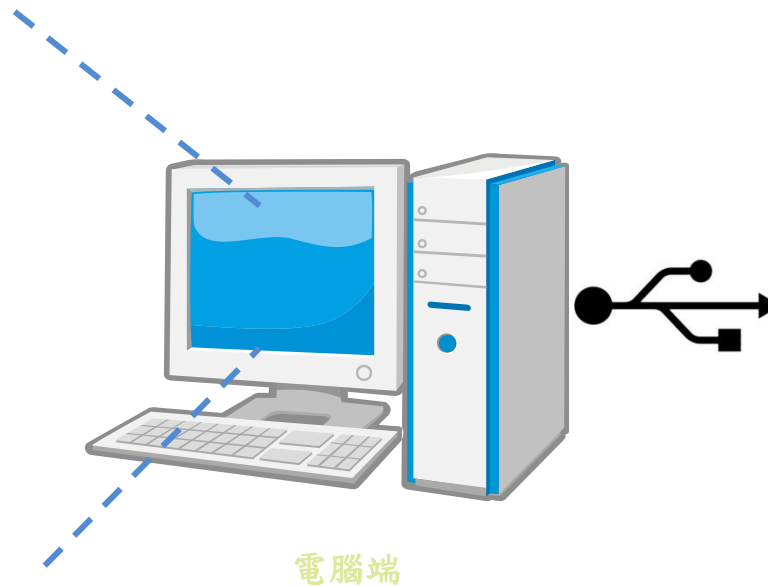
# 感測元件：壓力感測器



- 坐姿偵測
  - 壓力坐墊之變異量分析方法



電腦端資料畫面



壓力坐椅測試版

# 感測元件：壓力感測器



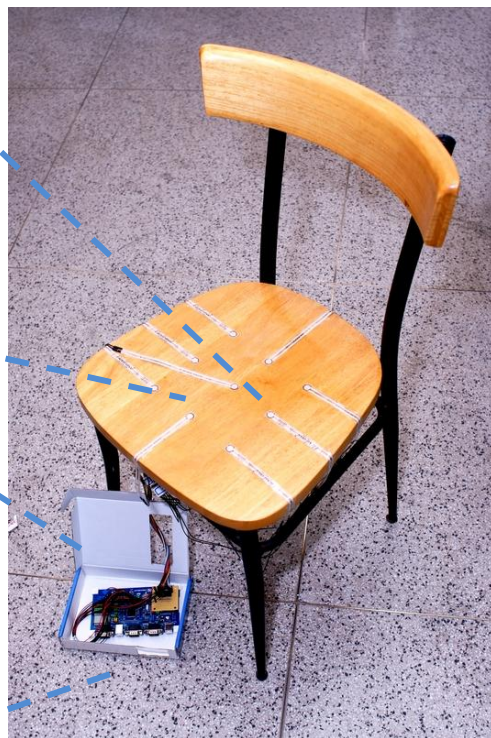
- 壓力坐椅
  - 連結電腦進行壓力分析



電壓式壓力感測器



類比數位連結器  
Adaptive Reading Comprehension



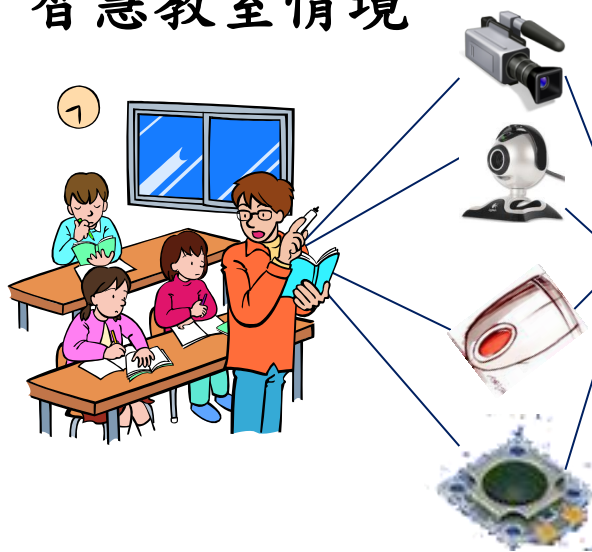
壓力坐椅測試版



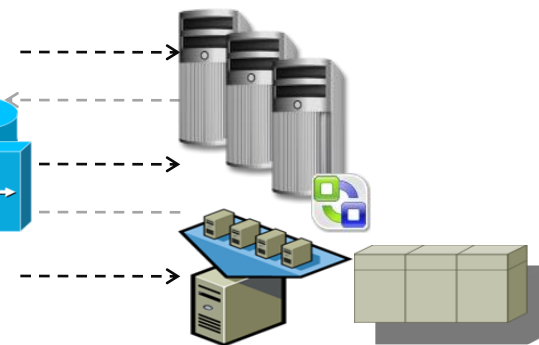
# 雲端元件



## 智慧教室情境



## 雲端運算中心





- 雲端架設
  - Hadoop架設



**NameNode '192.168.0.101:9000'**

**Started:** Mon Nov 01 13:44:07 CST 2010  
**Version:** 0.20.2, r911707  
**Compiled:** Fri Feb 19 08:07:34 UTC 2010 by chrisdo  
**Upgrades:** There are no upgrades in progress.

[Browse the filesystem](#)  
[Namenode Logs](#)  
[Go back to DFS home](#)

**Live Datanodes : 3**

Node	Last Contact	Admin State	Configured Capacity (GB)	Used (GB)	Non DFS Used (GB)	Remaining (GB)	Used (%)	Used (%)	Remaining (%)	Blo
cloud1	0	In Service	72.45	0	7.42	65.03	0	<input type="text"/>	89.76	
cloud2	2	In Service	72.14	0	7.21	64.93	0	<input type="text"/>	90	
cloud3	0	In Service	72.14	0	6.94	65.2	0	<input type="text"/>	90.38	0





# 學習狀態



成功大學  
工程科學系  
一年一班

學生名單

葉大雄

方大同

許阿福

王小明

賴技安

林小美

蕭叮噠

李小華



班級

一年一班

姓名

葉大雄

學號

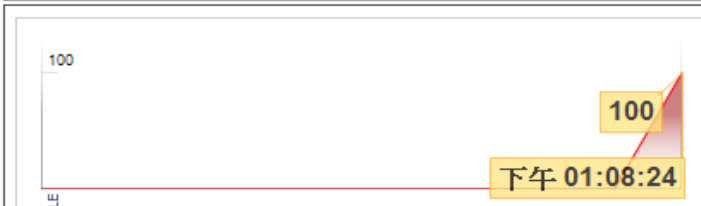
N1000

## 學生基本學習狀態資料表

### 專注力資料

#### 資料說明:

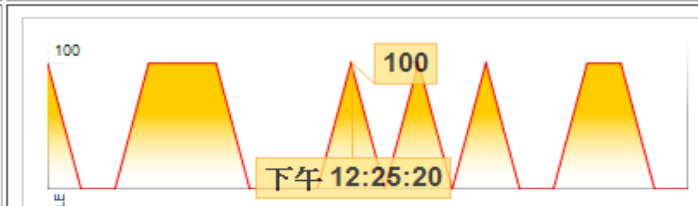
每次網頁更新時會呈現學生最近約一分鐘的專注力狀態100表示雙眼視線維持在電腦螢幕上0表示不專注，可能的原因是雙眼視線偏離電腦螢幕、持續閉眼超過5秒或離開位置。



### 壓力坐墊資料

#### 資料說明:

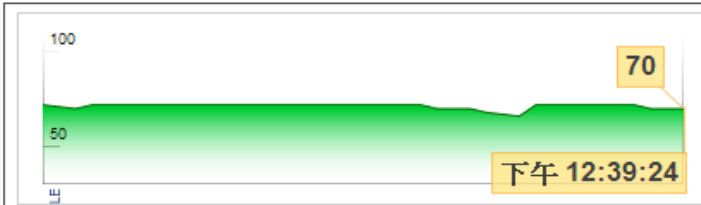
圖表呈現學生的上課坐姿狀態，狀態100表示坐姿為不穩定狀態，表示不專注於上課內容，狀態0為穩定狀態，表示專注於上課內容。



### 心跳資料

#### 資料說明:

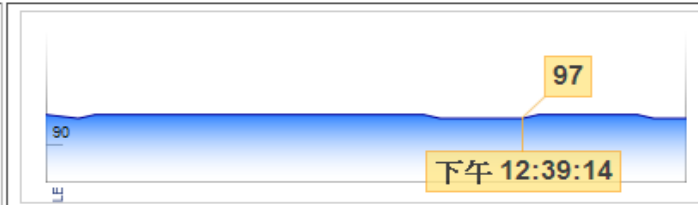
圖表呈現學生的心跳狀態，一般人的平均心跳為72下，數值大於72下為激動狀態，數值小於72下為穩定狀態。



### 血氧資料

#### 資料說明:

圖表呈現學生的血氧狀態，數值大於95為專注狀態，數值小於95為不專注狀態。



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最佳解析度：1024 x 768 最佳瀏覽環境：Internet Explorer 6.0版



# 影片展示



- 展示



## Electronic-aware glove



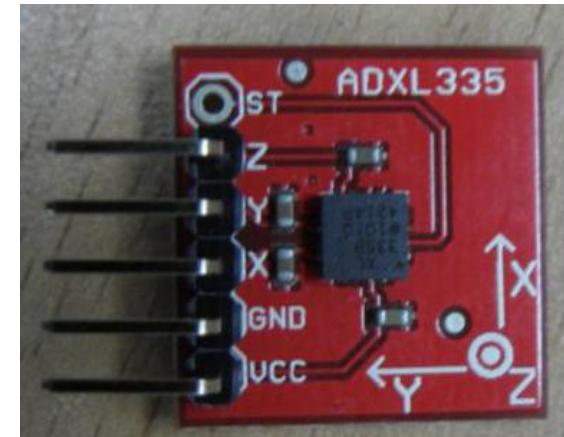
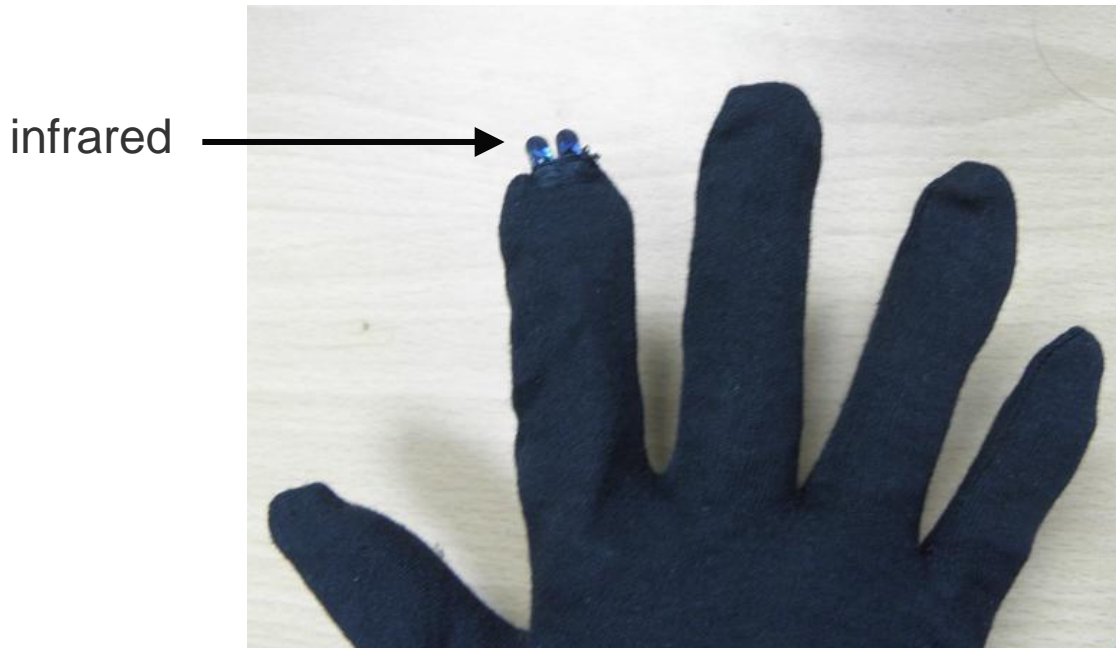
# Electronic-aware glove



- Flex sensor
- 3 axis accelerometer sensor
- Infrared



flex sensor



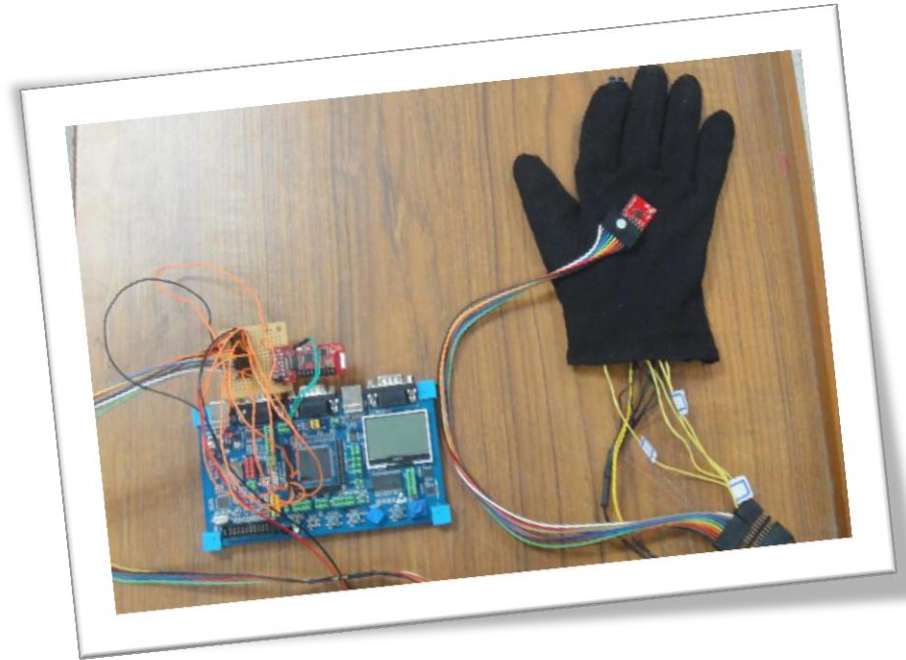
3 axis accelerometer sensor



# Electronic-aware glove



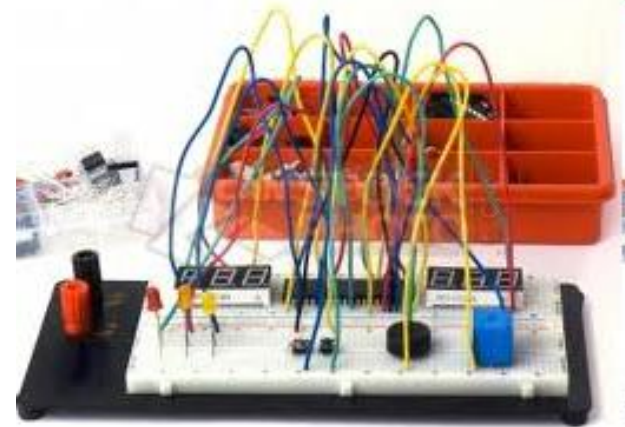
- human-computer interaction



# 應用於電子電路設計課程


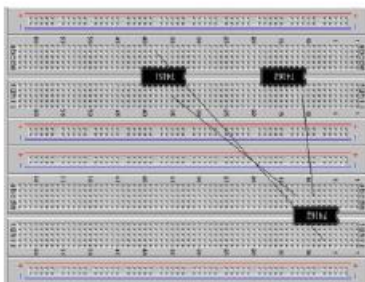
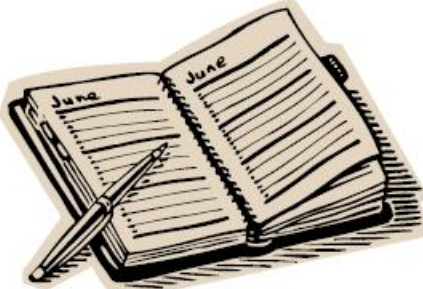

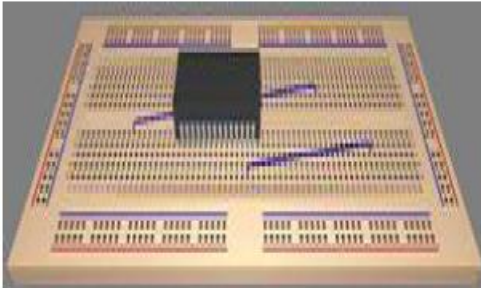



- 目的：  
基於前瞻性電子書環境發展整合虛擬與實  
境的電子電路實驗環境
  - 體感控制
  - 虛擬教具



# 應用於電子電路設計課程



	操作方式	介面	學習歷程
傳統 CAD	 滑鼠操控	 2D 模擬麵包板	 紙本記錄
本計畫	 直接動手操控	 3D 虛擬實境麵包板	 數位記錄





## Adaptive Reading Comprehension

# Thanks for your attention!

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