Experience of Using Mobile Technology in Digital Classroom: Two Case Studies

Siu Cheung KONG

Department of Mathematics and Information Technology
The Hong Kong Institute of Education, Hong Kong

Mobile Technology in School Education

- Growing integration of mobile devices and
- WiFi technology into the classroom environment

Digital Classroom

- Definition:
  - A classroom where learners have ample opportunities to use digital technology **to access digital resources** and **to interact among learning peers and teachers**
- Components:
  - **Whole class teaching**
  - **Individual learning**
  - **Peer interaction**

Educational Affordances of Mobile Technology for Digital Classrooms

- For whole class teaching:
  - **Clear representation of key concepts** and **easy capture of student works** for **reviewing and summarizing** subject matter
- For individual learning:
  - **Ubiquitous access to multimedia resources** for learning on an individual basis, under teacher guidance
- For interaction among learning peers:
  - **Clear representation of ideas** and **handy processing of data** among learners in small groups for discussion of subject matters

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

External Inputs required in Digital Classrooms supported by Mobile Technology

- **Connection to learning resources**
  - Textbook or subject-specific organized resources
    - e.g. cognitive tools selected by teachers for subject learning
  - Open resources not specially organized for subject learning
    - e.g. subject-related websites available on the Internet

- **Implementation of appropriate pedagogies**
  - Pedagogical strategies with various learning activities
    - e.g. inquiry-based pedagogy with mind map drawing activities

An Empirical Research in Hong Kong

- Investigated the effectiveness of using mobile technology in digital classrooms for supporting student learning in school education
- Conducted 10 case studies
  - 5 primary schools
  - 5 secondary schools
- Focused on 2 research issues
  - The effectiveness of using mobile technology in digital classrooms for supporting student-centered pedagogy
  - The perceptions of students and teachers toward using mobile technology for subject learning in digital classrooms

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Purpose of This Talk

- To share an **initial experience** of using mobile technology in digital classrooms in **two case studies** in the empirical research
  - Focus 1: Pedagogical practices in class
  - Focus 2: Perception of students and teachers
- Case 1 - Learning “perimeter of polygons” in Primary 4 mathematics classrooms
- Case 2 - Learning “photosynthesis” in Secondary 3 science classrooms

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Participants in the Two Case Studies

- Convenient sampling:
  - **Two Primary 4 classes** in Case 1; **Two Secondary 3 classes** in Case 2
- Random assignment:
  - **One class** in each case was **experimental class *(i.e. Pri-E and Sec-E)***; **Another class** was **control class *(i.e. Pri-C and Sec-C)***

Profile	**Case 1**		**Case 2**	
	Pri-E	***Pri-C***	***Sec-E***	***Sec-C***
Number of students	26	17	28	25
Ratio of boys to girls	16:10	12:5	13:15	20:5
Mean age in years	8	8	14	14

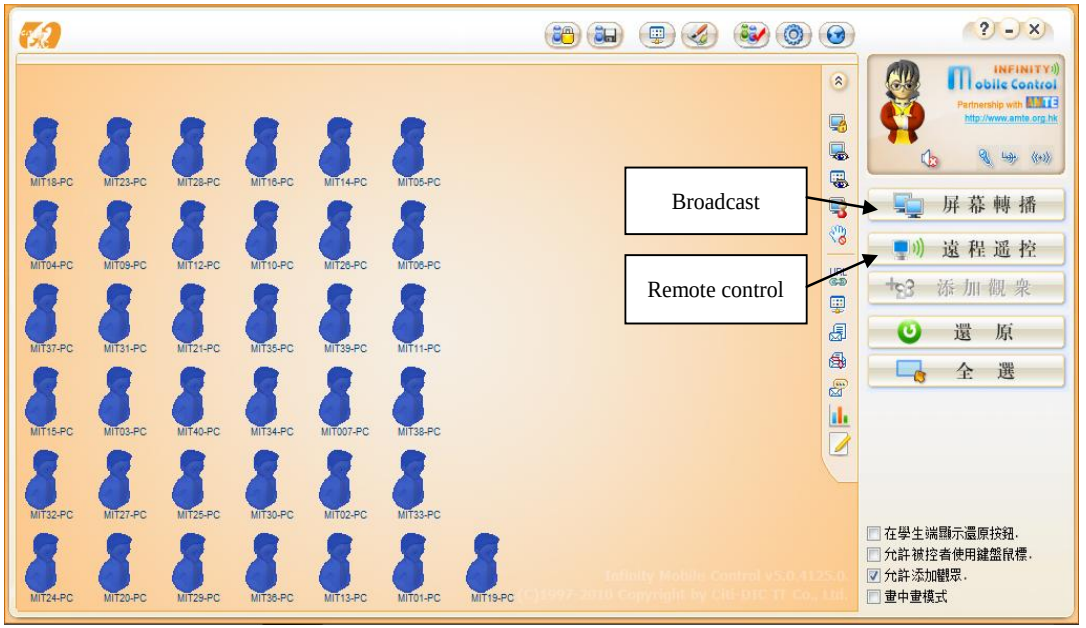
Design of the Two Case Studies

In each case:

- **Experimental class**: Students learned the topic with activity worksheets and mobile devices **(UMPCs for *Pri-E* class and Netbooks for *Sec-E* class)** which were:
  - connected to **a wireless classroom communication system**
  - preloaded with **a digital learning resource (an interactive software for *Pri-E* class and an information delivery tool for *Sec-E* class)** for subject learning
- **Control class**: Students learned the topic with traditional paper-based materials
  - **Textbook** and **notes**

The Wireless Classroom Communication System used in the Experimental Classes

- A software system use in a Wi-Fi (802.11 g/n) environment
- **Teachers** could use the system to easily:
  - **broadcast** information to the mobile devices for sharing and discussion
  - **display** outcome of any connected mobile devices to the whole class



The Hong Kong Institute of Education 香港教育學院

Department of Mathematics and Information Technology

Research Methods

- **Lesson observation**:
  - During the trial lessons
  - For investigating the pedagogical practices in class: Classroom activities and time use
- **Interviews with students and teachers**:
  - After the trial lessons
  - For investigating the perceptions of students and teachers: Opinions on the ease, confidence, autonomy, interactivity, effectiveness, and satisfaction in using mobile devices for classroom learning

Case 1 - Learning “perimeter of polygons” in Primary 4

- The topics of the learning dimension ‘measure’ in the primary mathematics curriculum in Hong Kong
- Developed upon the fundamental understanding of the concepts of ‘perimeter,’ the ‘perimeter of squares,’ and the ‘perimeter of rectangles.’

Cognitive tools (CTs)

- Both mental and computational devices
- Support the cognitive processes of learners

Computer-supported CTs

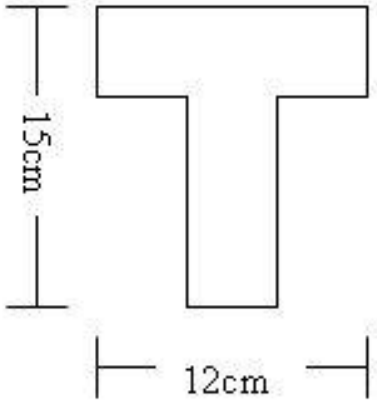
- Explore the gist of subject knowledge according to their individual needs
- Facilitate learner-centred learning
  - Support the learning process
  - Enhance the learning effect of learners

One of the inadequacies of students

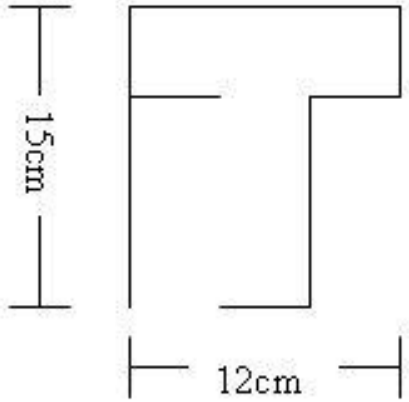
- Lack the ability to develop the relational knowledge about perimeters of polygons in regular and irregular shapes
- For example:
  - To find the perimeter of the irregular closed shape ‘T’
- Difficult to understand the abovementioned abstract association

Steps showing the movement of lines to find the formula for calculating the perimeter of the irregular closed shape ‘T’

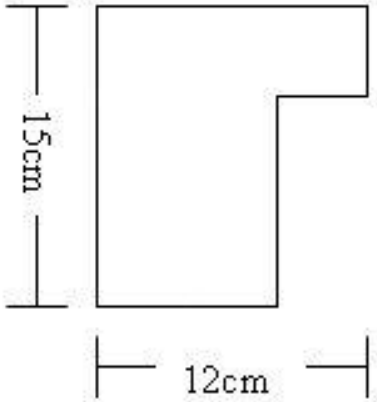
1.



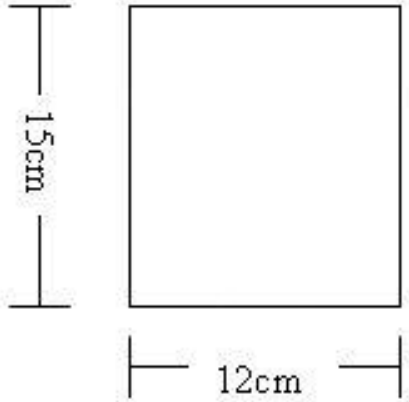
2.



3.



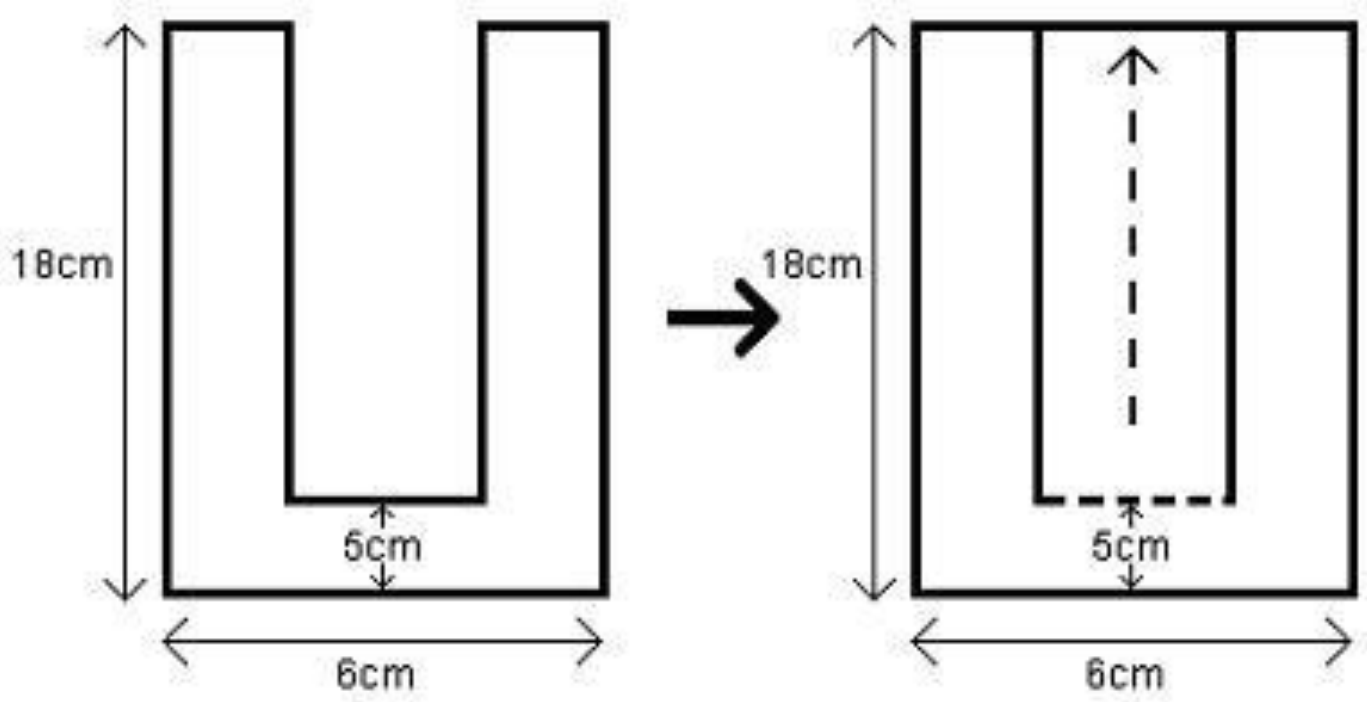
4.



The other inadequacy of students

- Lack the ability to restructure the procedural knowledge about perimeter of irregular closed shapes
- For example:
  - To find the perimeter of the irregular closed shape ‘U’
- Questioning to the need for the aforementioned complete inclusion of line segments

Example showing the movement of lines to find the formula for calculating the perimeter of the irregular closed shape ‘U’



Interactive Perimeter Learning Tool (IPLT)

- A graphical tool for the display of graphical representation of irregular closed shapes

- Three features were designed to cover the important concepts of the topic and address the common inadequacies

The Hong Kong Institute of Education
香港教育學院
Department of Mathematics and Information Technology

1st Feature: Movable line segments of shape border

- Characteristics:
  - Enabled students to freely move the line segments
  - Not allowed to be rotated
- Aim:
  - To develop the concepts of lines and shapes and the strategies of combining line segments in the calculation of perimeter of closed shapes.

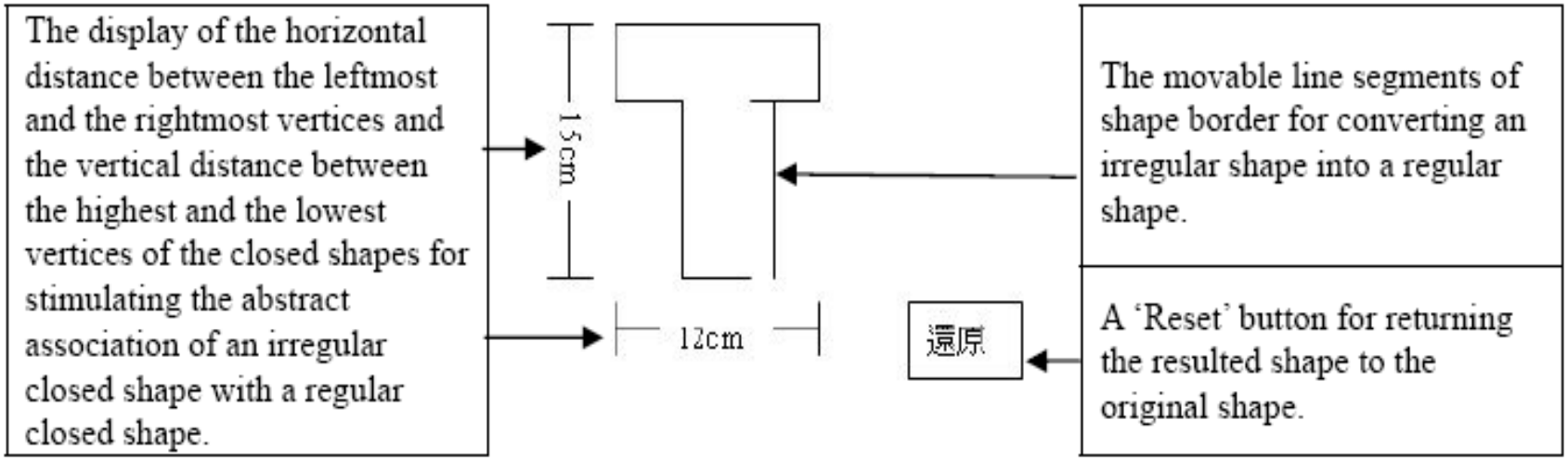
2nd Feature: Provision of just necessary information for calculation of perimeter

- Characteristic:
  - Measurements of the width between certain sides of the shape were shown in fixed positions
- Aim:
  - To address the inadequacy of students in forming an abstract association of an irregular closed shape with a regular closed shape in the computation of perimeter of closed shapes

3rd Feature: The returnable graphical representations of the closed shapes

- Characteristic:
  - Students could press this button to get back the original graphical representation of a closed shape at their convenience
- Aim:
  - In response to the inadequacy of students in making a complete inclusion of line segments of shape border in the calculation of perimeter of closed shapes

An interface of the IPLT



http://www.hkedcity.net/iclub_files/a/1/237/webpage/propackage/perimeter/perimeter.htm

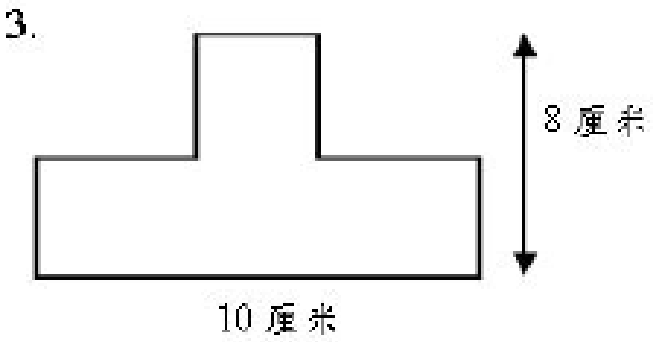
The Learning Process

- Three consecutive lessons in using the IPLT
- Duration:
  - 35 minutes for each lesson
- Size of group:
  - 2 students
- Teaching and learning material:
  - IPLT
  - PowerPoint presentations
  - A number of activity worksheets

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

A sample question in teaching

The graphical representation of an irregular closed shape with the length marks.

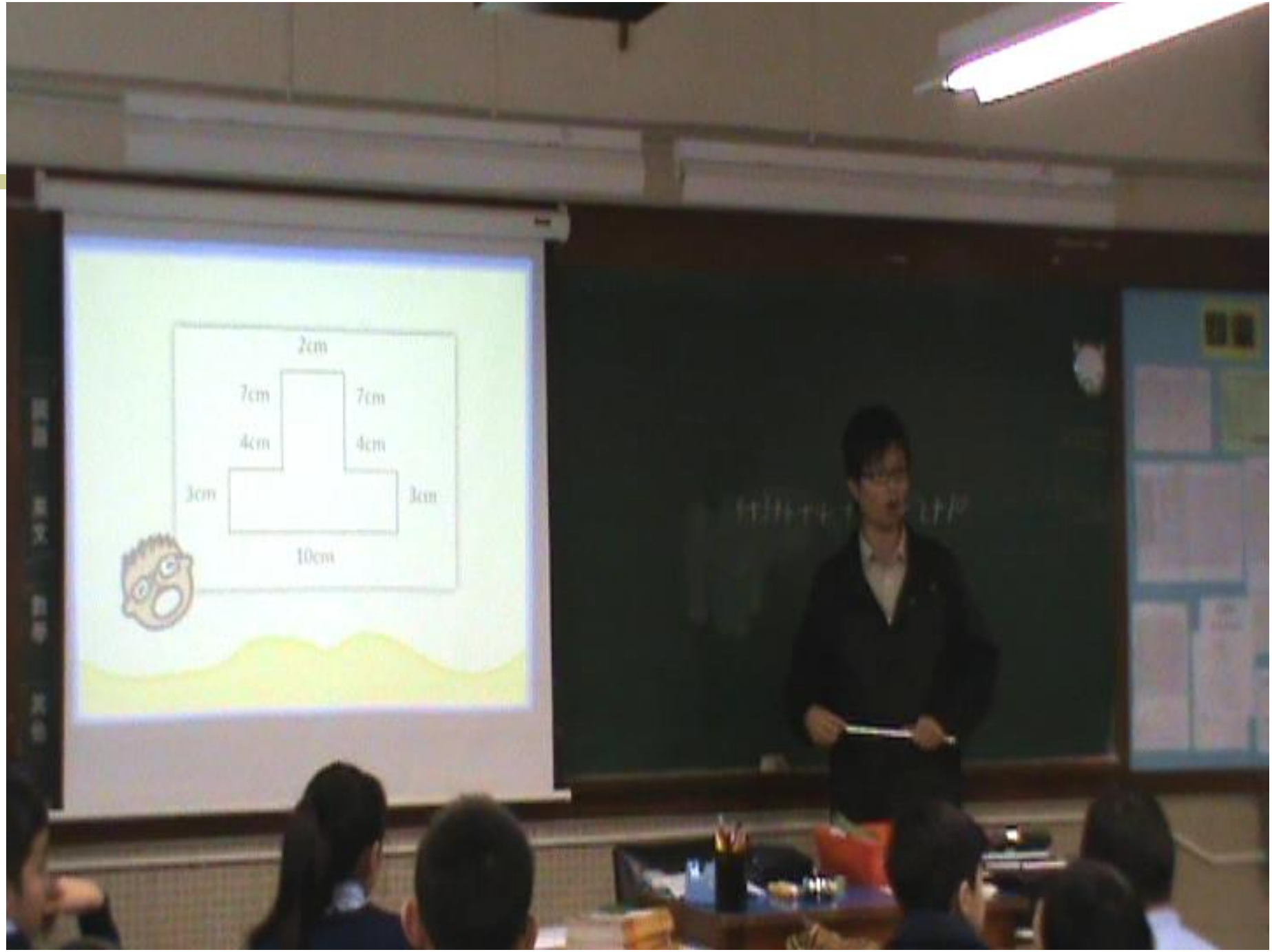


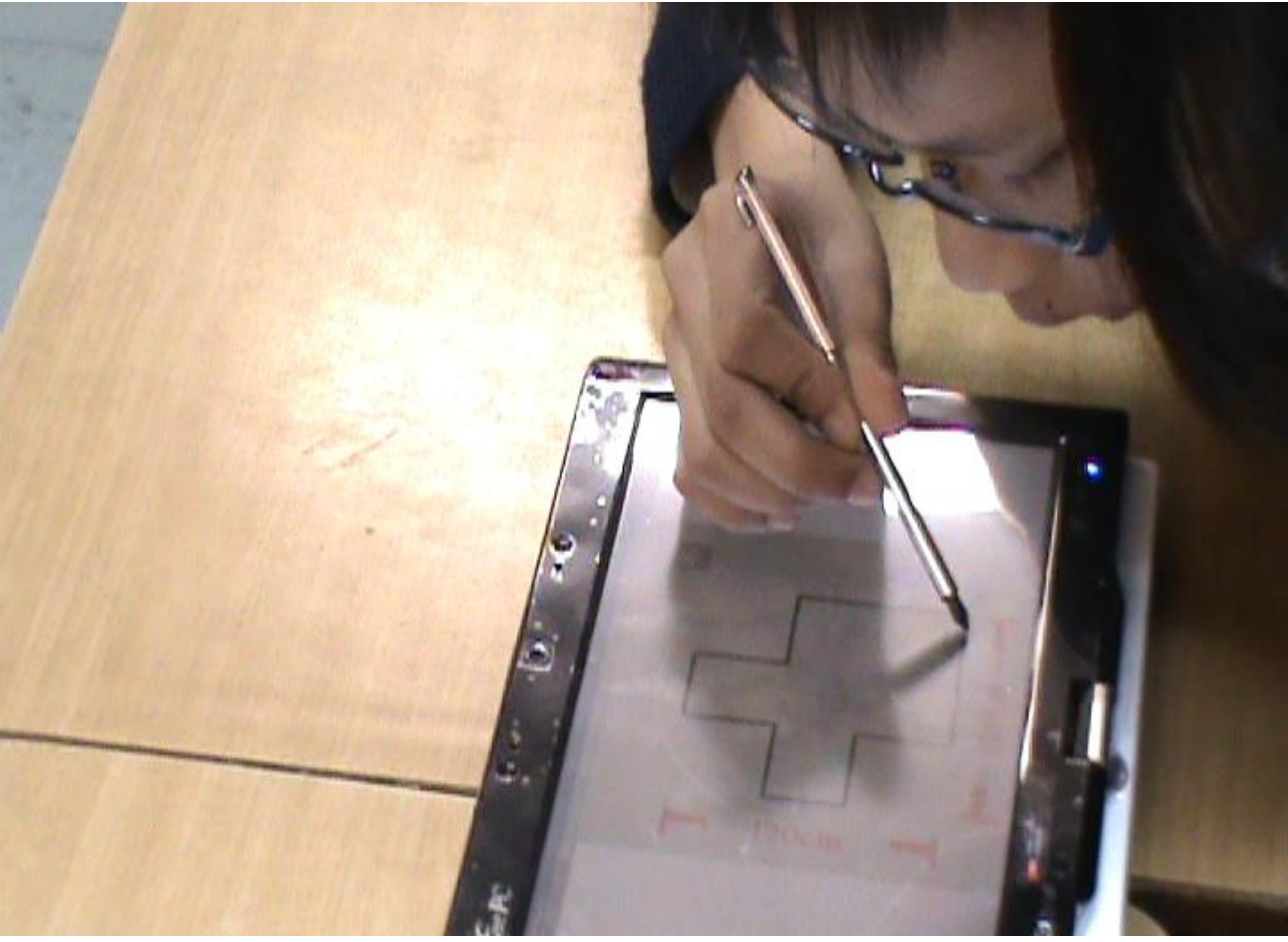
The answer spaces for the calculation expression and answer of the perimeter of the closed shape.

這圖形的周界是：

_____

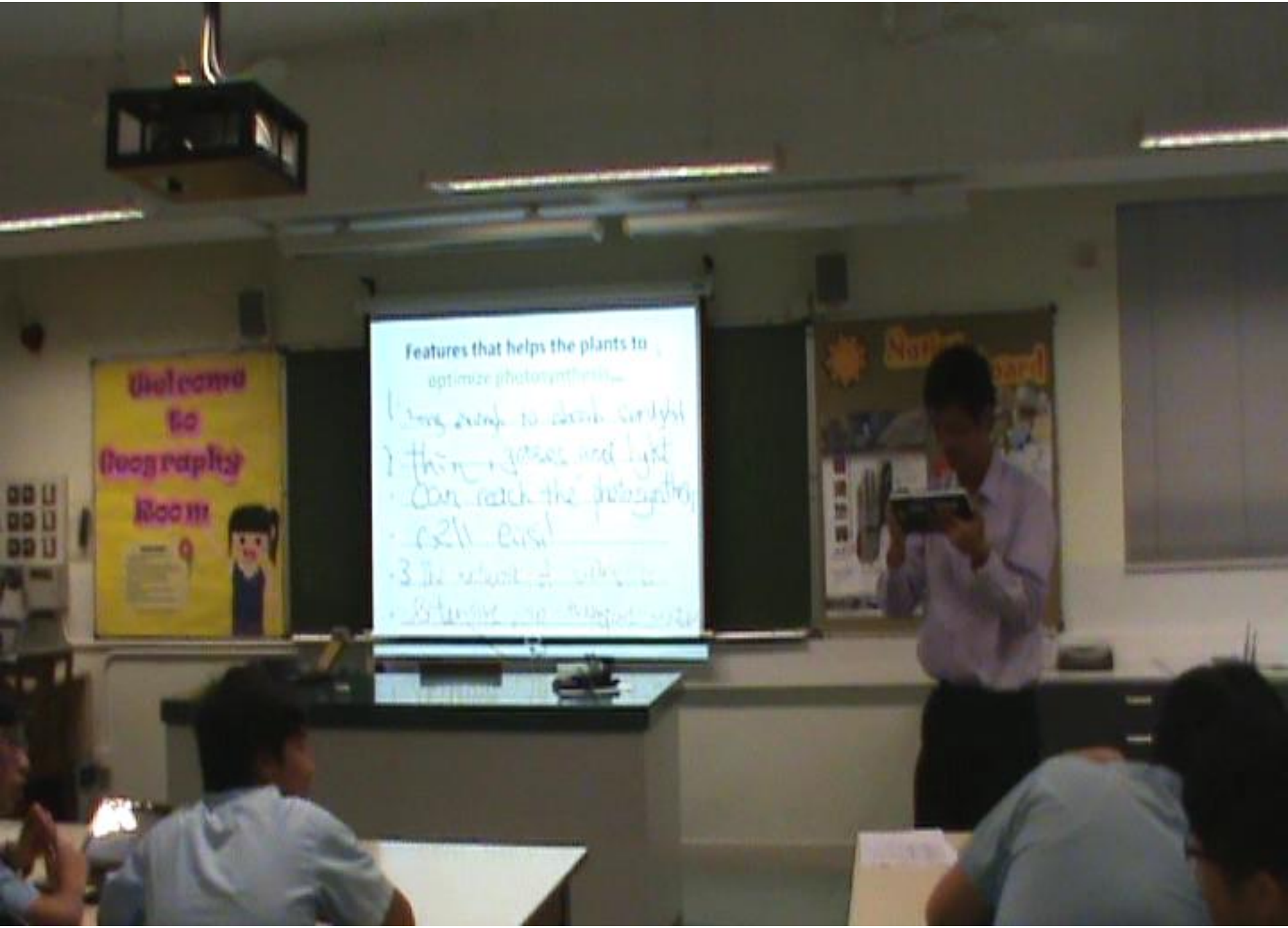
=_____厘米


2cm
7cm
7cm
4cm
4cm
3cm
3cm
10cm



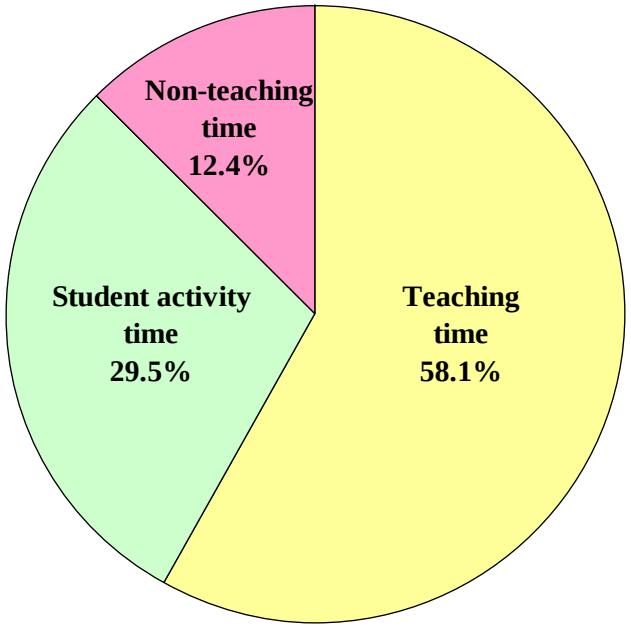
Case 2 - Learning “photosynthesis” in Secondary 3 science classrooms

- The topics of the learning dimension ‘photosynthesis’ in the secondary integrated science curriculum in Hong Kong

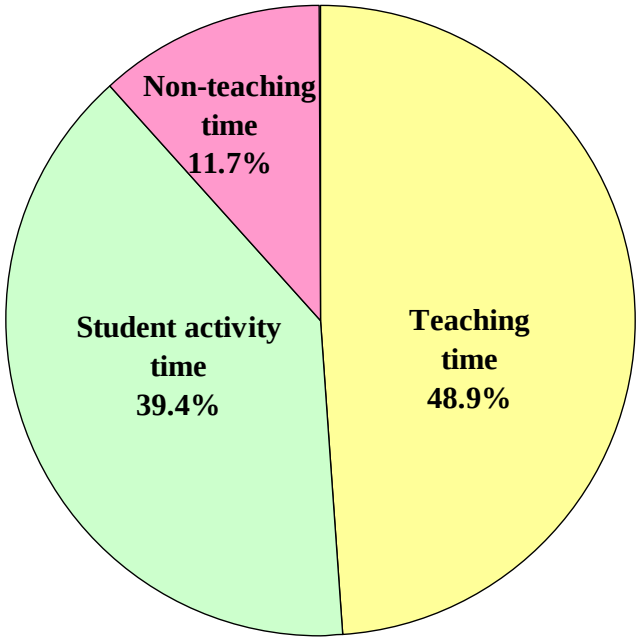

Welcome
to
Geography
Room
Features that helps the plants to

Pedagogical Practices in the Two Experimental Classes: Distribution of Class Time

- In *Pri-E* class



- In *Sec-E* class

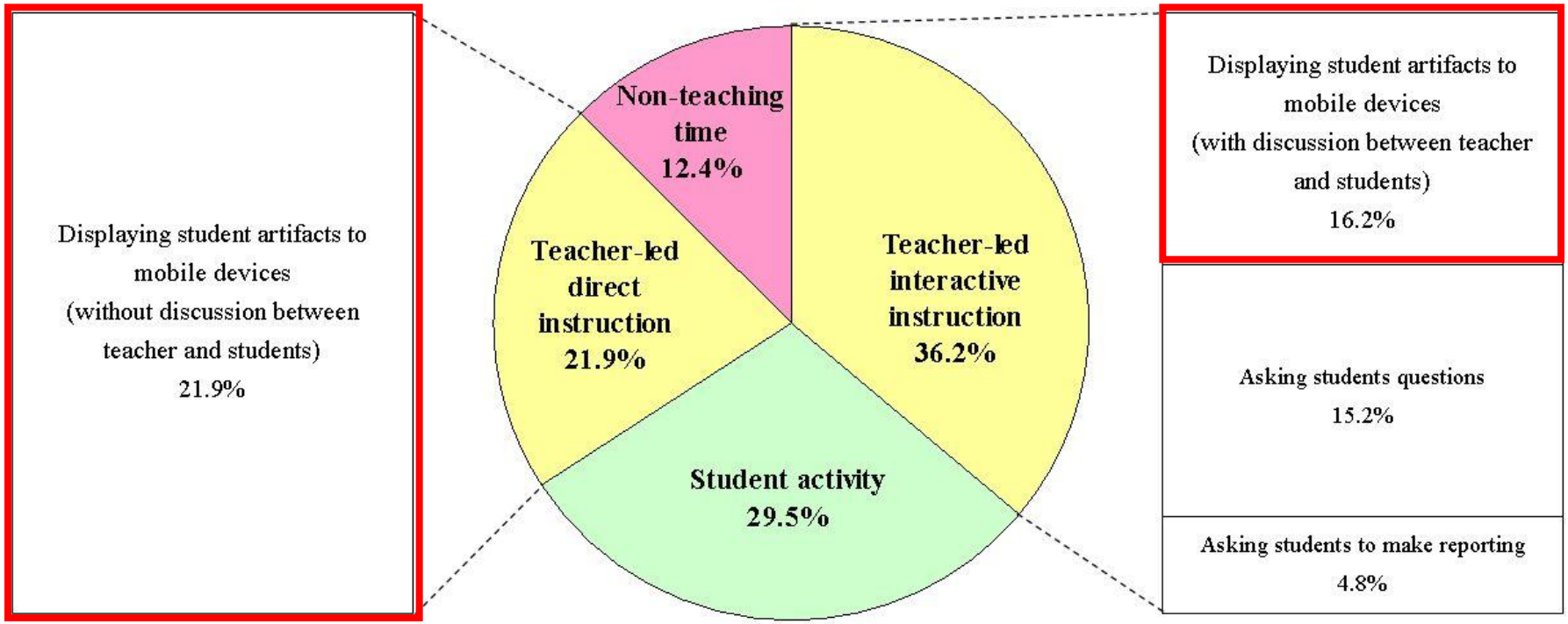


- The small proportion of class time spent on non-teaching activities indicates **the teaching progress was not slowed by the use of mobile devices**

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Distribution of Class Time for Teaching Activities: In *Pri-E* Class (58.1% of Total Class Time)

- The **major teaching activity**: **The teacher displayed student artifacts** to the mobile device of every student group

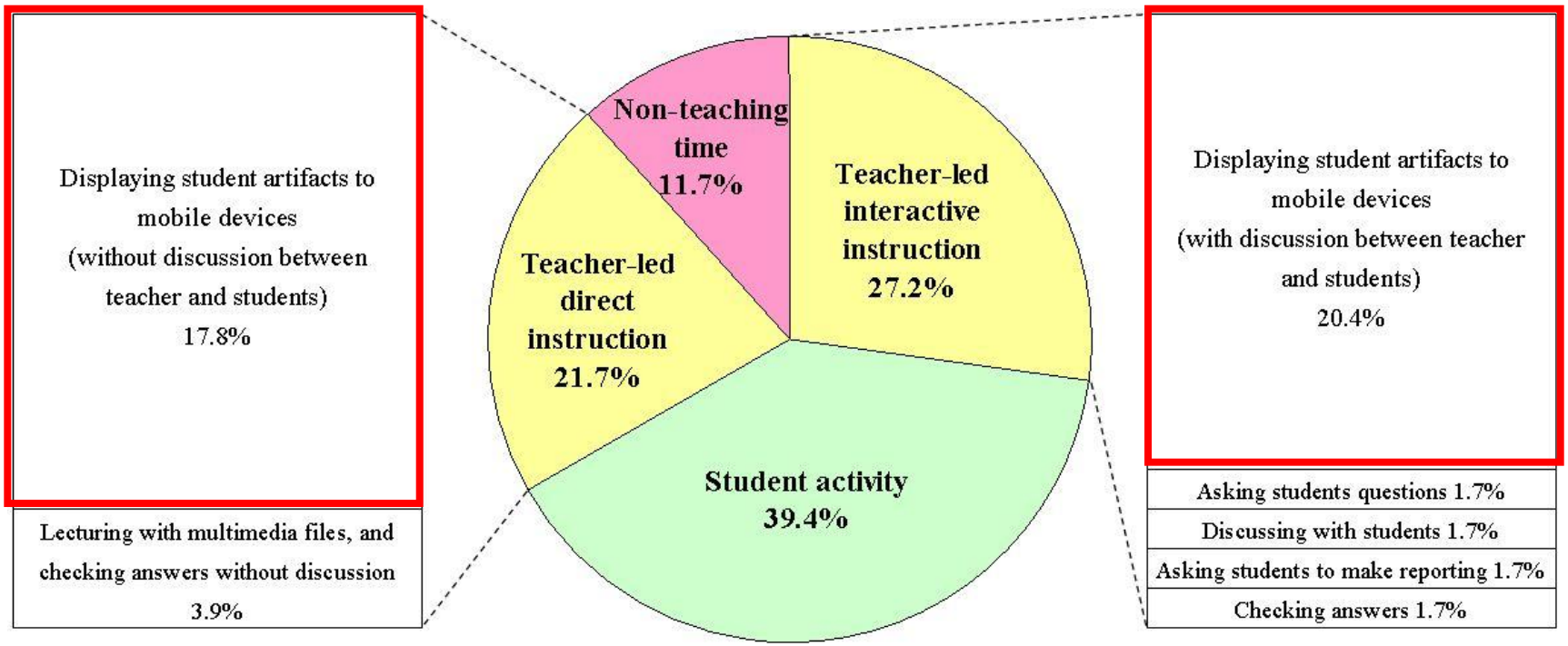


The Hong Kong Institute of Education 香港教育學院

Department of Mathematics and Information Technology

Distribution of Class Time for Teaching Activities: In *Sec-E* Class (48.9% of Total Class Time)

- The **major teaching activity**: **The teacher displayed student artifacts** to the mobile device of every student group

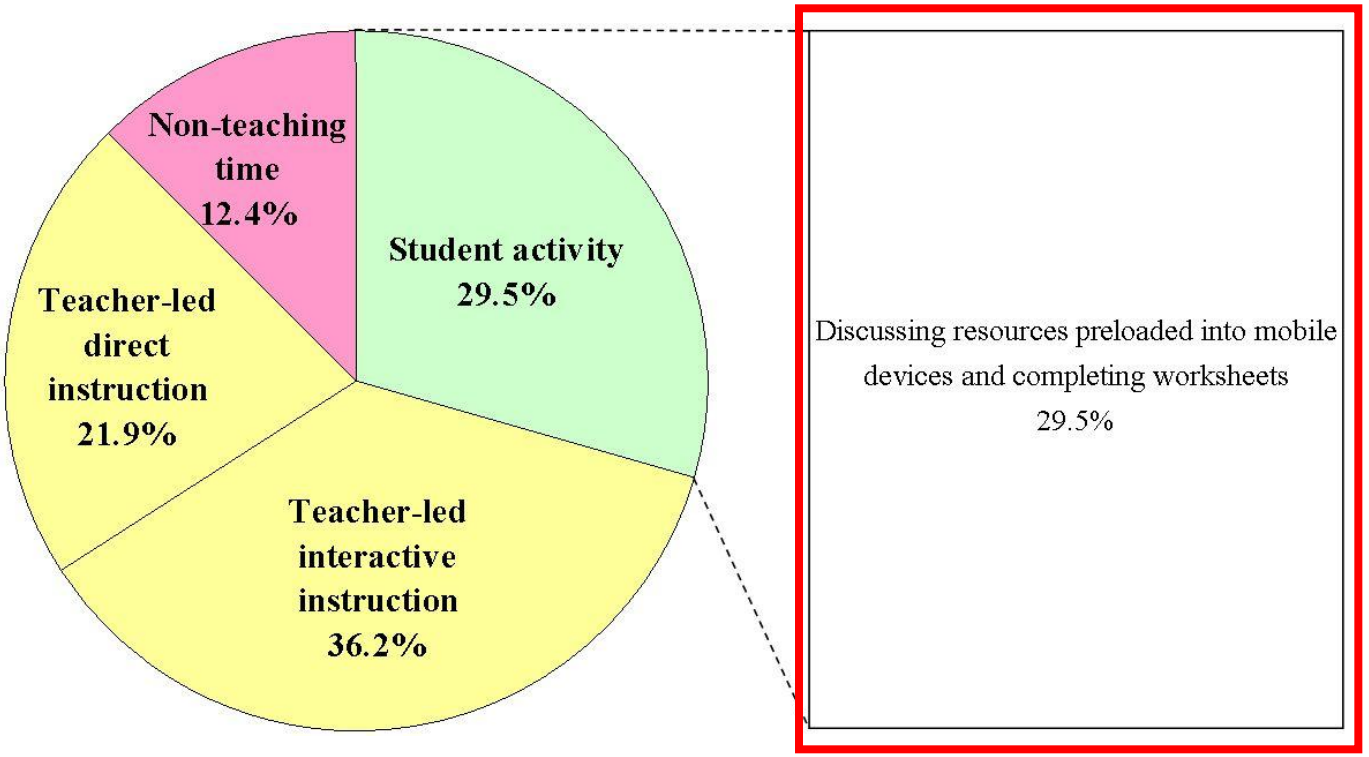


The Hong Kong Institute of Education 香港教育學院

Department of Mathematics and Information Technology

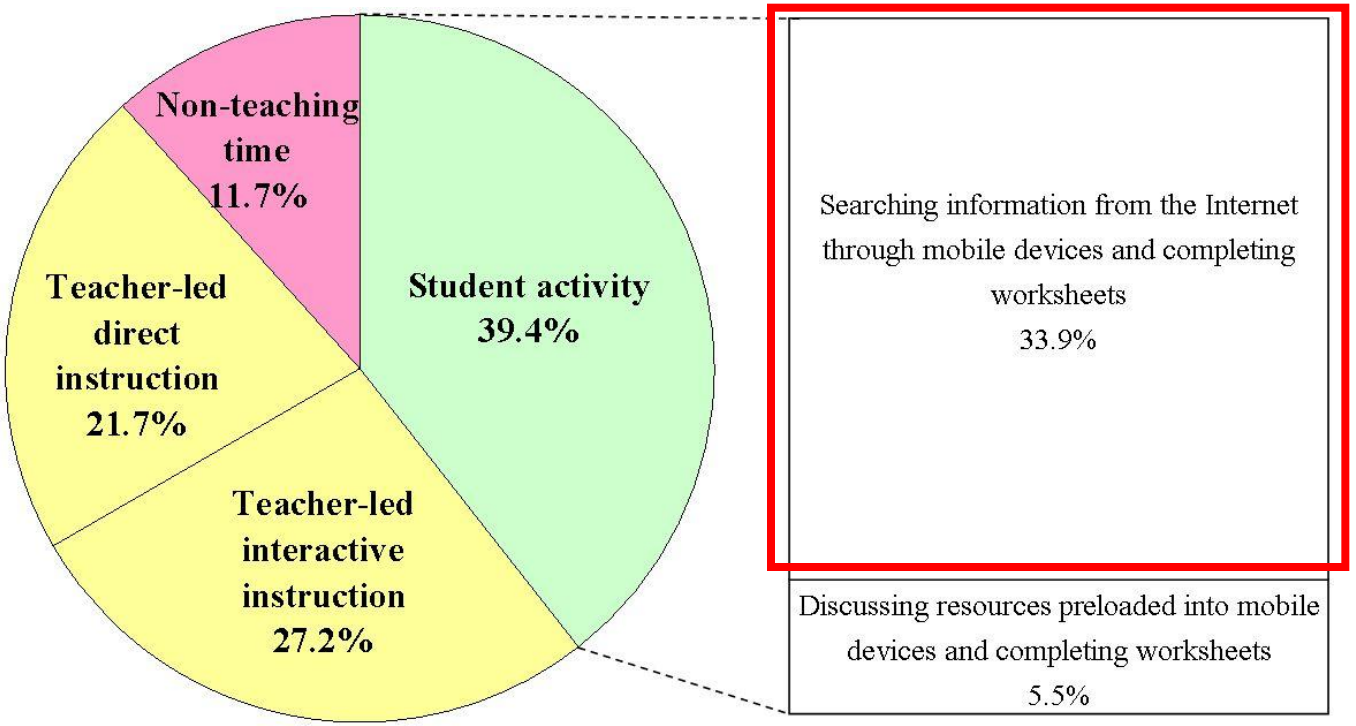
Distribution of Class Time for Student Activities: In *Pri-E* Class (29.5% of Total Class Time)

- **Student activity: The students discussed the solutions for worksheet completion**



Distribution of Class Time for Student Activities: In *Sec-E* Class (39.4% of Total Class Time)

- **Student activity: The students searched additional learning resources on the Internet for worksheet completion**



Note of Pedagogical Context in Digital Classrooms supported by Mobile Technology

- There was a **similar ratio of time use** between teaching activities and student activities

- Teachers were able to provide students with **more opportunities to**:
  - **view learning artifacts** by the classmates
  - **access additional resources** on the Internet
  - **interact with peers and teachers** for subject discussions

- The use of mobile technology in digital classrooms could **support both teacher-centered pedagogy and student-centered pedagogy in the classroom setting**

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Students' Perceptions: Ease and Confidence in Using Mobile Technology for Classroom Learning

- There was **no difficulty** in the use of mobile devices for classroom learning
  - Most students were able to operate mobile devices on their own during the class activities
  - Students helped one another to use the unfamiliar functions of the mobile devices
- Students were **confident** of using mobile devices for subject learning in class

Students' Perceptions: Autonomy and Interactivity in Digital Classrooms Using Mobile Technology

- Students found **more control over the learning process**, because the use of mobile devices in class could **support various class activities without teacher mediation**:
  - information search
  - peer discussions
  - group vote
  - problem-solving
- Students found **more opportunities for interacting with peers**, because they could:
  - walk around the classroom freely for peer discussions
  - take the displays of mobile devices as discussion references

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Students' Perceptions: Effectiveness and Satisfaction in Learning with Mobile Technology

- Students found it **interesting and effective** to learn subject matter with the use of mobile technology in class:
  - **Greater impression** of learning contents
  - **More opportunities** to share and discuss ideas with peers
  - **More convenience** in sharing materials
  - **Greater flexibility** in presenting ideas and exchanging feedback

Teachers' Perceptions: Ease and Confidence in Using Mobile Technology for Classroom Teaching

- It was **easy** to operate the mobile devices
  - There was no technical problem in operating mobile devices
- The classroom communication system sometimes had technical problems:
  - No display of screen captures to every mobile device in class
  - No response when any mobile device had technical problems

Teachers' Perceptions: Autonomy and Interactivity in Digital Classrooms Using Mobile Technology

- Students had more learning control. They were promoted to:
  - become **more attentive and engaged** in subject learning
  - take **initiative in discussing learning problems** with peers
  - complete **extra learning tasks** without teacher request
- Teachers had more interactions with students. They were promoted to:
  - intensively **observe** each student
  - immediately **give feedback** to each student
  - timely **provide tailor-made guidance** for each student

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Teachers' Perceptions: Effectiveness and Satisfaction in Teaching with Mobile Technology

- The use of mobile devices in class could **better support teachers' work** on addressing **learning diversity** and drawing **learning attention**
  - The clear representation of teaching contents could enhance students' impression of subject matter for knowledge generation
  - The convenient display of student works could trigger students' reflection on knowledge understanding through peer observation
- Teachers were **satisfied with the outcomes** brought about by the use of mobile devices in class, even though more time and effort were required for lesson preparation

Note of Perceptions of Digital Classrooms supported by Mobile Technology

The students and teachers in general positively perceived that:

- It was **easy to use mobile devices** for learning and teaching in class
- They were **confident of using mobile devices** in the classroom setting
- Students had **more control over learning** in digital classrooms
- Students had **more interactions in learning** in digital classrooms
- The use of mobile devices was **effective to support learning** in class
- They were **satisfied with the educational use of mobile devices** in class

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Implications from the Two Case Studies

- Three directions for using mobile technology in digital classrooms
  - Promoting **learning interactivity** in the classroom setting
  - Supporting **student inquiry** in the classroom setting
  - Realizing **paradigm shift** in the classroom setting

Direction 1: Using Mobile Technology to Promote Learning Interactivity in Digital Classrooms

- In the two case studies, the teachers inclined to provide students with **more class time for interacting with peers and teachers** for subject learning

- It is potential to use mobile technology in digital classrooms to
  - **promote classroom-based interaction**
  - enhance **students' communication** in class

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

Direction 2: Using Mobile Technology to Support Student Inquiry in Digital Classrooms

- In the two case studies, teachers inclined to spend **more class time on interacting with students for individual guidance** to complete inquiry learning in class

- It is potential to use mobile technology in digital classrooms to
  - **support inquiry-based pedagogy**
  - enhance **students' engagement** in learning

Direction 3: Using Mobile Technology to Realize Paradigm Shift in Digital Classrooms

- In the two case studies, teachers inclined to **arrange more learner-centered class activities** for students to take control over the process of exploring subject matter

- It is potential to use mobile technology in digital classrooms to
  - **realize a shift to student-centered pedagogy**
  - enhance **students' autonomy** in learning

Conclusion

- The experiences in the two case studies confirm that
  - using mobile devices in class can **support student-centered pedagogy** in digital classrooms
  - students and teachers were **satisfied with the use of mobile devices in class** for learning and teaching
- The two case studies reveal that the use of mobile technology in digital classrooms is **potential to promote student learning** in school education
- Future research should address an important trend in school education — **deep learning through classroom-based dialogic interaction** in digital classrooms

The Hong Kong Institute of Education 香港教育學院
Department of Mathematics and Information Technology

References

- Chan, T. W. (2010). How East Asian classrooms may change over the next 20 years. *Journal of Computer Assisted Learning*, *26*(1), 28-52.
- Fantuzzo, J. W., King, J. A., & Heller, L. R. (1992). Effects of reciprocal peer tutoring on mathematics and school adjustment: A component analysis. *Journal of Educational Psychology*, *84*(3), 331-339.
- Liang, J.-K., Liu, T.-C., Wang, H.-Y., Chang, B., Deng, Y.-C., Yang, J.-C., Chou, C.-Y., Ko, H.-W., Yang, S., & Chan, T.-W. (2005). A few design perspectives on one-on-one digital classroom environment. *Journal of Computer Assisted Learning*, *21*(3), 181-189.
- Mukama, E. (2010). Strategizing computer-supported collaborative learning toward knowledge building. *International Journal of Educational Research*, *49*(1), 1-9.
- Robinson, D. R., Schofield, J. W., & Steers-Wentzell, K. L. (2005). Peer and cross-age tutoring in math: Outcomes and their design implications. *Educational Psychology Review*, *17*(4), 327-362.
- Roschelle, J., Rafanan, K., Bhanot, R., Estrella, G., Penuel, B., Nussbaum, M., & Claro, S. (2010). Scaffolding group explanation and feedback with handheld technology: Impact on students' mathematics learning. *Educational Technology Research and Development*, *58*(4), 399-419.

References

- Säljö, R. (2010). Digital tools and challenges to institutional traditions of learning: Technologies, social memory and the performative nature of learning. *Journal of Computer Assisted Learning*, *26*(1), 53-64.
- Selander, S. (2008). Designs of learning and the formation and transformation of knowledge in an era of globalization. *Studies in Philosophy and Education*, *27*(4), 267-281.
- Staarman, J. K., Aarnoutse, C., & Verhoeven, L. (2003). Connecting discourses: Intertextuality in a primary school CSCL practice. *International Journal of Educational Research*, *39*(8), 807-816.
- Webb, N. M. (2009). The teacher's role in promoting collaborative dialogue in the classroom. *British Journal of Educational Psychology*, *79*(1), 1-28.
- Wong, L. H. (2012). A learner-centric view of mobile seamless learning. *British Journal of Educational Technology*, *43*(1), E19-E23.
- Wong, L. H., & Looi, C. K. (2011).What seams do we remove in mobile assisted seamless learning? A critical review of the literature. *Computers and Education*, *57*(4), 2364-2381.

Experience of Using Mobile Technology in Digital Classroom: Two Case Studies

Thank You for Your Attention!

Siu Cheung KONG

Department of Mathematics and Information Technology
The Hong Kong Institute of Education, Hong Kong