Developing Demo/Teaching Kits Based on Departmental Research Strength

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<u>Teaching & Learning Symposium (11/12/2007)</u>


Integrating Theoretical and Practical Skills
1
Extensive Reading & Searching
2
Common Objectives of Research Project Courses
3
Teamwork Spirit & Management Skills
4
Documentation & Presentation Skills

Innovation Features of Our Scheme

1 Incorporating Faculty's cutting-edge scientific discoveries / inventions

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Students' motivation is stimulated and strengthened

2 Target outcomes: Demo/Teaching Kits

↓

Used for enriching undergraduate physics courses and promoting science to general public.

Project Action (I)

Information sessions on

Departmental Research strength and Achievement

↓

Participated students are enrolled in PHYS191/291/391 or PHYS398 project courses

↓

Project outcome:

Demo/teaching kits (either hardware or software)

Project Action (II)

Use of research outcome:

* Teaching kits for upgrading existing experimental physics courses;
* Demo units for in/out school visits, science talk series and other outreach activities (for promoting science education and students' research culture);
* Student presentations as a component of PHYS1/2/380

Project Objectives

✱ Develop a learning culture through hands-on scientific research

✱ Promote ***student-led research*** (encouraging students' independent learning and critical evaluation of their own methodologies)

✱ To broaden students' knowledge base of Science

✱ To develop a variety of students' skills: experimental construction, multimedia production, independent and critical thinking, problem-solving and presentations

✱ To develop the potential and sustainability of the existing project courses

✱ To promote popular science to the public inside and outside HK

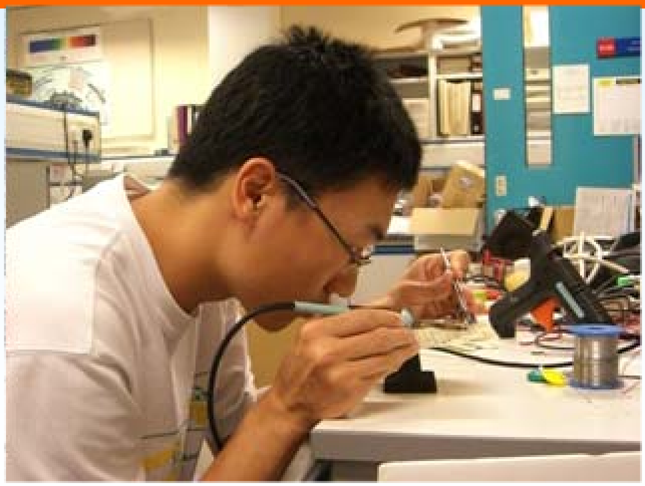
Peer Support

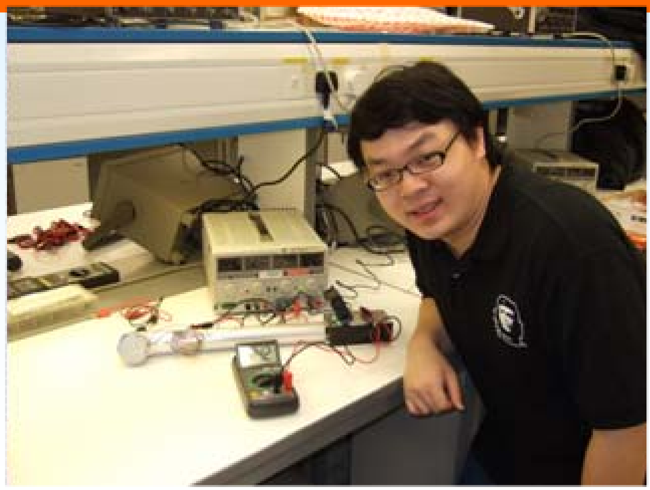
- ✱ Physics Teaching Lab (staff, space & equipment)

- ✱ CELT: attending oral presentations, designing evaluation sheets, conducting group and individual interviews

- ✱ Faculty supervisors visited 2ndary schools with the student presenters

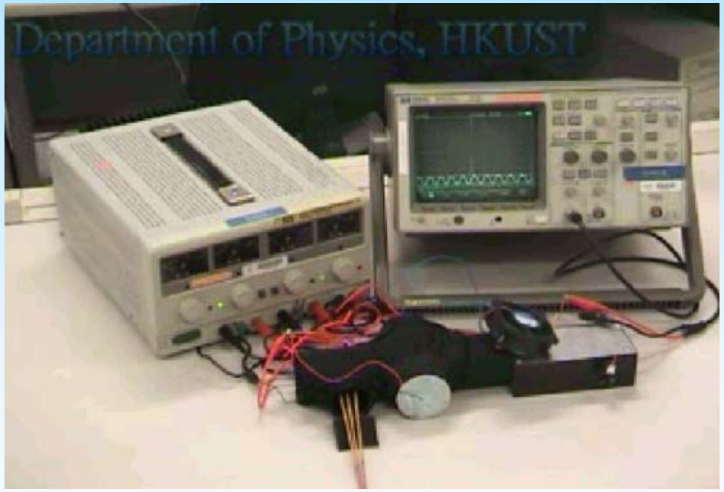
- ✱ School of Science: 1) arranged visits from overseas students
  2) selected one topic as a show case in Inno Expo 2007



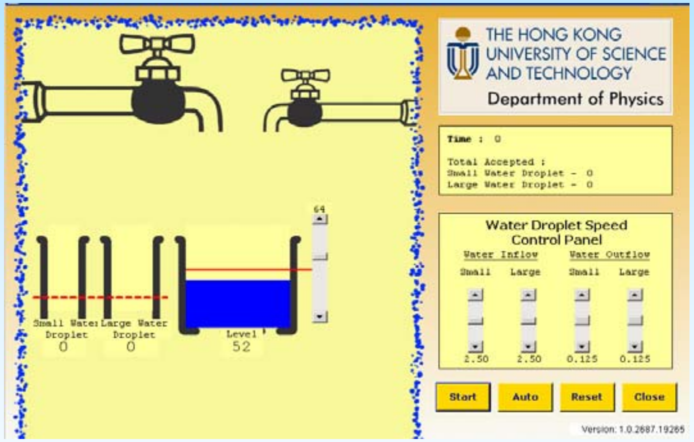


“Visible” Outcome

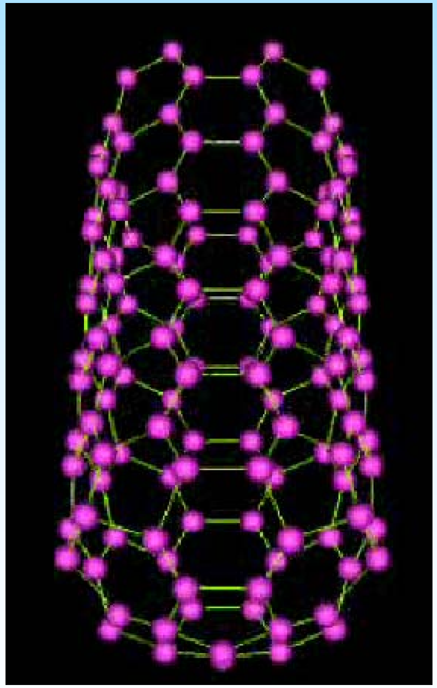
- **Since 2005, 6 software and 5 hardware demo/teaching kits have been developed**
- **Research outcomes are good: all the selected 15 students obtained B+ or above for their projects**



Air pollution monitor

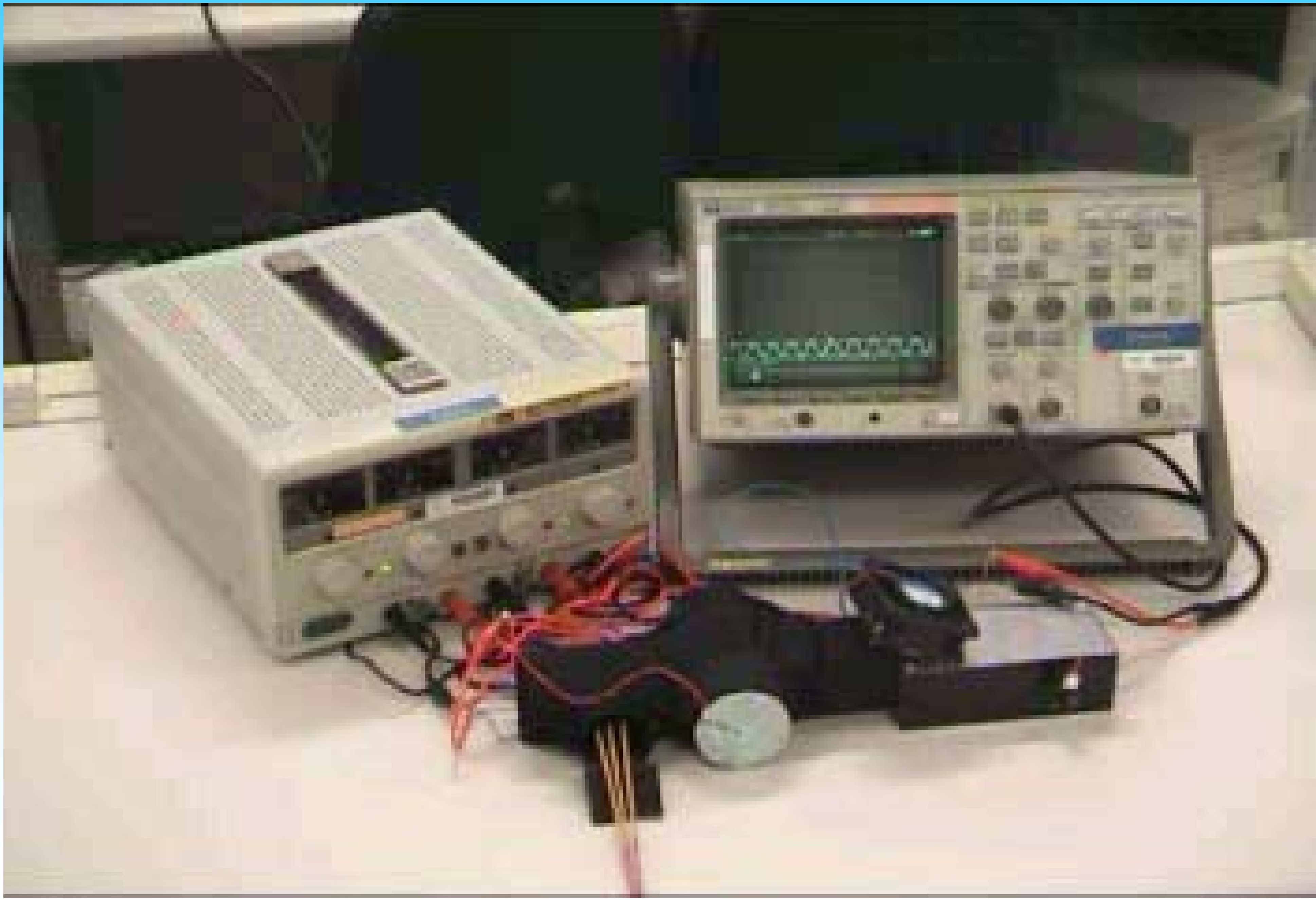


Admission Control Method of Multi-service Mobile Network



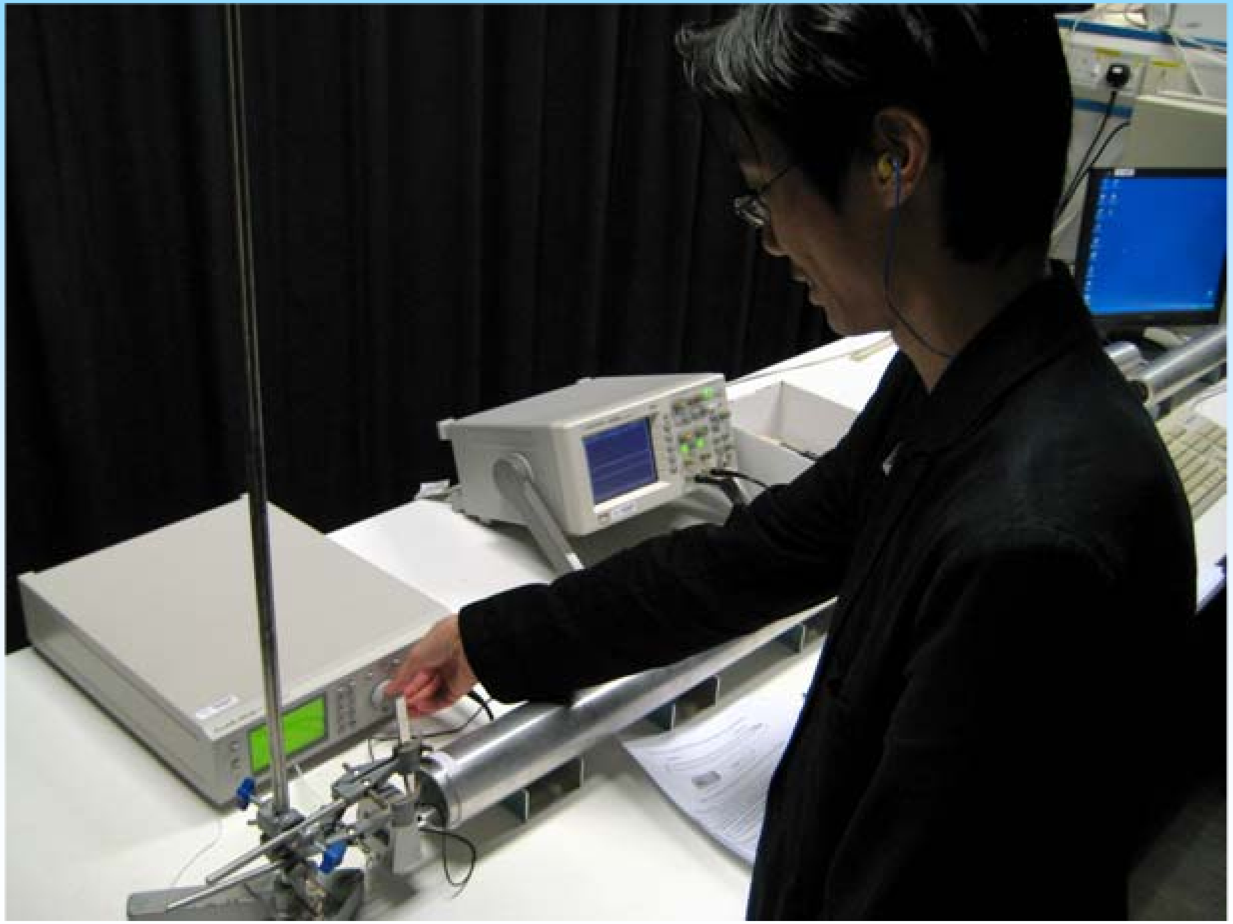
Carbon Nanotube

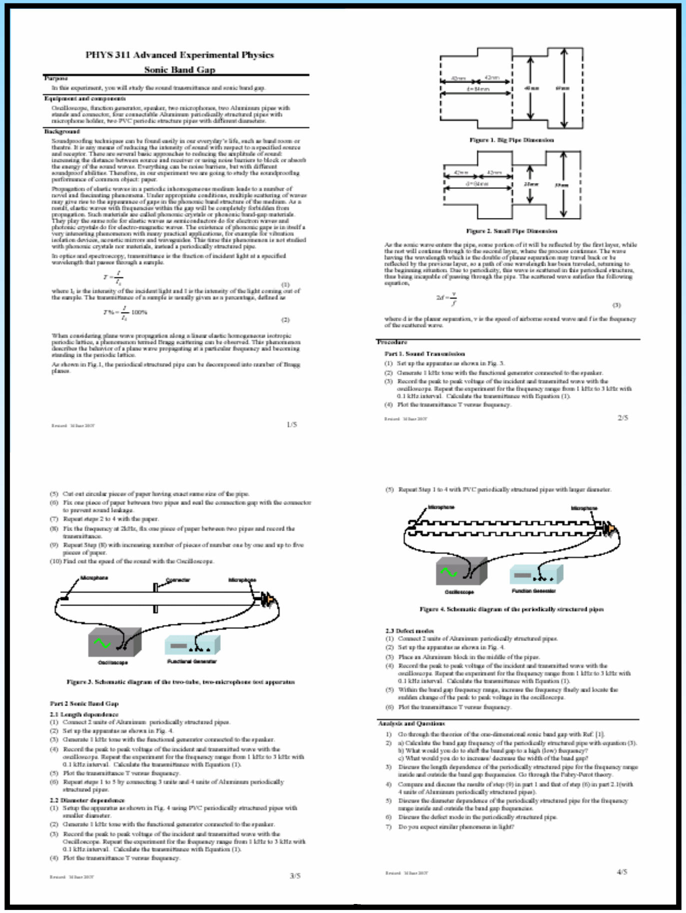
Air Pollution Monitor



"Visible" Outcome

A teaching kit, *sonic band gap experiment*, is being used in PHY311 (Advanced Experimental Physics)





PHYS 311 Advanced Experimental Physics

Sonic Band Gap

Purpose

In this experiment, you will study the sound transmittance and sonic band gap.

Equipment and components

Oscilloscope, function generator, speaker, two microphones, two Aluminum pipes with stands and connector, four connectable Aluminum periodically structured pipes with microphone holder, two PVC periodic structure pipes with different diameters.

Background

Soundproofing techniques can be found easily in our everyday's life, such as band room or theatre. It is any means of reducing the intensity of sound with respect to a specified source and receptor. There are several basic approaches to reducing the amplitude of sound: increasing the distance between source and receiver or using noise barriers to block or absorb the energy of the sound waves. Everything can be noise barriers, but with different soundproof abilities. Therefore, in our experiment we are going to study the soundproofing performance of common object: paper.

Propagation of elastic waves in a periodic inhomogeneous medium leads to a number of novel and fascinating phenomena. Under appropriate conditions, multiple scattering of waves may give rise to the appearance of gaps in the phononic band structure of the medium. As a result, elastic waves with frequencies within the gap will be completely forbidden from propagation. Such materials are called phononic crystals or phononic band-gap materials. They play the same role for elastic waves as semiconductors do for electron waves and photonic crystals do for electro-magnetic waves. The existence of phononic gaps is in itself a very interesting phenomenon with many practical applications, for example for vibration isolation devices, acoustic mirrors and waveguides. This time this phenomenon is not studied with phononic crystals nor materials, instead a periodically structured pipe.

In optics and spectroscopy, transmittance is the fraction of incident light at a specified wavelength that passes through a sample.

$$T = \frac{I}{I_0} \quad (1)$$

where I_0 is the intensity of the incident light and I is the intensity of the light coming out of the sample. The transmittance of a sample is usually given as a percentage, defined as

$$T\% = \frac{I}{I_0}\,100\% \quad (2)$$

When considering plane wave propagation along a linear elastic homogeneous isotropic periodic lattice, a phenomenon termed Bragg scattering can be observed. This phenomenon describes the behavior of a plane wave propagating at a particular frequency and becoming standing in the periodic lattice.

As shown in Fig.1, the periodical structured pipe can be decomposed into number of Bragg planes.

1/5

Lab Manual

Evaluation

- ✱ **Experience sharing meeting during the project period among the participating students.**
- ✱ **Comments from audience of the end-semester presentations**
- ✱ **Comments from the users of the prototypes**
- ✱ **Evaluation from 2ndary schools**

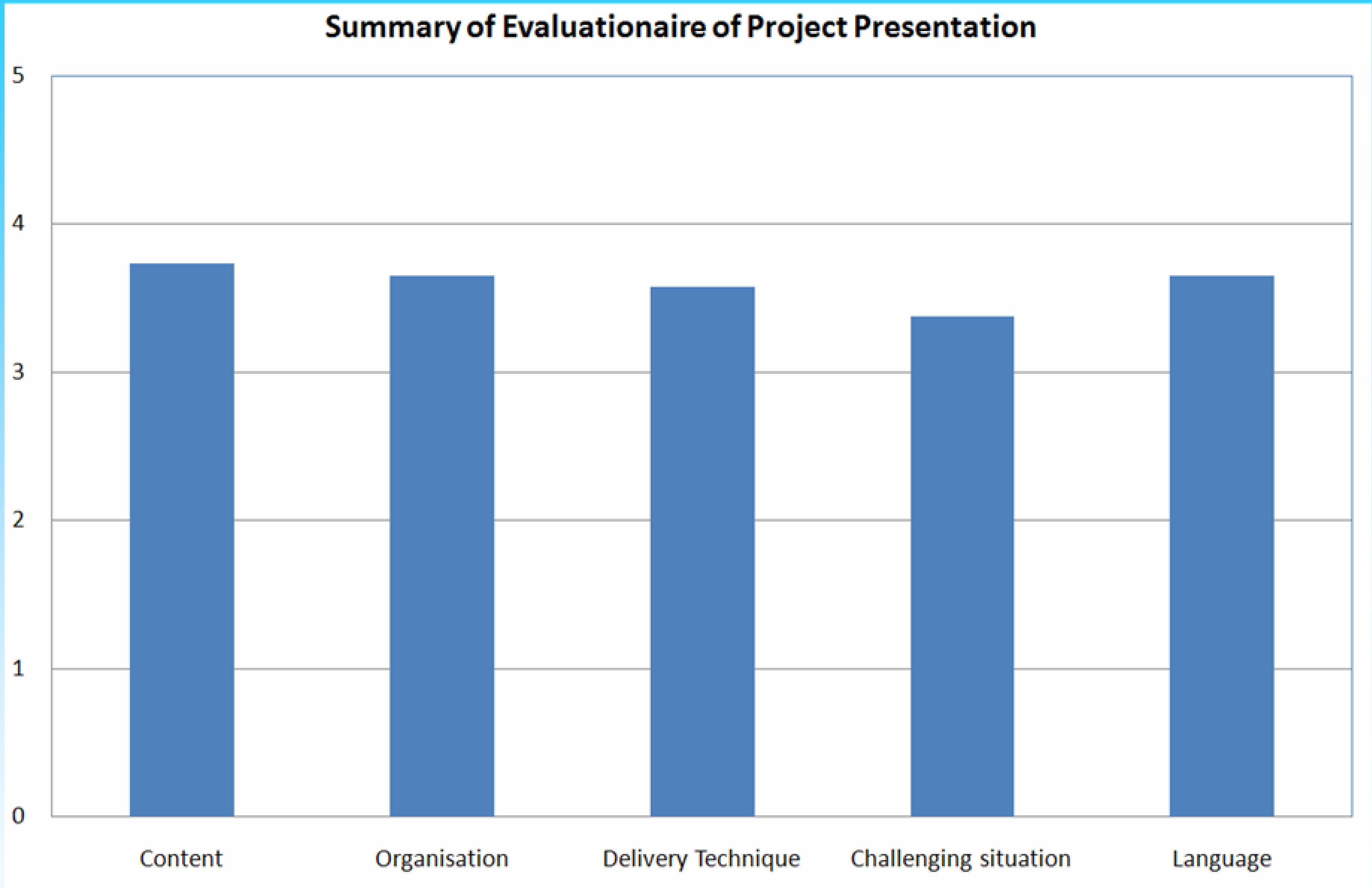


Figure 1: Statistics of the presentation assessment checklists (sample size = 55) on five aspects of the project presentations.

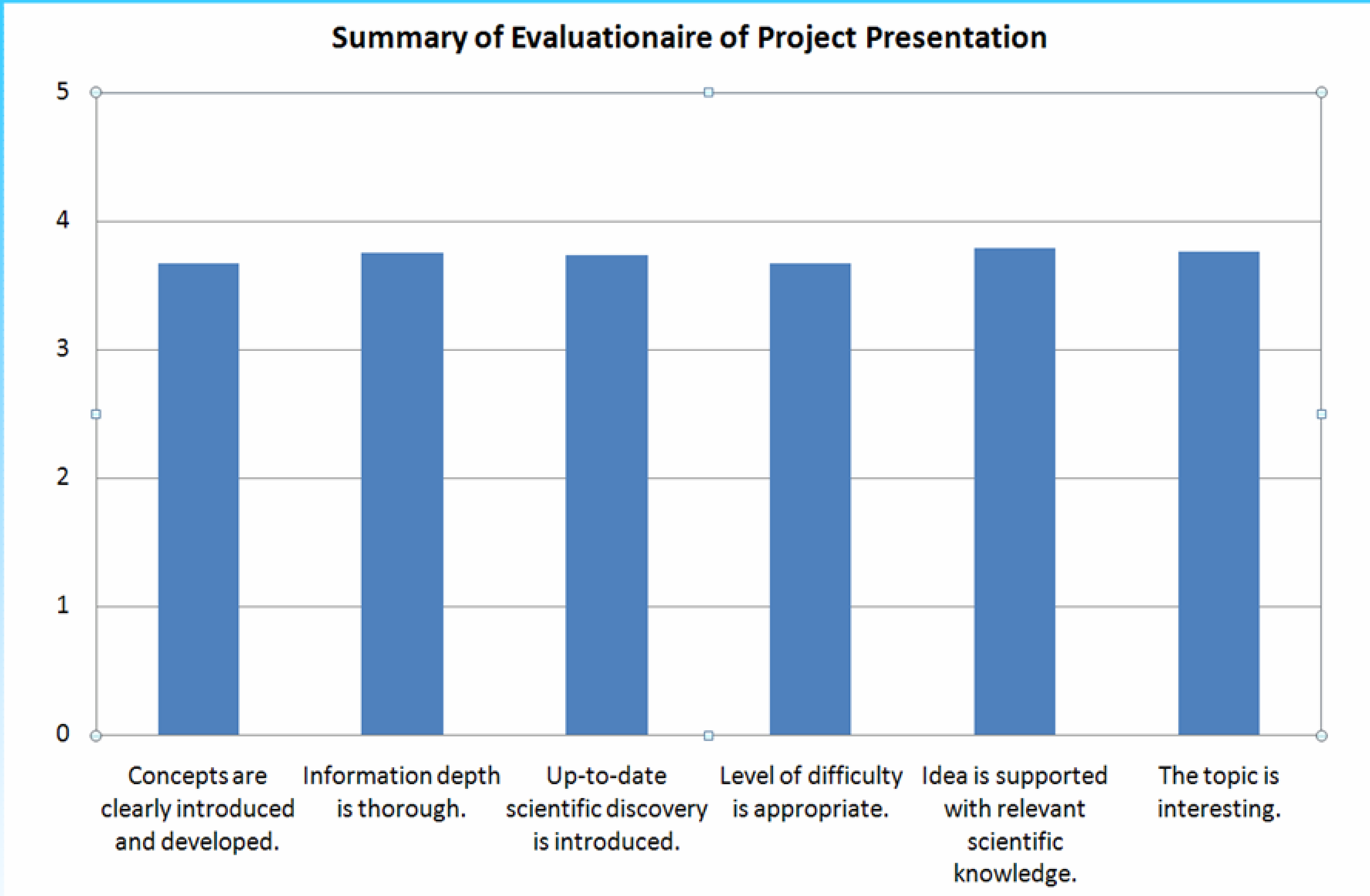


Figure 2: Statistics of the presentation assessment checklists (sample size = 55) on six sub-aspects of the content of the project presentations.

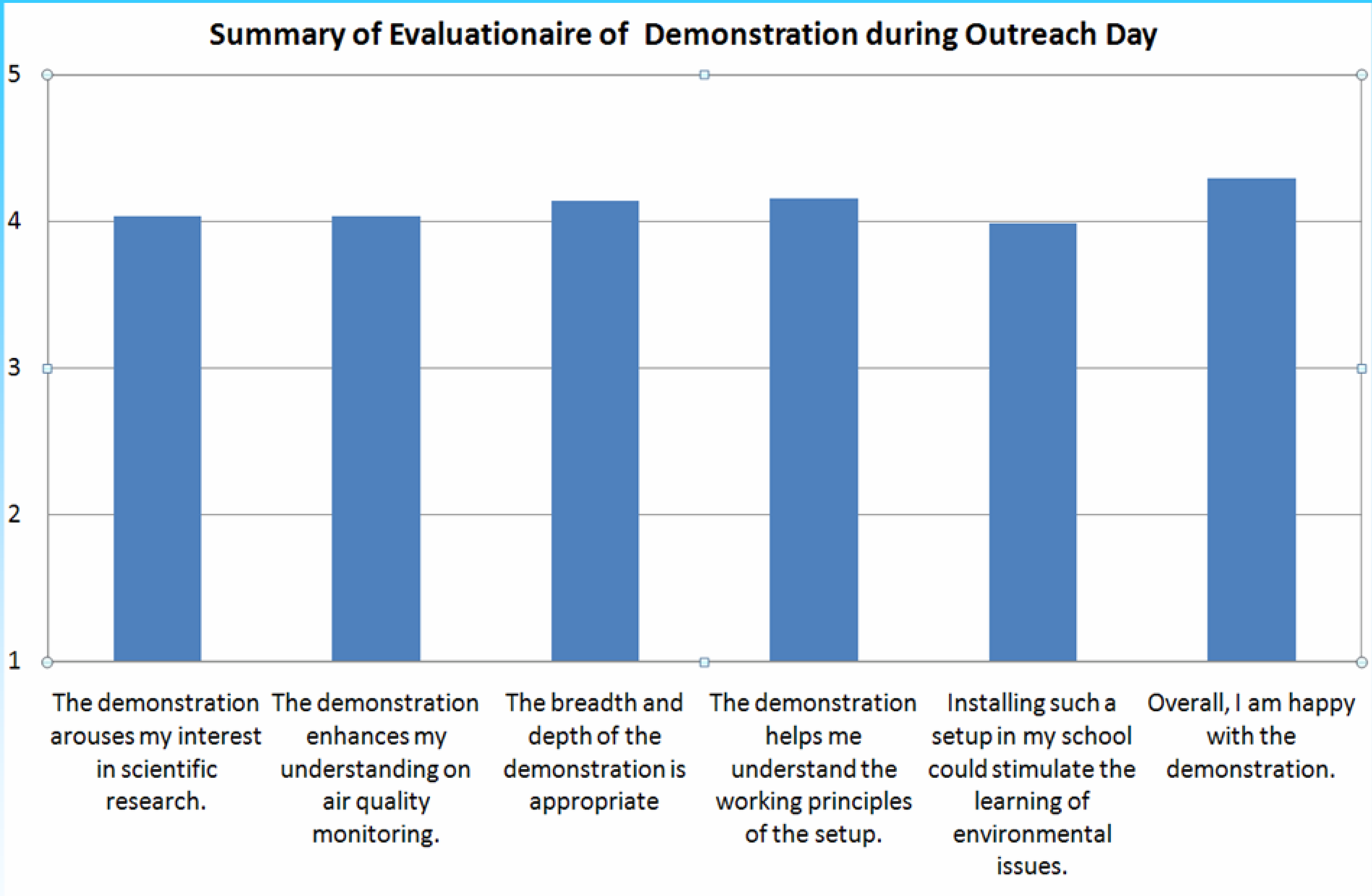


Figure 3: Statistics of the evaluation (sample size = 143 from 23 schools) on six aspects of the demonstrations during outreach activities.

Conclusion

* Our approach has better realized the potential and substainability of existing physics research project courses.

* It provides a platform for students to strengthen their various aspects in the learning culture.

* The "visible" outcome (demo & teaching kits), will certainly have long-lasting impact on improving the quality of teaching and learning within the department and on promoting science education in our community.

* The methodologies and experience gained in this approach are easily adaptive to other fields of University education.