

**Name of Presenter 1** : Jeanne Marie Ho  
**Organization** : ETD, MOE  
**Designation** : Senior Head  
**Email** : [jeanne\\_marie\\_ho@moe.gov.sg](mailto:jeanne_marie_ho@moe.gov.sg)  
**Areas of interest in IT:**

**Name of Presenter 2** : Ban Pei Ling  
**Organization** : ETD, MOE  
**Designation** : Educational Technology Officer  
**Email** : [ban\\_pei\\_ling@moe.gov.sg](mailto:ban_pei_ling@moe.gov.sg)  
**Areas of interest in IT:**

**Title** : **Informating Formative Assessment: Teachers using CPS**

**Abstract:** This study examines how technology, in the form of a classroom-specific network, is harnessed by teachers to informate (as opposed to automate) classroom-based formative assessment. The technology used is the Classroom Performance System (CPS), a wireless response system that provides instant, collated feedback to all the students in class, based on their responses to questions (mainly MCQ, true/false kind of questions). The study involved 107 teachers from 30 schools who were involved in designing, implementing and reflecting on lesson activities in various subjects using CPS. The main purpose of the study was to investigate if and how teachers made use of data generated by CPS to tailor their instructional practices to improve students' learning. This paper will share the range of strategies employed and how the use of technology enabled students to play a greater role in assessing/reflecting on their own learning outcomes, which is the first step towards improving their own learning.

**Keywords** : formative assessment, technology, classroom performance system

## 1. Introduction

“There is a firm body of evidence that formative assessment is an essential feature of classroom work and that development of it can raise standards. We know of no other way of raising standards for which such a strong prima facie case can be made on the basis of evidence of such large learning gains.” (Black and Wiliam 1998)

In a typical Singapore classroom of about 40 students, how can a teacher assess his/her students' knowledge or skills during a typical lesson of duration 30 minutes to slightly over an hour? Generally, he/she asks questions, sets written questions, or gets students to work on a given task. With 40 students, only a selected few get to answer the verbal questions, or receive immediate feedback from their teacher on the task. On-the-

spot whole-class feedback is usually provided by the teacher based on his/her assessment of a few students' answers and work. The teacher's perception of the effectiveness of his/her lesson also depends on the responses of a few students, usually those who are vocal or brave enough to ask or answer questions. If a series of questions is presented to all students, time to analyse the students' responses is required, which means that feedback is generally provided after the lesson. Yet one important characteristic of feedback is that it should be timely (Ho, Peh et al. 2005). Given the constraints of a large class size and limited curriculum time, how can a teacher integrate formative assessment into the classroom?

This paper examines how 107 teachers from 30 schools tap the affordances of a specific technology, the Classroom Performance System (CPS), to support formative assessment within their classrooms.

## **2. Formative Assessment**

Simply put, "formative assessment involves using assessment information to feed back into the teaching/learning process"(Gipps 1994). Formative assessment is "integrated within instruction and aimed at increasing learning" (Hunt and Pellegrino 2002).

According to Broadfoot and colleagues (1999), formative assessment involves a shared process of developing the learners' knowledge. The information from assessment is used to both "feedback" and "feedforward"(Broadfoot, Daugherty et al. 1999). It feeds back to the teacher how effective instruction has been, and "feeds forward" into planning for the next steps in learning and how to help students take these steps. Feedback is also given to students to help them identify and take action to close gaps in their learning. According to Sadler (1989), feedback "is considered feedback *only when it is used to alter the gap.*" If assessment information is simply recorded or given in the form of summary grades to the student, it is not considered feedback for formative assessment.

### **2.1 Formative Assessment in the Traditional Classroom**

In a traditional classroom, formative assessment is time-consuming, as illustrated in Figure 1. When the teacher asks a question to assess student understanding, one or selected students may respond. From the answer given (data), the teacher interprets and identifies the gap between what the student(s) has actually learnt or the learning outcome, and the desired learning goals. Then the teacher provides feedback to the student(s) and decides on action(s) to close the learning gap; to either move on or reteach the material. However, whether the teacher asks questions in class or marks pupils' work to assess their understanding, feedback given may not be timely and/or specific and the entire burden of classroom assessment falls on the teacher.

Black and Wiliam (as cited in MacCallum 2000) point out the central idea in formative assessment is that the learner knows or perceives a gap between a desired goal and his/her present state and takes action to close the gap. In the traditional classroom, interpreting where the gap lies and taking steps to close the gap is usually monopolized

by the teacher. Broadfoot and colleagues (1999) point out, “Assessment and marking are typically processes which are done for, and to, students”; it is the teacher who tests, gathers, grades and analyzes the responses before giving feedback to the students.

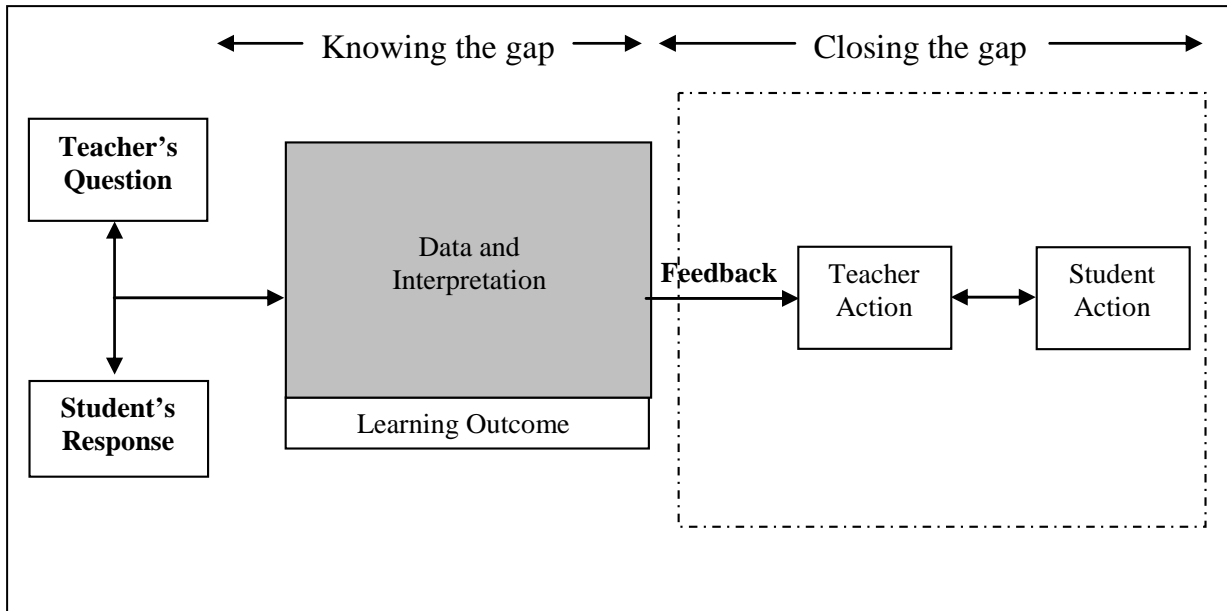


Figure 1: Formative Assessment in the Traditional Classroom

## 2.2. Formative Assessment with Technology

In an opinion paper urging the rethinking and redesigning of educational assessment, (Pelligrino 2001) stated that assessment with technology can inform teachers better about the nature of student learning because it offers “a complex stream of data about how students think and reason”. Pellegrino argued that assessment must evolve to give teachers better access to information about student understanding, thinking strategies and the nature of their misunderstandings. He proposed that technology could help achieve this. Our study began with this idea to explore how teachers harnessed technology, the Classroom Performance System (CPS), to *informate formative assessment*.

The word “informate” was first coined by Zuboff (Roschelle, Penuel et al. 2004), a sociologist who studied how new information technology (IT) affects workers. She used it to refer to how technology should not merely save time but it should also, by generating information that can refine ongoing processes, help workers perform better. At present, technology for assessment is used mainly to *automate* the assessment process, making it more efficient. Thus in order to *informate*, technology for assessment should also provide teachers with feedback or information that can enhance the quality of instruction.

## 3. Classroom Performance System

The Classroom Performance System is a wireless response system that provides instant, collated feedback to all the students in class, based on their responses to questions (mainly MCQ, true/false kind of questions). The system consists of a number of student input devices networked to a central computer. Questions can be delivered impromptu or prepared beforehand in CPS or other platforms (e.g. Internet, PowerPoint). Students can answer the questions individually or as a team. The students' responses, via the input devices, are relayed to the central computer.

Various reports and detailed analyses of every student / class performance are immediately available. The teacher can display the class' collective results for the students to view and or store them for future analysis.

#### **4. The Study**

Our study involved 107 teachers from 30 schools who designed, implemented and reflected on using the Classroom Performance System (CPS) with lesson activities in various subjects. We were interested in how teachers used CPS in their lessons and what they did with data generated by the system to improve their students' learning and/or their own instruction. In each of the schools who volunteered for our study, at least 2 teachers took part. There was no restriction on subject area or level of the teachers and the subjects involved in the study included various sciences, mathematics, geography, languages and social studies.

Over a period of 7 months, data in the form of lesson observations, post-lesson interviews with teachers and selected students, and teacher reflection journals was collected. A total of 292 journals were analysed. The journals were designed to elicit a brief description of the lesson, what data was generated by CPS, why the teacher needed the data, when and how the data was used. Teachers were also encouraged to gather and record comments from students on the use of CPS and to indicate these in their journals.

#### **5. Formative Assessment Using CPS**

The processes of formative assessment using CPS we observed are described in Figure 2. The teacher asks a question via the CPS and all the students indicate their answer using the response pads. The CPS collates the answers and displays the aggregated response, usually as a histogram.

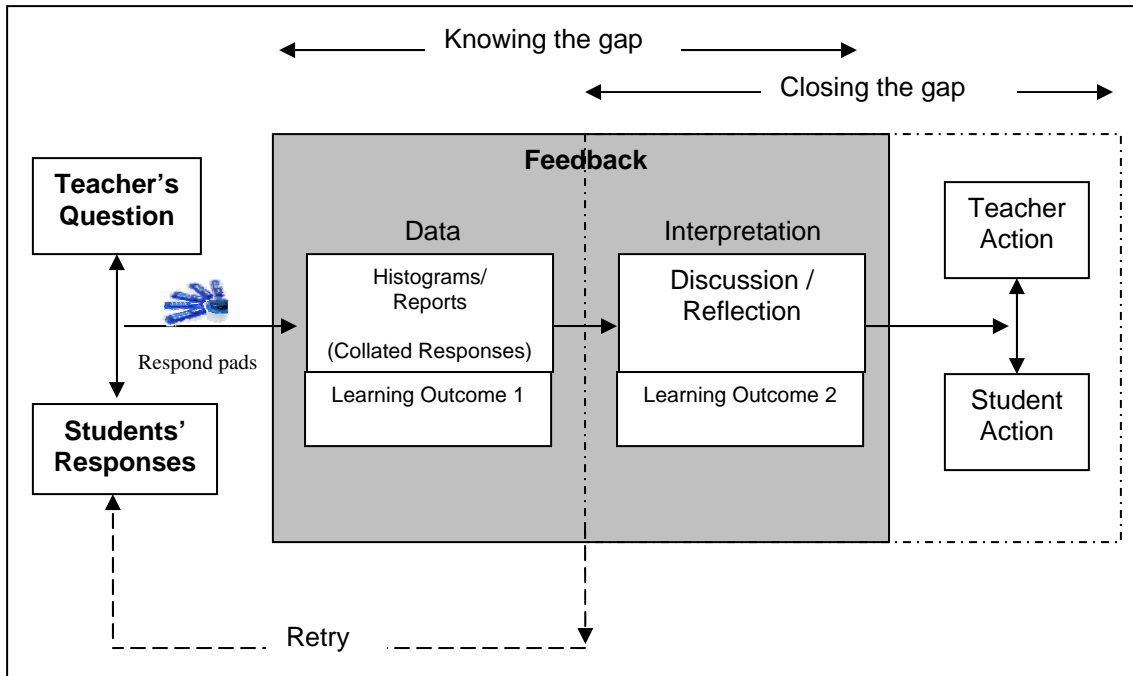


Figure 2: Formative Assessment with CPS

At this point, both the teacher and all the students are able to see the collated responses, learning outcome 1, projected on the screen. The teacher knows the level of student understanding and each student can recognize if there is a gap in their understanding immediately.

Unlike in Fig 1 where the data collection and interpretation is done only by the teacher, in Fig 2, technology has collated data that can be interpreted by 2 audiences – the teacher and the students. Both teacher and students know what the gap is between the learning outcome and the desired learning goal because of the immediate visual feedback from the histogram. Feedback is provided simultaneously for teacher and students about:

1. what the students have learnt
2. how the whole class is thinking about a given item
3. how individual students' answers fit in with the those of the class and,
4. how effective the instructional approach has been

The process of closing the gap also begins earlier than in the traditional classroom where specific feedback to individual students is delayed because of the time required for marking. Through class-wide, small group or pair discussion or individual reflection in class, students receive richer feedback about their learning which contributes to an enhanced learning outcome (Learning Outcome 2). By Learning Outcome 2, the gap between the desired learning goal and the learning outcome is smaller.

### 5.1 Strategies That Teachers Used

Our study found that teachers used CPS for formative assessment in ways that were teacher-centred and ways which were more student-centred. There were also

teachers who did absolutely nothing with the data generated by CPS. Although they ostensibly used the technology, they ignored the information generated and went on with their lesson as planned or as normal. For example, in one classroom observation, the teacher used CPS to collect pre-lesson data. However, instead of using the information in some way to feedback into the learning process, she proceeded with her lesson without reference at all to it.

Isolated instances aside, we found that many teachers managed, despite the limitations of an MCQ format, to capitalize on the following pedagogic uses of the system for formative assessment (adapted from (Draper and Brown 2004) and Black and Wiliam 1998):

Pedagogic use	Process	Examples of Use of CPS from the Study
Formative feedback on learning (for teacher)	Knowing the gap	<ul style="list-style-type: none"> <li>▪ perform pre- and post-testing to check students' prior knowledge before a lesson &amp; to gather evidence of change in students' learning after the lesson</li> <li>▪ use CPS throughout instruction (embedding assessment). For example in a lesson where the concepts are interrelated and understanding of a prior concept is necessary in order to understand a more complex concept, CPS can be used to test students' understanding of each concept before moving on to the next concept. For e.g. in Geography, students need to understand the concepts of local winds and convectional currents in order to understand the concept of monsoon winds.</li> </ul>
Formative feedback on learning (for learners)	Knowing and closing the gap	<ul style="list-style-type: none"> <li>▪ initiate small group/class discussion <ul style="list-style-type: none"> <li>- show histogram to provide visual feedback in terms of right &amp; wrong answers/ range of answers (no R/W indicated)</li> <li>- students to discuss the variations in responses</li> <li>- students to convince their peers to change their answers</li> <li>- students to provide reasoning for their answers (R/W, verbally or in writing)</li> <li>- students with the correct answers to explain to peers who got the wrong answers</li> </ul> </li> <li>▪ provide students with the opportunity to answer the same/ similar questions after discussion</li> <li>▪ students to make predictions prior to and after an experiment</li> <li>▪ students motivated to take responsibility for their own learning <ul style="list-style-type: none"> <li>- observed referring to their textbooks to check the answer after the histogram was projected</li> </ul> </li> </ul>
Formative feedback on teaching (for teacher)	Knowing the gap Adjusting teaching to close the gap	<ul style="list-style-type: none"> <li>▪ perform pre and post testing to ascertain if a particular instructional strategy, e.g using a computer animation, is effective in achieving specific learning objectives</li> <li>▪ use CPS to help pace the lesson. For eg., a science teacher used CPS to pace her instructions as students carried out a science experiment</li> <li>▪ make instructional adjustments, e.g. using new analogies, alternative vocabulary, provide more practice opportunities</li> </ul>

Pedagogic use	Process	Examples of Use of CPS from the Study
Peer Assessment	Knowing and closing the gap	<ul style="list-style-type: none"> <li>▪ provide sample answers for students to grade using CPS to help them understand the criteria for assessment               <ul style="list-style-type: none"> <li>- students to justify the score they give for each answer</li> </ul> </li> </ul> <p>Note: may want to consider involving students in setting the questions and answers</p>

## 6. Challenges

In our study, we noted that most teachers made use of existing questions (from textbooks, the Internet, or past assessment papers). To maximise the potential of using CPS, teachers need to learn how to develop or select quality questions, such as questions that are designed to surface misconceptions, highlight different perspectives, or to check if students can make distinctions between ideas.

Currently, our teachers are asking mainly close-ended multiple-choice questions (MCQs). While it is true that MCQs limit the kinds of questions a teacher can ask, it is possible to create open-ended MCQs which ask for students' opinions and which can generate dialogue. For example, in asking a question about Macbeth, the teacher can ask who the students consider the main villain: Lady Macbeth, the witches or Macbeth.

## 7. Conclusion

Technology helps by providing teachers with easy access to information about our students' understanding or lack of it. In other words, technology enables the teacher to identify gaps in understanding and be more responsive in terms of instructional approach. However, the teacher needs the skill to design questions which would highlight or surface conceptual gaps. Also, ultimately, it is what the teacher and students do with that information that will enable them to close the gap. As Wiggins says, "Assessment is derived from *assidere* to sit with or beside. It is something we do **with** and **for** a student, **not** something we do **to** them."

## References:

- Black, P. and D. Wiliam (1998). Inside the Black Box. London, School of Education, King's College.
- Broadfoot, P., R. Daugherty, et al. (1999). Assessment for Learning: beyond the black box, University of Cambridge School of Education.
- Draper, S. W. and M. I. Brown (2004). "Increasing Interactivity in lectures using an electronic voting system." Journal of Computer Assisted Learning **20**.
- Gipps, C. V. (1994). Beyond Testing: Towards a Theory of Educational Assessment, The Falmer Press.
- Ho, J., J. Peh, et al. (2005). Informating Formative Assessment with Technology. WCCE, South Africa.
- Hunt, E. and J. W. Pellegrino (2002). "Issues, Examples, and Challenges in Formative Assessment." New Directions For Teaching and Learning **89**(Spring 2002): 73-85.
- McCallum, B. (2000). Formative Assessment - Implications for Classroom Practice, Institute of Education.
- Pelligrino, J. (2001). Rethinking and Redesigning Education Assessment. Denver, Colorado, Education Commission of the States.
- Roschelle, J., W. R. Penuel, et al. (2004). "The Networked Classroom." Educational Leadership **61**(5): 50-54.
- Sadler, d. (1989). "Formative assessment and the design of instructional systems." Instructional Science(18): 119-114.