Actively Inspiring Maths Teaching
With Learner Response Devices

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Background
A research study was recently undertaken to investigate whether, and the extent to which, Year 7 and Year students' learning in mathematics lessons is enhanced by the combination of Learner Response Devices (LRDs), lesson flipcharts produced in ActivInspire for use with interactive whiteboards, and co-operative learning strategies. ActivInspire is a versatile Promethean software programme for use with interactive whiteboards to create teaching and learning resources. ActivExpression is a small handheld learner response device (LRD) that enables all students to answer in response to any question posed by the teacher or written on an interactive whiteboard. ActivExpression allows students to key in their own answers using a keypad like those on mobile phones. Teachers can display students' responses immediately on an interactive whiteboard in a variety of formats, from summary graphs to displays of individual students' responses.

A great deal of research has established that providing frequent formative feedback, to give both the teacher and the students themselves immediate indicators of students' current levels of understanding, can have a substantial impact on student learning (e.g., Black & William, 1998; Slavin, 1995; McMillan, 2004). Research on the use of learner response devices is in its infancy, but early studies have shown positive effects on learning (e.g., Marzano & Haystead, 2009; Mayer, 2009). Research on co-operative learning methods, in which students in teams work toward group success based on the individual learning of all team members, has found consistent positive outcomes in primary and secondary mathematics (Slavin & Lake, 2008; Slavin, Groff & Lake, 2009; Slavin 1995).

Theoretical framework
The study takes a socio-cognitive perspective (Derry, 2000) which views learning as cognitive conflict resolution through social discourse as learners co-operatively engage in problem solving and meaning-making. From this perspective, the use of LRDs by students in isolation may not produce optimal outcomes, as students who are struggling with the content may not gain from just posting their answers. However, LRDs used in co-operative groups, where students can help each other to learn and prepare for individual assessments, provides a potentially more powerful cognitive tool. The systematic introduction of co-operative teaching and learning strategies combined with the use of LRDs in mathematics lessons may offer a means of making replicable improvements in students' mathematical performance.

Research question
The research question is 'What is the impact on Year 7 and 8 students’ mathematical achievement of using ActivExpression LRDs in combination with co-operative learning?' While outcome measures from pretest and posttest comparisons are currently not yet available, preliminary findings draw on teacher and student reports and observations of implementation fidelity.

Method
Year 7 and 8 pupils in 6 intervention schools in England are participants in a randomised control evaluation, using pre and posttests, of the effectiveness of ActivExpression used in combination with co-operative learning. Students work co-operatively in 4-5 member teams to help one another master academic content. Teams receive recognition based on the degree to which all team members have learned the content of each lesson, and for team co-
operation. To help their team to succeed on tasks and problems set in lessons, group members tutor and encourage one another to achieve. In this way, individuals are accountable for their own learning and for the learning of others in their team. A pilot study highlighted teachers’ need for lesson structures that brought together teaching strategies that underpin co-operative learning and ensure its effectiveness, and the mathematical content requirement, referenced to the Secondary Strategy for Mathematics and to guidance materials for assessing pupil progress (APP). Sets of flipcharts for each mathematics module in the Year 7 and Year 8 curricular were developed in ActivInspire for use with the ActivExpression devices. An important feature of the flipcharts is systematically guiding the process and progress of the lesson through various teaching and learning stages and activities that lead from teacher modelling, through team support for learning, to individual learning gains. The various lesson stages and teaching and learning strategies are represented in the Cycle of Effective Instruction in Figure 1 below.

Figure 1. Cycle of Effective Instruction Represented In Lesson Flipcharts

**Active Instruction**: In this section of the lesson, present the concepts or skills of the lesson.

Procedures and symbols used during the Active Instruction section of the lesson:

- Think Aloud (Teacher Modelling): Model out loud your thinking process as you, the teacher, demonstrate to the class how to answer a question, or solve a problem.

Think-Pair-Share:
1) On their own, students think about how to answer a question or resolve a problem.
2) Students describe their thinking to a partner.
3) Ask two or three partnerships to share their thinking with the class.
Think-Pair-Share is primarily used during Active Instruction.

- Team Huddle: Students work with their teams, making sure everyone can answer and explain.

- The Random Reporter* from each team enters the team’s answers on LRDs. Click the green play button, and ask Random Reporters to enter their answers. View the results with the class, and then call on a Random Reporter to explain.

  - Use Random Reporter to randomly select a student to share his or her answer and explanation. (No devices.)

**Team Mastery**: During Team Mastery, students work with teammates to individually master the skills presented during Active Instruction. At the end of Team Mastery, randomly choose students from several teams to give and explain answers to the problems. Teams earn points when their Random Reporter gives correct answers and explanations. Every team member must be prepared to answer successfully.

Procedures and symbols used during the Team Mastery section of the lesson:

- Team Mastery: When the TM icon is clicked, the screen will show: “Work by yourself to solve the problem. Then check with someone on your team. If your solutions match, go on. If not, work together to
Random Reporters enter their team’s answer on LRDs. Click the green play button, and have Random Reporters enter their answers. View the results, and then call on a Random Reporter to explain.

Use Random Reporter to randomly select a student to share his or her answer and explanation. (No devices.)

**Assessment:** During the Assessment section of the lesson, set new questions that have not been discussed by the team to evaluate whether students have individually mastered the objectives of the lesson.

**Procedures and symbols used in the Assessment section of the lesson:**

- **Team Check:** This is a question not previously discussed by teams. Students solve the problem by themselves and write or enter their answer. Call on Random Reporters to explain their answers.

- **Team Check with LRDs:** Click the green play button, and have everyone enter their answers. View the results with the class, and then call on a Random Reporter to explain.

**Random Reporter:** Choose students from each team at random to answer a question for the team and/or to explain the team’s answer.

Examples of lesson flipcharts in ActivExpression presented below (see Figures 2a, 2b, 2c, 2d, and 2e for a lesson on nets and 3a, 3b, 3c, 3d and 3e for a lesson on interpreting data) exemplify various stages of the lesson and the teaching and learning strategies underpinning them.

**Figure 2a First sub-skill**

[Image of a lesson flipchart showing a team huddle with questions about nets and 3-D shapes.]
**Findings and contribution**

Teachers have reported very favourably on the resources and look forward to using them in the future. Teachers adapt the flipcharts or use the lesson template to meet the specific needs of their students. Far from being regarded as programmatic or formulaic, the flipcharts are seen to meaningfully bring together and make explicit lesson several crucial elements: lesson objectives, teacher modelling or exposition, individual learner accountability, peer support, maths talk, co-operation in problem solving, ongoing formative assessment, achievement and success. Teachers report increased student engagement and on-task behaviour in maths lessons. In addition, the resources promote a new dynamic in classroom practice and support an appropriate pace in maths lessons.

The research has also identified constraints impacting on the potential for learning of combining ActivExpression with co-operative learning in maths lessons. Constraints include student confidence and competence ineffective teamwork and dialogic learning techniques; teacher confidence in promoting maths talk and dialogic learning; teacher confidence in using the technology; problems accessing and managing the technology; teacher absence, inconsistency and variability in implementation. These findings suggest a need for increased support for student discussion and dialogic talk for learning in general, and for enhanced professional development for teachers in the use of dialogic teaching strategies and the technology itself.
References:


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