COLÁISTE MHUIRE GAN SMÁL ~OLLSCOIL LUIMNIGH~ | MARY IMMACULATE COLLEGE ~UNIVERSITY OF LIMERICK~

Looking in classrooms: Improving the teaching and learning of statistics in primary classrooms

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The knowledge needed to teach statistics

- Subject matter understanding
  - In order to teach statistics, teachers must understand statistics themselves. Teacher knowledge impacts instruction and achievement.
- Pedagogical understandings
  - How to engage learners, repertoire of teaching approaches, understandings of curriculum and classroom culture
- Knowing about children including how children learn
  - Children's interests, problematic content areas, listening and interpretation skills, how children learn, differences among learners
- Habits and dispositions of statistical thinking
  - Processes of statistical thinking, reasoning about data, cycle of statistical investigation, EDA approaches etc.

Teacher Knowledge

Subject-matter knowledge (SMK) (Shulman, 1986)		Pedagogical content knowledge (PCK) (Shulman, 1986)	
common content knowledge (CCK) (Ball et al., 2008)	specialized content knowledge (SCK) (Ball et al., 2008)	knowledge of content and students (KCS) (Ball et al., 2008)	knowledge of content and teaching (KCT) (Ball et al., 2008)

Learning in and from practice

How do we navigate this complex terrain and provide necessary experiences and support for pre-service teachers?

- Importance of inquiry stance in teacher education (Ball & Cohen, 1999)
- Teaching is complex and must be parsed (Hiebert, Gallimore & Stigler, 2009)
- Consideration of math content inside teaching practices is important (Ma, 1999)
- Importance of engaging pre-service teachers in analyzing teaching (Hiebert, Morris and Berke, 2007)

The classroom is a place where knowledge is transmitted through various processes, in particular through situations that contextualize knowledge and through interactions about this knowledge amongst people (teacher and students) who act within and on these situations. Thus …… the classroom teaching situation constitutes a pertinent *unit of analysis for* didactic research in mathematics, that is, research into the ternary didactic relationship which binds teachers, students and mathematical knowledge.

Laborde & Perrin Glorian (2005)

Lesson Study is used a tool to provide insights into problems of practice and to identify the emerging needs of pre-service teachers as they engage in teaching statistics

Structure of the study

Participants

- 21 final year pre-service teachers; two males; four studying mathematics

Working groups

- Lesson study group 1: Data in the early years
- Lesson study group 2: The mean
- Lesson study group 3: Exploring distribution, typicality and sampling
- Lesson study group 4: Comparing data and informal inference.

Stages of the study

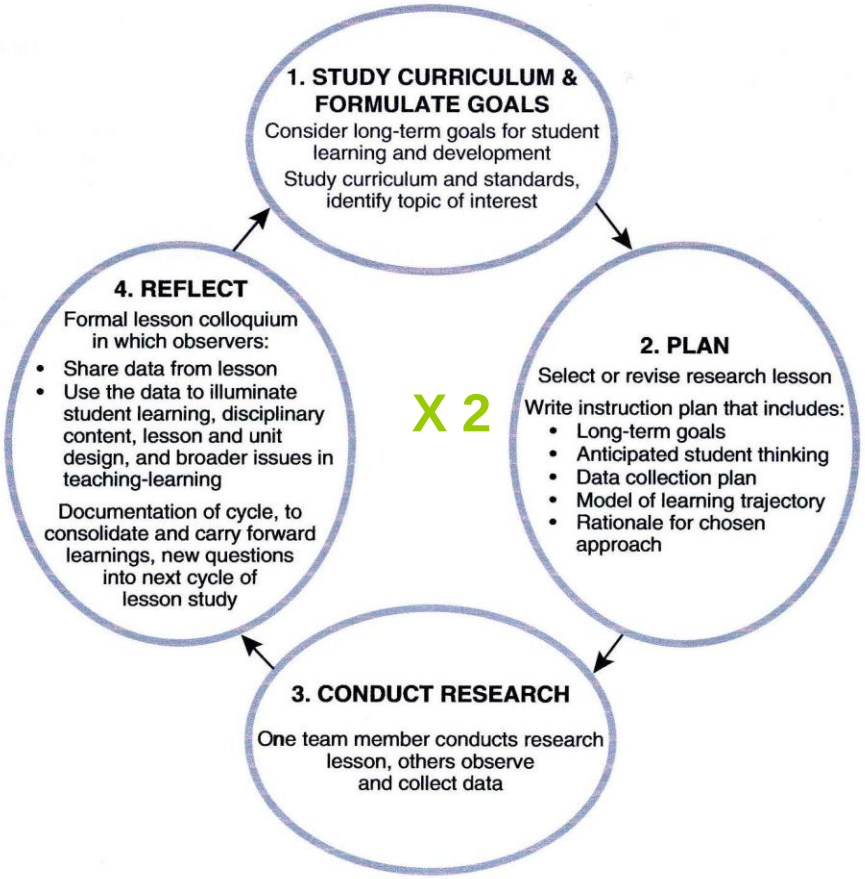
Stage 1
Weeks 1-3

Introduction
to lesson study

Teaching data handling in the primary classroon

Statistical
concepts

Stage 2
Lesson Study
Weeks 4-10



Stage 3
Weeks 11-12

Sharing reflections on teaching statistics

Group presentations

Stage 1

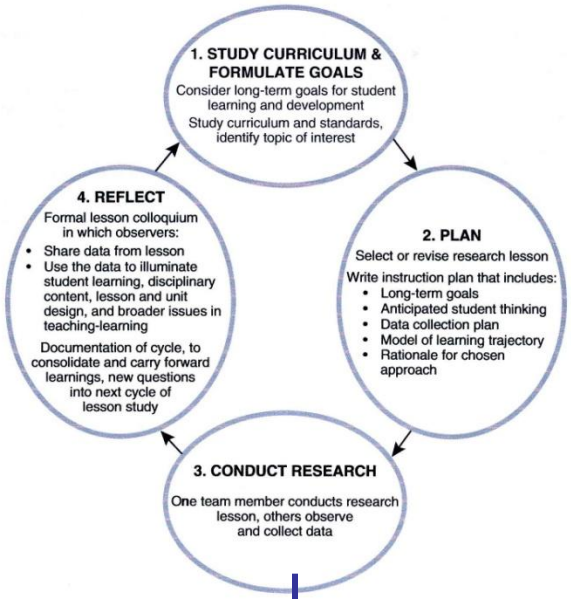
Introduction
to lesson study

Teaching data handling in the primary classroom

Statistical
concepts

Copies of lectures
Written group logs

Stage 2
Lesson Study



Audio-taped meetings with group
Digital copy of lesson plan
Observation and video-recording of classroom teaching
Classroom observation notes
Written group logs
Focus group interviews

Stage 3

Sharing reflections on teaching statistics

Group presentations

Videotaped presentations
Individual reflective report
Group reflective report

Methodology

Method of inquiry employed was collective case study (Stake, 1997)

Analysis of the data proceeded in a manner consistent with a naturalistic inquiry approach (Lincoln & Guba, 1985).

The principal *data collection technique* used was participant observation.

Primary *methods of data collection* constituted: researcher observations, audio taped interviews, and written reports and responses produced by groups.

Data collection methods synchronized closely with the stages of lesson study

Throughout the process of data analysis, action codes were created and the *constant comparative method* (Glaser & Strauss, 1967) employed.

Results

- Analysis of classroom teaching revealed ‘problems of practice’ that include but extend beyond the traditional realm of content knowledge studies.
- New understandings were categorized predominantly into three knowledge domains:
  - Specialized content knowledge (SCK)
  - Knowledge of content and students (KCS)
  - Knowledge of content and teaching (KCT)

Teacher Knowledge

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The activity of planning lessons developed *Knowledge of content and teaching (KCT)*

Case 1: Teaching data in the early years

- **Challenge:** The design of a series of questions that support the analysis of graphical representations of data while at the same time build in complexity
- **Response:** Adoped Curcio's (1987) three levels of questioning
  - Reading the data
  - Reading between the data
  - Reading beyond the data

The activity of reflecting on lessons developed *Knowledge of content and students (KCS)*

Case 1: Teaching data in the early years

- The act of reflecting on the lesson provided the opportunity to think about what the children responses in relation to statistics and/or mathematical reasoning.
- Reflection on classroom events supported the development of a ‘community of practice’ where members were eager to share observations and discuss issues as they arose

Video Time code 25:33-28:24

Focusing on *Knowledge of content and teaching* (KCT) stimulates growth in *Specialized content knowledge* (SCK)

Case 2: Teaching the mean

- Development of *specialized content knowledge* (SCK) of the mean was stimulated by the activity of selecting models (KCT) for representing the mean
- Engaging in debate with their peers regarding the relative merits of models of the mean to use with children was a qualitatively richer learning experience than the traditional approach of 'presenting models' commonly used in pedagogy courses.
  - *As we were experimenting with the different methods and using the concrete materials, the actual calculation and what happens to the numbers in a data set became more obvious and therefore my understanding developed. The "Levelling out" method really gave a clear and distinct demonstration of what the average number is and how it is calculated using concrete materials'*

Anna, final reflective paper

Focusing on *Knowledge of content and teaching* (KCT) stimulates growth in *Specialized content knowledge* (SCK)

I learned ... that the mean of a number doesn't have to be a number in the set. It can be any number within the range of numbers. It cannot be smaller than the smallest number in the set and it cannot be bigger than the biggest number. This is important as some children think they are wrong if they get a number for the mean which is not part of the set. Prior to the study I would not have taken this factor into consideration when teaching the mean and I wouldn't have been able to illustrate it because I didn't know about the levelling out technique

Teresa, final reflective paper

Summary and conclusions

- Developed links between theory and practice
- Highlighted the importance of *contexts* and on the *process of statistical investigation*
- Greater appreciation for the capacity of children to think and reason statistically
- Uncovered and tackled content and pedagogical knowledge difficulties during the *practice* of teaching in live classrooms
- Structure of LS provides a mechanism for engaging students in inquiry-based learning

Much of what they (teachers) have to learn must be learned in and from practice rather than in preparing to practice

Ball & Cohen, pg. 10