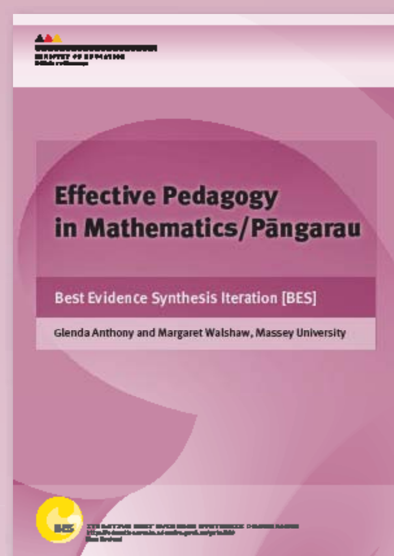
Use fun games to build mathematical knowledge and confidence in young learners

This is one of a series of cases that illustrate the findings of the best evidence syntheses (BESs). Each is designed to support the professional learning of educators, leaders and policy makers.



ITERATIVE BEST EVIDENCE SYNTHESIS PROGRAMME
HEI KETE RAUKURA
http://educationcounts.govt.nz/goto/BES
New Zealand

MINISTRY OF EDUCATION
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BES cases: Insight into what works

The best evidence syntheses (BESs) bring together research evidence about 'what works' for diverse (all) learners in education. Recent BESs each include a number of cases that describe actual examples of professional practice and then analyse the findings. These cases support educators to grasp the big ideas behind effective practice at the same time as they provide vivid insight into their application.

Building as they do on the work of researchers and educators, the cases are trustworthy resources for professional learning.

Using the BES cases

The BES cases overview provides a brief introduction to each of the cases. It is designed to help you quickly decide which case or cases could be helpful in terms of your particular improvement priorities.

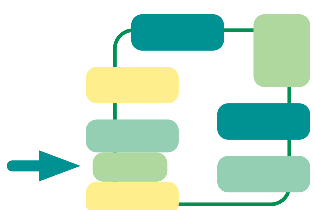
Use the cases with colleagues as catalysts for reflecting on your own professional practice and as starting points for delving into other sources of information, including related sections of the BESs. To request copies of the source studies, use the Research Behind the BES link on the BES website.

The conditions for effective professional learning are described in the Teacher Professional Learning and development BES and condensed into the ten principles found in the associated International Academy of Education summary (Timperley, 2008).

Note that, for the purpose of this series, the cases have been re-titled to more accurately signal their potential usefulness.

Responsiveness to diverse (all) learners

Use the BES cases and the appropriate curriculum documents to design a response that will improve student outcomes



The different BESs consistently find that any educational improvement initiative needs to be responsive to the diverse learners in the specific context. Use the inquiry and knowledge-building cycle tool to design a collaborative approach to improvement that is genuinely responsive to your learners

Use fun games to build mathematical knowledge and confidence in young learners

Playing fun mathematical games is one of the most powerful and positive ways in which families can support mathematical learning.

This case demonstrates how adults can support children to develop deeper understanding of fractions by playing informal language games. In this case, the game was played for a few minutes several times a week. The difficulty of the tasks and problem-solving approaches varied, but all were based around the familiar context of sharing cookies amongst a number of children. This case will be useful for parents, caregivers, and educators in early childhood centres and schools.

Building on learners' prior knowledge and experiences

Prior to formal schooling, many opportunities for learning mathematics can be found in children's everyday experiences—in the home, the community, or centre. CASE 1 exemplifies the supporting role of the adult. Building on a relationship of trust, the adult is able to engage with the child in sustained, shared thinking involving an imaginative and experientially real context.

CASE 1: Cookies

(from Sharp, Garofalo, and Adams, 2002)

Mathematics teaching for diverse learners:

- demands an ethic of care;
- creates a space for the individual and the collective;
- provides opportunities for children to explore mathematics through a range of imaginative and real-world contexts;
- provides for both planned and spontaneous/informal learning.

Through experiences such as 'sharing', young children develop intuitive fractional knowledge in which they combine thought, informal language, and images (Kieren, 1988).

Targeted outcomes

Informal knowledge of fractions developed through context-based sharing situations.

Learning context

Leah, who is almost five, and Joe, an adult, often play games while driving to Leah's preschool in their truck. Leah is engaged is a sustained shared-thinking episode as part of a game that she regularly plays with Joe, which she calls 'Kids and Cookies'.

Task and activity

Joe:	Hey Leah, what do you want to play today?
Leah:	Let's play Kids and Cookies.
Joe:	OK. What if you had 4 cookies and 3 kids? How would you share them?
Leah:	One, one, one, and then there is one left. Then they each get one third, one third, one third.
Joe:	So, how much does each kid get?
Leah:	They get one whole one and one third.
Joe:	What if you had 5 cookies and 3 kids? How could you share the cookies?
Leah:	One, one, one. Then there's two more left. OK. Then they get a third, a third, a third, and then a third, a third, a third.
Joe:	So how much do they each get?
Leah:	They get one whole and two thirds.
Joe:	What if you had 7 cookies and 4 kids?
Leah:	That's a hard one, maybe I can't do it.
Joe:	Think about what you did to solve the other two.

Leah:	Whole, whole, whole, whole, then there's three more left. Um, three more cookies left. Then you break up one into halves, then there are two left. And, another into half, half. Break the last one into quarter, quarter, quarter, quarter.
Joe:	Great! How much does each kid get?
Leah:	One whole, one half, and one quarter.

Joe and Leah played the game for a few minutes, several times a week, with Joe varying the numbers so that Leah was able to resolve more and more complex situations. Sometimes Joe would ask Leah to find two ways to share the cookies (e.g., four cookies could be shared among six children by splitting each cookie into sixths and giving each child four-sixths, or by giving each one-half of a cookie and one-sixth).

Learner outcomes

By comparing different solution strategies for problems, Leah developed an understanding of equivalent fractions. With repeated exposure to the game, Leah's ideas were both valued and challenged. She was able to build on her existing conceptual understanding of fractions and operational sense of whole number to develop a procedure that would foreground operations with fractions.

Quality pedagogy

Leah's growth in understanding of fractions was assisted through:

- interaction with a supportive adult. Joe's questions incorporated ideas about sharing and used Leah's informal language.
- activities situated in experientially relevant contexts. Leah's conceptual knowledge of fractions grew from encounters with whole-number division.
- instruction that built on her informal knowledge. This gave Leah access to participation, allowing her to make contributions that were personally meaningful.

Bridge to school

Children may well enter school with a rich bank of informal or intuitive understanding of rational number concepts and procedures, based on their activities in their personal environment. It is through these activities that students develop thinking tools and imagery for the construction of important knowledge about rational numbers.

References

Kieren, T. (1988). Personal knowledge of rational numbers: Its intuitive and formal development. In J. Hiebert & M. Behr (Eds.), *Number concepts and operations in the middle grades* (pp. 162-181). Hillsdale: Lawrence Erlbaum Associates.

Sharp, J., Garofalo, J., & Adams, B. (2002). Children's development of meaningful fraction algorithms: A kid's cookies and a puppy's pills. In B. Litwiller & G. Bright (Eds.), *Making sense of fractions, ratios and proportions* (pp. 18-28). Reston: National Council of Teachers of Mathematics.