Chapter 8
Conclusions

The purpose of this chapter is to summarise and comment on the main outcomes of the JUMP evaluation conducted in 2013/14. The study used a variety of measures to evaluate JUMP, including analyses of JUMP materials and of how well JUMP matched the content objectives of the Irish primary school mathematics curriculum (PSMC). Classroom observations were conducted, pupils' and teachers' attitudes and behaviours were examined using questionnaires and interviews, and pupil mathematical achievement was assessed pre- and post-intervention using a standardised achievement test widely used in Irish primary schools (the Drumcondra Primary Mathematics Test).

Unlike most previous evaluations of JUMP, the evaluation included a comparison group (the IMPACT programme, developed by the PDST to help teachers implement the PSMC) and classes were assigned to each programme in a manner that maximised similarity between baseline pupil mathematics achievement. Previous studies of JUMP efficacy have tended to examine how JUMP works with a selection of pupils/classes/districts without a control group (e.g., Aduba, 2006, 2007, 2009; Maciejewski, 2012 [centring on college-age students]; Murray, 2013) or only to focus on pupils' mathematical attitudes or confidence (e.g., Biswas Mellamphy, 2004; Hughes, 2004). These studies have typically found positive effects arising from JUMP, but interpretation of such findings can be problematic. In particular, in Aduba's Lambeth study (where JUMP was mainly delivered as an add-on mathematics programme for low-achieving pupils), JUMP coincided with a number of other interventions, including intensive whole-school improvement programmes in many participating schools. This makes it difficult to disentangle the effects of JUMP from the effects of the school having extra support from a range of professionals (education advisers, teaching and learning consultants, outreach workers, partnership schools).

Solomon et al.'s (2011) as-yet-unpublished study used a random control trial model to assign classes to JUMP or to continue with the regular (Ontario) curriculum. While the randomised assignment to programme is preferable to school self-selection or being "volunteered" for the programme as part of a wider attempt to address school underperformance, it does not seem to address the fact that the control group knew they were the control group. Garforth's (2013) work is an exception, in that she compared classes who experienced JUMP alone, JUMP combined with other programmes, and normal curriculum materials. Her results indicated that JUMP was associated with improved performance only for Number, and poorer performance on computational skills. However, with only 106 pupils across the three conditions, it is difficult to draw many conclusions from such a small sample.

Therefore, as noted in Chapter 1, this evaluation included a control (or comparison) group, with efforts made to ensure they did not know they were the control group. Although IMPACT was not the main focus of the evaluation, significant parts of the preceding chapters have described what happened in IMPACT classes. This was to take into account two key issues that might affect attitudes and behaviour: the Hawthorne Effect (possible effects on behaviour from knowing you are part of an evaluation), and gradual changes that might occur naturally over the course of an academic year. Thus, any changes that manifested only in the JUMP group might therefore be more directly attributable to characteristics of the JUMP programme.

Unlike previous chapters, the focus here is largely on JUMP. The chapter is divided into three sections, the first of which outlines the five main questions the evaluation was designed to answer, and what answers were found. The second section examines what contributed to improved mathematics achievement, and the third section examines future possibilities for JUMP in Ireland, drawing on the outcomes of the present evaluation.

All of what follows is, however, necessarily limited by the relatively small scale of the study. The overall number of pupils is quite small, the numbers of schools and teachers are very small, and analyses by subgroups of pupils within each programme are therefore somewhat problematic. These considerations should be borne in mind when interpreting findings.

The research questions

There were five main research questions of interest in the evaluation. The first, and most important, was the effect, if any, of JUMP on pupils' mathematical achievement. The second question was what effects JUMP had on pupils' attitudes to mathematics, while the third was what effect JUMP might have on teacher mathematical knowledge. The fourth question was how well JUMP materials matched with the objectives of the Irish Primary School Mathematics Curriculum (PSMC) and with Irish-developed mathematics materials currently used, and the fifth was how faithfully participating classes implemented the programme.

Has mathematics achievement changed?

In terms of mathematics achievement, pupils who experienced the JUMP programme showed statistically significant gains in mean DPMT scores from the results of the September 2013 to the May 2014 tests. However, so too did pupils in the IMPACT programme. JUMP pupils averaged a gain of nearly seven points (almost half a standard deviation), whereas IMPACT pupils averaged a gain of just over five points (one third of a standard deviation). Both gains would be considered not just statistically significant, but also of pedagogical significance. Although the overall increase in mean scores by pupils in JUMP classes was slightly larger than the increase among IMPACT pupils, it was not statistically significantly larger.

In both programmes, slightly higher gains were made by low- rather than high-achieving pupils (defined as those over one standard deviation below or above the mean when tested in September). Low achievers in both programmes improved by about five score points, while high achievers improved by two points in JUMP and three points in IMPACT. The gains made in each group were broadly similar by gender.

In terms of particular aspects of mathematics (i.e., content and processes), pupils in both groups showed generally similar patterns of performance over the course of the year. Slight differences were apparent in end-of-year performance on Data and on Integrating and Connecting. The slight advantage shown by JUMP pupils on these areas can largely be attributed to three items on which JUMP pupils did *much* better than did IMPACT pupils. The items require pupils to interpret a pictogram in which one symbol represents multiple objects. While the PSMC implies that pupils should develop this skill, the three Irish Third class textbooks reviewed for this evaluation address pictograms only briefly, and limit themselves to examples in which one symbol represents *one* object.[1] However, JUMP dedicates three lesson units to pictograms (called "pictographs" in its materials), and includes examples in which a single symbol represents more than one object. In other words, JUMP satisfies the PSMC aim

[1] As IMPACT materials did not cover the Data strand directly, it seems likely that many IMPACT teachers would have used their usual mathematics textbooks when covering Data topics.

that pupils be able to "read and interpret pictograms" more thoroughly than most Irish textbooks, and this appears to have been borne out in test results.

In sum, the evaluation failed to find a statistically significant effect for JUMP over and above the effect found for IMPACT. Closer analyses of performance did not reveal any particular sub-groups of pupils for whom JUMP was particularly effective, suggesting JUMP is reasonably successful for all, but not particularly successful for any one sub-group of pupils.

Did pupil attitudes change?

Key elements of the JUMP philosophy are that every pupil can be good at mathematics, that teachers should try to decrease pupils' anxiety about mathematics, and that pupils should come to appreciate and be excited by the beauty of mathematics. Therefore, the evaluation examined pupil attitudes to mathematics at the start and end of the year. In most cases, large change in pupil views was not observed. For example, there was no more than a percentage or two difference in those agreeing with these statements: *I wish I didn't have to study maths/I am good at maths/I worry that I won't be able to answer questions in maths class.* There were, however, increases in the percentages of pupils in JUMP classes indicating that they liked maths (6%) and who learned interesting things in maths lessons (8%). The percentage who believed everyone could be good at maths increased by 5% (but increased by 7% among IMPACT pupils).

In JUMP, boys seemed to show a greater increase than girls in positivity towards mathematics, and in mathematical confidence, while the reverse was true of IMPACT. For instance, over the course of the year, there were drops in the percentages of JUMP boys and IMPACT girls who wished they didn't have to study maths. Also, there was an increase of 4% from September 2013 to May 2014 in JUMP boys and IMPACT girls who believed they were good at maths (yet percentages decreased for JUMP girls and IMPACT boys). Although there was little change in the overall percentages of pupils who worried that they would be unable to answer questions in maths class, slightly fewer JUMP boys expressed anxiety about being questioned by the end of the year. Also, the nature of the relationship between questions and mathematics achievement changed slightly: for JUMP, anxiety about being questioned was more weakly correlated with achievement by the end of the year, while for IMPACT, it was much more strongly correlated with achievement than at the outset. In other words, low-achieving IMPACT pupils were more anxious about being questioned in class by May than they had been in September.

As part of the questionnaires, pupils were asked about typical behaviour in mathematics lessons. For the most part, there were few notable changes in responses from September to May or when compared with pupils in IMPACT classes. Regular use of memorisation increased only marginally (by 3%) amongst JUMP pupils during the year, and there was a somewhat surprising larger increase evident amongst IMPACT pupils. However, JUMP pupils were more likely – as would be predicted – to report regularly working on a problem on their own in class.

Among pupils interviewed, the percentage of JUMP pupils who said that mathematics was their favourite subject dropped from 57% (in December 2013) to only 29% (in May 2014). While the drop is quite marked, an almost identical drop was observed amongst IMPACT pupils, suggesting factors external to the programmes may be at play. By the end of the year, pupils in JUMP classes were far more likely to mention (unprompted) that they enjoyed being challenged or stretched in their mathematics lessons. Also, JUMP pupils were overwhelmingly positive about enjoying mathematics and preferring their current mathematics lessons to those in Second class (in contrast to a more ambivalent attitude among IMPACT pupils).

The strength of the correlation between pupils' general positivity to mathematics and mathematics achievement decreased for JUMP pupils over the course of the evaluation, although it increased for IMPACT pupils. In particular, JUMP pupils with above-average achievement scores, and whose scores had improved during the year, were likely to report mildly negative attitudes to mathematics in May. It is possible that the step-by-step, repetitive aspects of the programme may not have appealed to high achievers, or that insufficient use was made of bonus questions for such pupils. However, results should be interpreted with caution due to the small number of pupils involved.

In sum, pupil attitudes and behaviour did change slightly but not as much as might be expected. JUMP did not lead to any notable reduction in pupil anxiety about mathematics, or improved mathematical self-confidence, but mathematics as a school subject does seem to have become slightly more appealing, and, as would be predicted, pupils spent more time engaged in solo work. Differences by gender as well as programme *might* indicate that JUMP promoted positive attitudinal change more effectively for boys than girls, while IMPACT did this more effectively for girls than boys. However, small sample numbers mean that further research would be required to investigate this more fully.

Has teacher knowledge changed?

The evaluation also examined teacher knowledge about teaching mathematics, using a shortened version of the Mathematical Knowledge for Teaching Questionnaire (Delaney et al., 2008; Hill et al., 2004). Baseline MKTQ-S scores collected in September were closely matched for teachers in both programmes, and were slightly above the mean of an Irish norm group of teachers. By the second administration, average number of correct answers increased for teachers in both groups, although very slightly more in JUMP. There was, however, considerable variation with each group in the extent of gains or drops on the MKTQ-S.

Overall, the average improvement among teachers in the JUMP programme was not markedly different from those in the IMPACT programme. Thus, both programmes may have had a positive effect on teacher mathematical knowledge for teaching or the participation in an evaluation of two mathematics programmes may have focused attention on issues related to mathematics teaching (a type of Hawthorne Effect). There may also have been a slight practice effect, although this is unlikely to be marked, given the large amount of time between the two administrations.

In a related vein, an unexpected finding was the noticeable drop in the percentage of JUMP teachers expressing confidence in their ability to adapt their teaching to engage pupil interest. While not directly related to teacher knowledge, knowledgeable teachers tend to be more confident about aspects of their teaching. The reasons for the fall in confidence are unclear. It may be that teachers realised they had heavily relied on JUMP materials and not drawn on their own resources, they may have felt that they did not sufficiently adapt their teaching to pupil need during the year, or there may be other considerations.

How does JUMP align with the PSMC and textbooks?

Most of the teachers who used JUMP felt that it was reasonably well aligned with the Irish PSMC. The most common criticisms related to the use of Canadian expressions and currency, although differences in strand emphases were also raised. The "pitch" of JUMP materials was raised in initial interviews (some teachers thought it too high, others too low) but by only one teacher in the May interviews.

Based on a more formal content analysis of JUMP materials (teacher manuals, pupil materials), it is clear that while some terminology needs adaptation for use in an Irish context, overall JUMP and PSMC content and pitch is quite similar. Generally, the five strands of the JUMP materials correspond closely with those of the Irish PSMC, although some topics appeared under different strands in JUMP. Of the 70 content objectives of the PSMC for Third class, 63 were fully addressed by JUMP materials, six were partly addressed, and only one not addressed at all. The sole objective not addressed related to developing an understanding of the relationship between fractions and division, and is also rarely addressed in Irish-produced materials.

Perhaps surprisingly, the JUMP pupil workbooks were more closely aligned with the PSMC (in terms of relative strand emphasis) than were any of the three Irish textbooks considered. Indeed, the Irish mathematics textbook most commonly used was the one most poorly aligned with the PSMC. Despite this, some teachers felt aspects of JUMP did not align well with the curriculum. For example, there was an inaccurate perception that JUMP paid insufficient attention to Number. This may suggest that some teachers consider their usual mathematics textbooks (some of which over-emphasise Number) as the de facto curriculum.

In sum, despite superficial differences in language and terminology, and some difference in how topics are classified, JUMP represents a reasonably good match with the Irish PSMC.

Was JUMP implemented properly?

JUMP implementation can be examined from the perspective of those who observed lessons, from questionnaire data, and from teachers' own views. Observation data suggest most teachers demonstrated *some* adherence to the relevant lesson plan or programme principles, but few demonstrated very close adherence. Teacher-led instruction and solo work was, as would be expected, more prominent in JUMP than IMPACT, but not markedly prominent vis à vis what might be expected generally. (IMPACT is based on a social constructivist model whereby pupils construct meaning as a group, so teacher-led instruction and solo work should be less common than in mathematics classes *generally*.) The observations suggested that use of some aspects of JUMP (e.g., bonus questions, use of memorisation and repeat procedures, use of workbooks) might have tailed off during the course of the year. Further, the subject matter experts who rated the recorded lessons felt that teachers sometimes missed the spirit of the JUMP programme (e.g., considerable repetition and practice, but no reference to the larger mathematical ideas behind the repeated steps).

From the teacher perspective, most recognised JUMP's positive aspects – the quality and depth of materials, the "ready-made" lesson plans for teachers, the hands-on methods, and the emphasis on building pupil confidence. The main criticism related to the need to adapt the language for an Irish context, the amount of material, and, specific to the present evaluation, there was considerable dissatisfaction about organisational issues.[2] Nearly half of JUMP teachers did not attend the initial CPD day that introduced teachers to the main features of the programme they were to implement during the year. This may partly explain complaints about the amount of material,[3] and why only a minority of teachers used the Confidence Building

[2] As noted in previous chapters, an issue with part of project funding contributed to a delay in project initiation. This in turn caused some organisational problems, most notably, relating to the provision of initial CPD.

[3] Pupils are not expected to complete every part of the JUMP workbook. Some materials are to provide practice opportunities for pupils struggling to grasp a concept, while others are to maintain the engagement of high-achieving pupils. However, this is not immediately obvious from the materials alone.

Unit as intended, while some did not use it at all. Teachers generally expressed dissatisfaction with the amount of CPD provided, the very short notice given for the first two sessions, the webinar format of later CPD, and delays in getting JUMP materials.

CPD is more likely to be found effective by teachers, and to influence their classroom practice, when it is of substantial duration, both in terms of contact hours and overall time span (e.g., Garet, Porter, Desimone, Birman, & Yoon, 2001). Indeed, Guskey and Yoon's (2009) review of the literature found that in order to produce positive effects, CPD initiatives needed to involve 30 or more contact hours, with sustained and structured follow-up. In the present evaluation, the lack of initial training for many teachers, coupled with the paucity of ongoing training (and the technical problems with at least one CPD session) made it harder for teachers to implement JUMP as it should be implemented. Further, anecdotal evidence suggests that JUMP suffered by association with organisational problems involved in its pilot rollout. This may have contributed to reluctance in some parts to fully adopt JUMP methods.

In sum, implementation was not as good as might be hoped, and was poor in some cases. The initial organisational difficulties and poor uptake of CPD could be remedied by a longer run-in time between securing funding and project initiation. However, our understanding is that the relatively limited amount of CPD provided was intentional, based on advice from JUMP staff about what represented adequate support for teachers. Those who provided CPD for IMPACT matched the amount to that provided to JUMP teachers, but noted that it fell well short of what was normally offered. The outcomes suggest that the amount of support provided during the evaluation was insufficient to bring about major change in classroom practice, and that what constitutes adequate levels should be reconsidered.

What contributed to improved achievement?

As noted, the average mathematics achievement scores of pupils in both programmes improved over the course of the evaluation, by a statistically (and a pedagogically) significant amount. However, JUMP gains were not significantly greater than IMPACT gains. As JUMP and IMPACT are based on quite different approaches to teaching mathematics, we must examine what might be associated with improved test performance.

Effects of being evaluated

As has been noted at a number of points, once people know they are being studied, they often modify their behaviour. Behaviour change can be expressed on a continuum from spending a little more time planning mathematics lessons all the way to practising for the test. As evaluators, we made it very clear to all participating teachers that the programme, not the teacher, was the subject of the evaluation. Nonetheless, we are aware from contact with teachers throughout the year that many also felt their teaching was under the microscope.

It is likely that at least some of the teachers involved in each programme put a little more time and thought into lesson plans, or tried a little harder than normal to motivate and engage pupils in mathematics lessons. We also have anecdotal reports from observers that pupils in a few classes may have developed familiarity with the types of questions asked in the DPMT.

In a real-life environment, it can be difficult to separate out the effects of an intervention from the effects of knowing you are part of a study, hence the widespread use of control groups and placebos. IMPACT was not a placebo, but it is essentially an extension of the philosophy of the PSMC. We cannot provide a precise quantum for the Hawthorne effect,

but by using a similar approach for both programmes, we can hope that any Hawthorne gain effects are similar and cancel each other out. This means that the *difference* in gain scores between the two programmes is important. An approach that represented a major improvement over that of the PSMC and its underlying philosophy might be expected to show significantly higher achievement gains. Average JUMP gains were slightly, but not significantly, higher than IMPACT gains. The lack of a significant difference may be attributable to any number of reasons, including patchy implementation of JUMP. Nonetheless, JUMP performance has not yet been proven to be significantly better than performance in a control group, indicating that a Hawthorne effect may have contributed to overall improved performance.

Conclusion: Some of the improvement in mathematics achievement is likely to be related to the effects of being evaluated.

Lesson length

The most recent comparable national data for mathematics lessons at primary schools come from TIMSS 2011 (Eivers & Clerkin, 2012; Mullis, Martin, Foy, & Arora, 2012). Conducted at Fourth class, the TIMSS data for Ireland indicate that in 2011 the typical mathematics lesson lasted about 49 minutes. Similarly, the two most recent cycles of the National Assessments of Mathematics found that mathematics lessons averaged 45 minutes in Second class and 52 minutes in Sixth class (2009 Assessment: Eivers et al., 2010), and 43 minutes in Fourth class (2004 Assessment: Shiel, Surgenor, Close & Millar, 2006). All are shorter than the typical lesson duration for JUMP (56 or 57 minutes, depending on time of year) or for IMPACT (55 to 58 minutes). Thus, for example, pupils in this evaluation received about 30 to 40 minutes extra mathematics instruction over the course of an average week than did the Fourth class pupils in TIMSS 2011.

It may be the case that the average amount of time devoted to mathematics instruction has increased since 2011, perhaps due to the launch of the Department of Education and Skills' strategy document *Literacy and numeracy for learning and life* (2011). It may equally be the case that, given their participation in an evaluation of two mathematics programmes, teachers allocated more time than they normally would to mathematics lessons. Whatever the reason for the change, pupils in both programmes are likely to have spent more time in mathematics lessons than did pupils in classes when the DPMT was standardised.

Conclusion: Some of the improvement in mathematics achievement may be related to the extra time allocated to mathematics lessons.

Materials and methods

JUMP materials comprise the Confidence-Building Unit (CBU), the pupil workbooks, and the teacher manuals. Teacher reports show that the CBU was not widely used, or not used appropriately, and its function was not fully understood by most teachers. As such, its efficacy has not really been evaluated here. However, analyses suggest that other JUMP teacher and pupil materials are (despite superficial differences) a reasonably good match for the PSMC. Indeed, in many ways JUMP represents a better PSMC match than the textbooks commonly used in Irish classrooms.

JUMP's simplified design for the pupil Assessment and Practice Workbooks lends itself to a relatively inexpensive workbook designed to be used by pupils, not a glossy book from which problems are copied and completed elsewhere. This was mentioned as a positive by many of the pupils interviewed, who commented on time saved by not having to copy, how

copying out was annoying, and how, generally, they liked their workbook much more than the previous year's textbooks.

JUMP materials present "ready-made" lesson plans for teachers. While some might feel that this underplays the importance of the teacher's role in developing and adapting material to meet the needs of their pupils, teachers are able to adapt JUMP material to local need. Indeed, the (Canadian) Pacific Institute for the Mathematical Sciences (2011) has criticised many of the Canadian textbooks used in mathematics lessons as not presenting material in a clear manner, or helping teachers understand the concepts being taught, thereby making it harder for pupils to make connections between content and underlying mathematical concepts. This criticism applies less to JUMP than to some Irish materials, which might benefit from greater clarity in organisation and more guidance for teachers.

Although IMPACT did not provide pupil materials, responses suggest that IMPACT teachers relied less than normal on textbooks, but probably drew on textbooks for the Data strand (for which IMPACT manuals were not available). Data was the only content strand on which there was difference in the overall percent correct scores between the two groups at the end of the year, suggesting that the Data strand might be better covered in JUMP materials than in Irish textbooks. The process area of Integrate and Connect also showed a slight advantage for JUMP pupils, perhaps reflecting the findings in Chapter 3 that JUMP asked pupils to reason, connect and problem-solve, whereas the comparison Irish textbook did not.

Conclusion: Due to limited or incorrect use, it is not possible to judge if the JUMP CBU is effective. However, JUMP pupil and teacher materials appeared to be at least as good as Irish mathematics textbook series currently in use. JUMP's better coverage of aspects of Data, and of Integrating and Connecting, may be related to slightly better performance in these areas.

Future possibilities

To a certain extent, the present evaluation was an incomplete evaluation of the merits of JUMP, and makes it difficult to adjudicate on JUMP's effectiveness. Due to very limited notice, there were poor levels of initial participation in professional development intended to explain JUMP methods and hone skills based on applying JUMP methods. Teacher dissatisfaction with how the initial phases of the evaluation were organised may also have contributed the some cynicism about the *programme's* likely effectiveness.

In addition, the amount of CPD and support provided for the duration of the evaluation was relatively limited. Many teachers complained about feeling isolated and uncomfortable because they spent a few months not only being unsure if they were implementing JUMP correctly, but not knowing how to check or who to ask if they were correct. A consistent research finding is that, almost irrespective of programme efficacy, teachers require ongoing support if it is to be adopted and implemented effectively (e.g., Guskey & Yoon, 2009). This was not the case here, and data from the classroom observations, from teacher self-reports and from pupil descriptions suggest that although there were differences between what typically happened in classrooms in each programme, the differences were not of the size that might be expected.

The fact that JUMP was not fully implemented in many or most classes in this evaluation makes it difficult to establish what effects the programme might have if used as intended. That aside, the programme seems to have merit, it is reasonably popular with teachers and pupils, pupils who took part in JUMP showed achievement gains, but those gains

were not significantly greater than gains by pupils in the IMPACT programme. It would be worthwhile to see how JUMP would work if all teachers attended CPD and received more ongoing support. As noted in previous chapters, the short notice given for CPD was related to an unforeseen delay in the release of some project funding, and is highly unlikely to recur. However, the amount and nature of CPD required was agreed with JUMP staff prior to the evaluation, and needs reconsideration, as it appears insufficient to effect behaviour change.

The significant improvements in pupil scores in both JUMP and IMPACT suggest that a further evaluation of both programmes might be merited. If such an evaluation were to be considered, some changes should be made, to the organisation of the evaluation study itself and to JUMP and IMPACT content. The possibility of combining aspects of both programmes and of further analysis of the match between textbooks and the PSMC might also be considered.

Changes to the study

We suggest that any future studies differ from the present one in three main ways. First, and most importantly, teachers should have a much clearer idea from the outset about how JUMP and IMPACT are implemented in practice. Initial CPD should be detailed, precede the adoption of the programme, and be supplemented by more comprehensive training and support during the implementation.

Second, baseline measures of achievement and attitudes should be taken in the spring *before* initial teacher CPD and programme adoption (i.e., in the spring of Second class, assuming that the evaluation focused again on Third class pupils). This would eliminate the possible interference of summer learning loss and slight programme effects in the baseline data, allowing a comparison of spring results with spring results.

Third, a larger sample should be used, ideally split into four groups. The first additional group might combine the most effective aspects of JUMP and IMPACT in a hybrid programme (described in a later section of this chapter). The fourth group would be an "absolute control group" – i.e., a group of pupils simply following the PSMC as normal. We noted earlier that the time spent on mathematics lessons in this evaluation was higher than that found in previous nationally representative samples. This may be due to programme effects or evaluation effects, but it may reflect a broader national trend (attributable to *Literacy and numeracy for learning and life*). If an absolute control group also showed that more time was devoted to mathematics than when the DPMT was standardised, and also showed significantly higher achievement than the test mean, then the improved test scores might simply be attributable to a recent greater focus on mathematics in primary schools.

Adapting JUMP

JUMP CPD and materials both require adaptation in an Irish context, but would benefit from some more general changes too. Regarding local adaptation, some terms and phrases need adaptation in both teacher and pupil materials. This is particularly evident in relation to money, where the Canadian "loonie" and "toonie" either confused or amused, but there are other "Canadianisms" where the language used may interfere with pupil (or indeed teacher) understanding. All sections of JUMP materials should be reviewed and, where necessary, adapted for Irish use prior to any further rollout of the programme (a point also made in the British context by Aduba, 2007). Also, infrequent contact with JUMP experts unfamiliar with the Irish education system, and working in a different time zone, was less than ideal. A better approach would be to supply intensive training in JUMP methodology to a small group of Irish teachers, who could then support the programme locally.

More generally, the initial JUMP CPD day (September 2013, delivered by JUMP founder, Dr John Mighton) was more research-based and theoretical than expected by most of those who attended. While a research base is important, it is also important to discuss practicalities. It is illustrative that most did not understand how to use the JUMP Confidence Building Unit correctly, nor realised that not every child had to answer every question in the pupil materials. Several teachers indicated that watching the sample lesson on perimeter was useful. A set of such videos would provide teachers with a resource on which they could draw throughout the year. Also, while the lesson units gave clear and concise guidelines for teachers, the general introduction and guidelines in the teacher manuals did not. For example, the quite short Introduction section contains a mixture of methods, theory, descriptions of research, quotes from, and information about, Dr Mighton, and some practical advice on implementing the programme. The Introduction should be re-considered and re-designed so it can be referred back to by teachers when they want to check something or refresh their minds about JUMP principles. It is curious, given JUMP's emphasis on scaffolding, repetition and recapping, that none of these feature in the introduction to the teacher materials.

Adapting IMPACT

Teacher feedback indicated that while the IMPACT approach was generally liked by teachers, the materials could be improved, on both a practical and a theoretical level. Dealing first with practicalities, resources in the manual cannot be photocopied for use by pupils, but have to be re-created by teachers. Also, some of the manipulatives recommended by the manuals were difficult to find. Simply adding resources that can be copied or printed and a pack of manipulatives (or recommending only readily accessible material) would improve usability considerably.

The amount of pedagogical theory in the manuals was not popular with many teachers. However, it should be possible to provide a better combination of theory and practical implementation than is found in the current manuals. In particular, the concept of the learning trajectory proved confusing for some. For example, IMPACT identifies two aspects of the learning trajectory – the mode of representation (concrete/pictorial/abstract) and the concept – but does not always show how to combine these to develop and consolidate concepts and processes.

Also, teachers need more guidance on how to integrate some of the (generally very useful) suggested activities into a lesson. In this regard, some exemplar IMPACT lessons would be of use. Finally, the programme should be extended to cover the full PSMC. Although IMPACT *methods* are intended to be transferable across strands, most teachers did not do this, using IMPACT only to teach the strand units covered in the manuals.

Combining aspects of JUMP and IMPACT

Combining JUMP and IMPACT methodology seems counterintuitive, given that JUMP emphasises scaffolding and guided practice, while the social constructivist IMPACT framework emphasises guided discovery. However, the positive features identified in *both* programmes, by teachers, pupils, and mathematics subject matter experts, suggest that an approach that takes the better aspects of each could be worth considering. A full and proper combination of the programmes' best features would involve considerable effort in developing a framework and materials and might run the risk of being too complex and disparate for teachers to implement. It might also, quite understandably, not appeal to those responsible for JUMP or IMPACT. While a worthy idea, we realise it is unlikely to be realised. However, a hybrid model *is*

possible, particularly if the proposed changes to each programme outlined in the preceding sections are made.

It is worth looking at the main strengths of each programme. JUMP strengths relate to its comprehensive coverage of curriculum content, good structuring and scaffolding of content, easily implemented lesson plans, and ready-made materials for pupils. In contrast, IMPACT's strengths are its strong focus on group/collaborative activities and fostering of discussion, and a good balance between lower order (e.g., recall concepts or implement procedures) and higher order (reason, communicate, problem-solve) skills. Teachers who become familiar with and understand each approach are likely to employ the different pedagogical approaches in a flexible manner.

JUMP has extensive coverage of the Number and Algebra strand, while IMPACT covers a sizeable number of strand units, but not all. Garforth's (admittedly very small-scale) 2013 study also suggested that JUMP's treatment of Number was more effective than that found in the British Columbia curriculum. Number is the strand typically covered in the first half of the school year, and it lends itself to a very structured approach – which may be more appealing to children in the earlier part of the school year.

JUMP devotes more coverage to Shape and Space than do most Irish textbooks, but level of coverage falls slightly short of that in the PSMC. In contrast, it is extensively covered in IMPACT, and is a strand that lends itself more to discussion, to use of real life materials and manipulatives (i.e., the IMPACT approach). Data is well covered in JUMP (receiving proportionally more coverage than in any of the Irish textbooks reviewed, and slightly more than in the PSMC), but not yet covered in IMPACT. It was also a strand on which JUMP pupils performed well in the present evaluation.

As such, we suggest that any hybrid model might consider using modified JUMP materials and methods to teach the Number and Algebra strand for the first part of the school year. Shape and Space could be taught using IMPACT approaches and (slightly modified) materials, while Data seems suited to a more JUMP-oriented approach. As JUMP also provides reasonable coverage of Measures, a topic not covered in IMPACT materials, it may be more appropriate to use JUMP methods and materials to teach the strand. All this is of course only a rough outline of what form a hybrid model might take, and (as with the programmes themselves) it is highly likely that teachers will modify methods and materials to suit their own situation.

Aligning Irish mathematics textbooks with the PSMC

An unexpected finding from the present study was that JUMP was in many ways a better match to the content and aims of the Irish PSMC than were the more popular Irish mathematics textbooks. Relative to the curriculum, there was a very heavy emphasis in the Irish materials on Number and on isolated computation, with a concomitant limited coverage of Shape and Space. The reason for the mismatch between some textbooks and the curriculum is unclear.

When the PSMC was developed, the National Council for Curriculum and Assessment (NCCA) supplied mathematics textbook specifications to publishers (NCCA, undated). One element of the specifications indicates that Shape and Space should use materials that can be handled and rotated. Perhaps some publishers felt the strand would therefore not need as much coverage as other strands, as teachers would largely deal with it using resources other than textbooks. However, this does not account for the over-focus on Number or isolated computation, especially as the same NCCA document states that "Closely-written pages of

'sums' should be avoided." (p. 6), and that all the strands should receive a balanced level of emphasis and reflect the integrated nature of the curriculum.

Lewis and Archer (2012) noted that 56% of countries participating in TIMSS 2011 had mandated mathematics textbooks at primary school, while 48% had recommended instructional activities. Ireland has neither. We do not propose a single mandated textbook series, and it seems unlikely that the Department of Education and Skills will initiate a system whereby commercial mathematics textbooks must meet minimum standards before they are approved for use in schools. In the absence of greater national oversight, we suggest that teachers, perhaps with advice from the Inspectorate, need to consider how well textbooks match the intent and content of the curriculum. Publishers may tailor materials to marketplace demand, and may originally have been responding to a perceived demand for a strong emphasis on computation. If there is a perceived demand for textbooks and other resources that pay due attention to all strands of the PSMC and its underlying philosophy, it is likely that publishers will respond appropriately.