

Curriculum-led Improvement

Summary

This strategy takes the most direct route to improving student learning by focusing on improving the quality, pattern and structure of day-by-day learning activities in the classroom. It embodies the principles set out for all *standards-based improvement* – these should be read in conjunction with this paper. The core move is to adopt and implement a broader, more-balanced curriculum in line with the best of national and international standards. *Standards-based mathematics curricula* describes such tools.

Commitment by the system, careful preparation, and substantial support for teachers are all needed to make this approach work well. The main elements of this model implementation sequence are:

- building capacity through professional development
- making the case
- selecting a curriculum for adoption
- preparing for implementation
- year-by-year implementation
- sustaining the effort

backed up with:

- continuing professional development support for teachers;
- assessment that is aligned with the goals of the curriculum;
- communication with the community.

As with any change initiative, managing setbacks effectively is important – methods are suggested.

This approach, within a coherent framework where you *plan long and short term*, leads to continuing improvement of the mathematics education and achievement outcomes of students.

Challenges addressed

Our teachers need help establishing problem-solving environments

We have a mandate for a standards-based curriculum

Our professional development efforts are not having much impact in classrooms

How do we get an evidence-based curriculum?

Curriculum materials

Standards-based mathematics curricula are key tools for this strategy. These materials are realizations of the *Principles and Standards for School Mathematics* (PSSM), developed by the National Council of Teachers of Mathematics in consultation with, among many others, the thirteen leading societies of US mathematicians, pure and applied. These reflect international standards and the current state of research on the teaching and learning of mathematics.

These materials were designed and systematically developed to enable typical teachers with appropriate support to give their students the broader range of mathematics that they now need. They embody the variety of classroom learning activities needed to develop mathematical power.

For each grade range (elementary, middle and high school) there are now several alternative published curricula for systems to evaluate and choose from. Each has its own style and emphasis within the framework defined by the Standards. *Standards-based mathematics curricula* outlines the principal characteristics and lists the main published curricula currently available, with links to more detailed descriptions of each curriculum and its source.

Implementing the strategy

Local circumstances will affect in many ways the detailed implementation of a curriculum-led improvement strategy. (*Stories* of how this approach has worked in various school systems will show something of the variety.) Nonetheless, an explicit model of how the various elements can be integrated into a working strategy will provide a framework for planning which users may find helpful. That is the purpose of this section.

Building system capacity

This strategy requires a culture shift in attitudes towards learning and teaching mathematics and, for most teachers, the acquisition of new skills. Achieving this from the beginning of implementation depends on a substantial investment in professional development. Delivering this effectively depends on a core of people who understand the planned changes in some depth – people at every level of the school system, from superintendent through professional leadership to core groups of principals and classroom teachers. Though this capacity will build as implementation proceeds, a substantial core is needed before the main work begins. Focused professional development is the key.

Most systems that are contemplating *standards-based improvement* will have some in their professional leadership in mathematics education who can lead this process of *building system capacity* prior to and through the implementation of the new curriculum. (If not, hiring a few such people is essential.) Among the effective types of professional development are:

Professional development for and through assessment. This can provide an approachable small-scale start, now well supported by materials. Sessions built around rich assessment tasks, their rubrics and samples of student work bring out all the key issues of what is mathematics, student performance and instructional decisions in a form that is motivating to members of all key groups.

Professional development focused on curriculum units from the new curricula, once it has been chosen, is the essential step, looking in more depth at the instructional issues. This is the core of the substantial and continuing commitment to professional development that is so important for long-term success.

Making the case

Here we list the main elements in the case for curriculum-led implementation. They are those that are important for any *standards-based improvement* program.

Adopting and implementing a new curriculum is a major step for any school system. For many systems, it involves a substantial culture shift in their view of mathematics, and how to learn and teach it. Active support from the superintendent and the school board is essential before implementation – acquiescence is not enough to sustain the necessary long-term effort.

Gaining agreement from decision makers will depend on making a strong case. Here we list the main elements in the specific case for standards-based improvement. They include evidence on:

- **current system performance**, and the shortcomings shown by *benchmarking performance* against that in similar districts;
- **student scores** on standardized tests will improve significantly over a few years;
- **students' ability to use mathematics** to solve both mathematical and practical problems will greatly improve (not surprising, since traditional curricula hardly address these important goals);
- **student attitudes** to, and motivation for mathematics will improve, particularly for students who are currently low achievers (this "narrowing the performance gap" is an important equity issue);

Evidence on effectiveness of curricula summarizes the research evidence for the greater effectiveness of standards-based curricula, with references to the original studies. It shows gains in student performance on traditional tests (and massive gains on broader, more balanced tests of mathematics), built on improved understanding and motivation.

Carefully selected outside experts can help make the case – professional and research leaders, mathematicians, teachers and administrators who know these curricula can all play useful roles.

It is also important to emphasize the benefits for specific constituencies that will be crucial for the success of the program, for example:

- **teachers**, provided they are given appropriate support, will enjoy the professional development and the greater strength they gain from moving to standards-based teaching. Though there will be initial resistance from some, teachers come to appreciate how much better their students are learning mathematics (Once change is achieved, teachers rarely revert to the narrower range of traditional teaching and learning.);
- **principals** will appreciate how the new program energizes the staff, and the spin-off benefits for other subjects from students' improved understanding of mathematics (e.g., of algebra in science, of statistics in social studies and science, of number in many subjects);
- **parents and the community**, provided they are properly introduced to the curriculum and their concerns addressed, will appreciate mathematics that has more obvious connections with the rest of the world than "what we had at school";
- **academic mathematicians, engineers and physicists** and other professional users of mathematics are a subgroup that needs specific attention – with good communications they can be of help to the implementation (particularly in helping to counter a few individuals who, though discontented with the status quo and despite the evidence, feel strongly opposed to standards-based reform – see *Math Wars*).

A positive attitude from all key constituencies is important for long-term success.

Making the case does not end with the decision to adopt a new curriculum; it continues to be an important, though decreasing, part of communication with the community.

The curriculum selection process

Once a decision to adopt a standards-based curriculum has been made, there is a range of alternative *standards-based mathematics curricula* to choose from at each grade level. The process of deciding which to adopt is important for the success of implementation.

Comparing curriculum materials needs to be thorough and rigorous enough to ensure that

the system is choosing the curriculum that is best suited to its needs and resource commitment. Equally important, it should provide an early opportunity for making the key constituencies gain ownership of the change, and of the new curriculum. (Review and recommendation by an expert committee that is based only on inspection of the materials meets neither of these criteria.)

Key inputs to the decision process include:

- **review of the evaluation research**, summarized in *Evidence on effectiveness of curricula*, should be considered for each candidate curriculum. Include, where possible, studies from other sources than the publisher or the author team. Independent education researchers from local universities have useful skills in interpreting research;
- **pilots in local schools** help in several ways. The pilot should include units from two or three of the most promising programs as judged by the professional leadership. Pilots in local schools can provide useful information on each curriculum in the local context and, where seen as successful, a group of teachers who can talk later to colleagues directly about their and their students' experience. It is important for a fair trial that the teachers involved are already expert enough, either through prior experience or through specific professional development, to handle the new curriculum effectively. *Feedback* from these trials should include: *observation* by professional leadership of each classroom, to see how well the curriculum is implemented, and the challenges it presents to teachers; *analyses of student work*, making comparisons with their work on the current curriculum; *interviews with teachers and students*, backed by questionnaires from a larger sample of students. Apart from prior interviews on attitudes to the change, this evidence should begin to be collected after a few days of acclimation to the new curriculum. Again, researchers from local universities may be willing to help (it could provide a nice study for them); the system's priorities are, of course, more practical (decisions will normally need to be based on 'handful-size' samples of classrooms).
- **review of capacity and commitment**, particularly of resources for professional development including the number of teacher-leaders who can help the professional development of others.

The evidence from these inputs will inform system decisions about the choice of curriculum.

Preparing for implementation

Key elements have been listed above. These include:

- capacity building;
- selection and adoption of a specific curriculum;
- introductory professional development workshops for the teachers joining in the first year.

The other essential is the detailed development of a **specific but flexible five-year plan**. This will cover

- implementation schedule – how many grades per year, in how many schools, etc;
- professional development program and schedule, also covering teacher turnover and recruitment;
- public communications program;
- budgetary implications of all these.

Plan long and short term discusses these and other aspects and how they are turned into a plan.

Year-by-year implementation

First implementation year will be largely determined by the plan, and in responding to setbacks and other unexpected events (see below). Everyone involved will be more-than-fully occupied. Teachers are learning to teach the new curriculum, putting into practice what they learned in the professional development workshops, generalizing this to other units, and sharing their experience with others in further professional development. Professional leadership is busy with further professional development, supporting those teachers already 'in action' and preparing the next cohort. They and the administration will be monitoring progress and problems, responding to concerns of the community, and leading sessions for parents on the new curriculum. Everyone will be planning for next year.

The second year. This may be the first implementation year for a new cohort of teachers; all the same activities are needed. (With most scheduling models, their students will already be accustomed to the new curriculum from the previous year.)

The first cohort are now introduced to *standards-based assessment*, with low-stakes internal reporting only. Workshops on assessment tasks, scoring and using student work to guide instruction clarify the learning goals for both teachers and students. They make explicit the broader range of performance that is demanded, and now valued in the assessment.

Now is the time to review and update the planning, developing a rolling five-year plan and the budgeting it implies.

The third year. Again there may be a new cohort of teachers, needing the same pattern of support. The second cohort should be introduced to the assessment, and so on. The broader range of mathematics in the new tests is explained to parents and the community, including examples of interesting tasks and student work on them. The professional development for teachers with two years experience of the curriculum begins to move to their role as professional development leaders in their schools, supporting new staff and working with colleagues to review and refine their teaching of the now-familiar units, learning from each others' experience through sharing and discussion of student work.

This is the stage to make the standards-based assessment an integral part of the accountability system. Scores on standards-based tests should be reported separately from state and other tests, with the aim that their greater validity as measures of performance in mathematics will gradually be recognized.

Sustaining the effort

By this stage, the curriculum, well-aligned assessment, and a program of continuing professional development are all becoming familiar. The focus of professional development moves from the curriculum units to higher-level aspects of teaching, such as *teacher self-monitoring* and *lesson study*.

The achievements so far now provide the basis for establishing regular professional development as an integral, scheduled part of the work of the teaching profession. This is key to long-term improvement in the system, and in student performance. Making sure it happens is the highest priority. It has, of course, scheduling and funding implications, but these demands are similar to those necessary for the successful launch of a new curriculum.

Managing setbacks

All initiatives have setbacks; predicting them and handling them to minimize their impact is key in sustaining the improvement program. The following (from *standards-based*

improvement) are some common problems, and strategies and tools that can be effective in handling them:

- **Teachers don't teach the curriculum.** "The textbook determines what *might* be taught" is, alas, only too true. Initially many teachers will look through the published lesson, identify the topic, think "I know how I teach that" and do what they always have done. That is *not* implementing the new curriculum, in which an essential element is a different pattern of learning activities from the traditional. Professional development based on specific curriculum units should overcome this, provided the problem is recognized and made an explicit focus. Feedback is as important as in all learning – students' work, video or observation from each classroom can contribute.
A good preventative measure is professional development that works through the first unit or two in detail.
- **Cuts in professional development support.** The level of professional development support needed for this approach is substantial. Even when it is funded initially, cuts are often imposed for a variety of reasons: financial stringency; a belief that teachers are only working when they are teaching; skilled people leaving, particularly when the program is seen from elsewhere as successful. System commitment to a rolling five-year plan can limit the scale of this problem. In the worst case, when funds *must* be cut, revise the implementation schedule to honestly reflect the delays this will cause. The revision should reflect the scheduled restoration of funds in future years.
- **Backlash from parents or outside opponents.** Good communications, before and during the introduction of the new curriculum, should minimize the number of concerned parents, and ensure that there are plenty that offer strong support. However, there is also a politically well-organized national alliance that opposes the introduction of standards-based mathematics. *Math Wars* describes this challenge and how to counter it. Of course, it is always important to listen to the concerns of parents and others within the system, and make improvements where it makes sense.
- **New superintendent and/or school board.** Perhaps the most serious problems in establishing any coherent program of improvement in mathematics education are its role as a local political issue, and the short tenure of superintendents (below two years in large urban school districts). School boards live by short time scales – looking for visible success before the next election. Candidates for superintendent have to present new visions that offer quick cures for long standing problems. *Plan long and short term* offers ways to reconcile this conflict of time scales between these short-term pressures and the decade time scale of general improvement.

Careful preparation in the introduction of the program reduces the chance of these setbacks happening, and the damage they cause. However, unexpected blows from federal, state or local sources are a regular experience in any school system; defining and maintaining a long-term plan is the key to sustaining improvement through this buffeting.

Where next?

In a system that has established standards-based curriculum and assessment, with a culture of continuing professional development, everyone has reason to be pleased with progress. However, that is not the end of improvement. Ways to develop further include:

- **Further curriculum enrichment.** In order to be accessible to most systems, published curricula have to play safe in the demands they make on teachers, many of whom will have only worked with traditional curricula. After several years of

teaching and professional development on a standards-based curriculum, many teachers will be ready for further progress. This will involve: students sustaining longer and deeper investigations with less guidance, much of it through further questions; students building a portfolio of solutions to extended problems that fit their own interests, both within mathematics and in its application to problems from the world outside; students learning mathematics outside the main core of the curriculum to increase their power over such problems. There are many sources of materials for advanced learning that support this kind of curriculum enrichment.

- **Students at both ends of the performance spectrum** merit special attention – not easy to find much time for in a typical classroom. *My students don't remember things* – lack of long-term learning is a particular problem for many students, but particularly for those with learning difficulties. Students who are behind need systematic *catch up* strategies

What do I do with my gifted students? This is a very different but important challenge – it is more easily ignored when passing tests is the focus and the whole class is demanding support.

- There are strategies for tackling both these areas of challenge.

Strengths

The curriculum-led improvement strategy has great strengths:

- Curriculum-led improvement starts with its focus on student learning in the classroom – the most direct route to real improvement.
- It involves an immediate substantial commitment by the school system to improvement.
- It uses well-engineered materials, based on sound research on learning mathematics, to support teachers.
- Provided an appropriate program is implemented, it establishes professional development as an ongoing part of the professional life of teachers, and thus an ongoing commitment of funding by the system.

Likely challenges

The likely challenges to this strategy are a reflection of some of its strengths.

- It requires a major commitment by the system without much prior experience of the curriculum chosen and the response of teachers, students and parents to it.
- To deliver it successfully, the system needs substantial capacity, notably a core of skilled professional leaders to provide support to schools through professional development sessions and a network of continuing support.
- It is likely to be a few years before improvement shows through in higher scores on state tests and on the standards-based assessment, which only follows curriculum implementation. (If scores must go up in one year, mandate 75 minutes per day of mathematics in the elementary grades.)

These challenges can largely be met by careful attention to all the aspects of implementation set out above. (Where test scores are a strong focus in the system, the earlier introduction of standards-based assessment should be considered. *Assessment-led improvement* has spin-off benefits in motivating professional development, sharpening teachers awareness – of performance goals, and of students' strengths and weaknesses.)

Key tools and their roles:

The following are the main tools that are available to support this strategy. Others, including planning tools, can be found through links above.

Standards-based mathematics curricula outlines their principal characteristics and lists the main published curricula currently available, with links to more detailed descriptions of each curriculum and its source. These curricula, often developed with funding from the National Science Foundation, offer comprehensive sets of materials for a specific grade range, along with associated support for professional development.

Standards-based assessment provides parallel information on the main published standards-based tests.

Evidence on effectiveness of curricula summarizes the current research on the effectiveness of these curricula, absolutely and in comparison with traditional curricula.

Other Considerations:

Planning: It is essential to *Plan long and short term* with active commitment, personal and financial, from the school system management structure, and adequate personnel to support the professional development needed – together with a plan for *building system capacity* to this level before and after implementation begins.

Budget issues: These include the growing year-by-year costs of assessment materials, professional development, and curriculum materials during implementation, and of effective communication with the community on the nature, goals, effectiveness and progress of the program.

Benefits

Improved understanding of mathematics, by students and teachers. Improved student motivation. Growing teacher professionalism. Gains in student performance on traditional tests (and massive gains on more balanced tests of mathematics).

Implementation pitfalls

Change of superintendent and/or school board. Teachers don't teach the curriculum. Cuts in professional development support. *Math Wars* backlash from parents or outside opponents.

Evaluative evidence

There is *evidence on effectiveness of curricula* that shows gains in student performance on traditional tests (and massive gains on more balanced tests of mathematics), built on improved understanding and motivation.

There is case study evidence in the accounts of those who have taken this approach, with local variations, to systemic improvement. See 'Stories'

Development status

Draft in development by the Toolkit team in consultation with many of those involved in the NSF-funded curriculum development projects and their implementation.

Comments please to **team@toolkitforchange.org**

'Stories'

***We are seeking accounts of, experience in implementing strategies of this kind
If you might be able to help, please email team@toolkitforchange.org***

Other similar strategies: Assessment-led improvement Professional development-led improvement

Complementary strategies: Building system capacity; Plan long and short term

Other comments: It is, of course, to be expected that each implementation will include variations on this model, driven by local circumstances.