Rethinking Curriculum: A Developer's Perspective

Andy Begg
The Open University
<a.j.c.begg@open.ac.uk>

For many years the research-development-dissemination (RDD) model has been used in education. From my experience and scholarship this model seems unsatisfactory and I have been theorizing about alternative models that recognize the complexity of change. In offering a model with eight activities occurring simultaneously at three levels, and with these activities being interrelated, I have replaced the simple RDD model with a complex model. This model emphasizes involvement by teachers and offers an inclusive and empowering approach to change. The challenge is now to trial and improve this model.

Introduction

There are many ways to think about curriculum and my interest is from a developer's perspective. My doctorate was about professional development, as curriculum development did not seem to result in the expected changes. Since then I have developed this new model to include other influences on change that impact on mathematics teachers.

Historical perspective

For over thirty years the research-development-dissemination (RDD) model has been used in curriculum development in many countries. It is a linear model as in Figure 1.

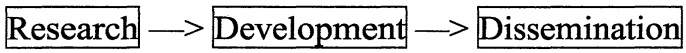

Figure 1. RDD model for development.

This model's three discrete stages are usually undertaken by separate groups of people. This, together with its linearity, made it a simple model to plan, budget for, and control. The model fits with new-right political notion of "no provider capture" as people involved in one stage are easily excluded from later stages. However this model does not consider all the influences that impact on development, and in keeping it simple we may have ensured its lack of success. In improving the model three well-documented factors that needed consideration have been the establishment and maintenance of a culture of change, teacher ownership, and the provision of adequate time for the process. In addition it seems important to identify the other influences that impact on teacher change.

While seeking an improved model I was involved in the use of 'exploratory studies' in mathematics. These were small informal research projects undertaken by self-nominated groups of teachers supported by minimal seeding funding that investigated areas of concern that they had identified. The studies were excellent professional development for the participants, and the reports and resources produced were valuable input for curriculum projects. This involvement with research, resources, professional development, and curriculum development seemed to integrate more of the aspects than usual, but I saw it only as a first step. Two other integrating were the 'rich learning activities'[1] of Ahmed (1987) and the idea of 'curriculum anticipating' (Davis, 1996), but more of those later.

B. Barton, K. C. Irwin, M. Pfannkuch, & M. O. J. Thomas (Eds.) *Mathematics Education in the South Pacific* (Proceedings of the 25th annual conference of the Mathematics Education Research Group of Australasia, Auckland, pp. 123-130) Sydney: MERGA.

Influences on Development, or Co-Emerging Activities?

For me, differences between development, change and learning have disappeared. With an emergent[2] view of learning the question is not 'what influences impact on curriculum and professional development?' but rather, 'what co-emerging activities impact on each other?' I see eight activities—teacher development, teacher practice, research, theory, policy development, assessment development, curriculum development, and resource development. I have replaced nouns with verbs to emphasize process rather than product. In figure 2 these activities are connected with dotted lines to show the two-way relationships between them, these being lines of influence rather than causal relationships.

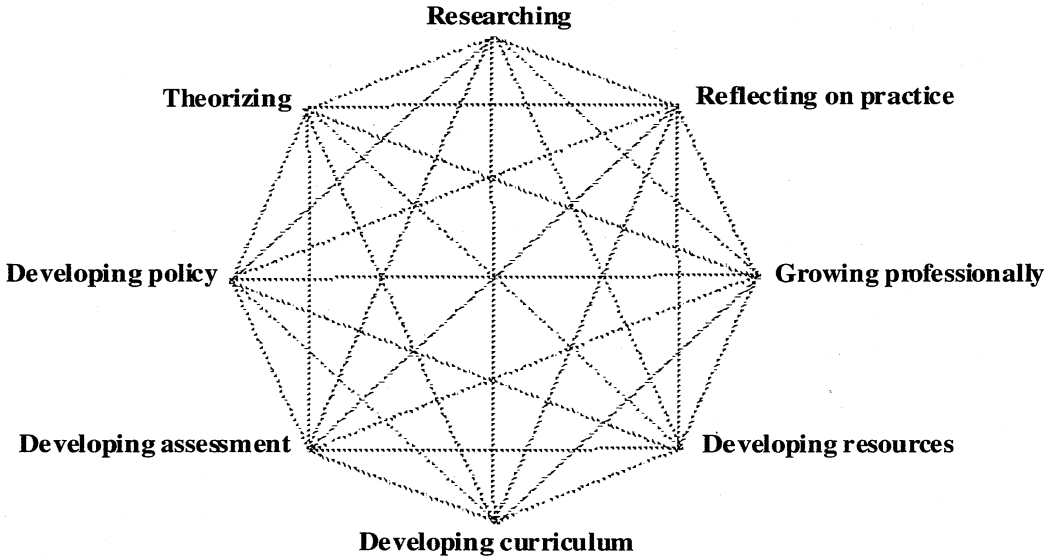

Figure 2. The eight co-emerging activities in the educational change process

This model has 28 dimensions because of the links between activities. It is complex, and becomes more so if one considers 'ideas' flowing to the activity nodes from outside. Other activities may also exist, but these may be implicitly included. While the model may suggest that teachers grow and reflect, academics research and theorize, and others develop policy, assessment, curriculum, and resources, this is not intended. I see teachers involved in the eight activities at three levels (teacher, school, and regional), and this adds to the complexity because development is not top-down, nor bottom-up, but both-ways, and enhanced by rich dialogue. In addition, this model is not dependent on who initiates change. Teacher involvement in the activities is part of their professionalism, and one of my assumptions is that teachers are (or would like to be) professionals, in spite of pressures that exist to deprofessionalize them and replace them with educational technicians.

Growing Professionally

Professional development is not changing other people. One changes oneself, and one only helps others if and when they want to change. Whether teachers plan change individually, as a school project, or as a regional activity, the growth varies with individuals. In addition, the focus for change varies between participants and may concentrate on the personal, social or professional dimensions, or a combination of these.

Reflecting on Practice

The centrality of teachers' existing practice needs to be recognized because, just as the good teacher starts where the learner 'is', the teacher's practice is where the teacher 'is'. When teachers are busy they find little time to reflect, yet until they are aware of what they do, what they could do, and why they might want to consider a change, it is unlikely that they will change. Reflecting-on-practice can be done individually, or with colleagues, and it may include feedback from students, parents, or the community. Reflecting-on practice is not restricted to teachers, all participants in change activities need to be doing it.

For some, thinking about reflecting-on-practice is thinking about what has happened. This is descriptive reflection. For me reflecting-on-practice involves this descriptive level, but also working at an interpretive level thinking about why things happened, and delving deeper into assumptions and alternatives. This deeper aspect of is the 'critical' level, its aim is to critique assumptions made or acted upon, and to empower oneself to act differently if one wishes to do so in the future; that is to anticipate possibilities.

Researching

Research is often thought of as academic. I believe this concept should be expanded. The list in table 1 adds some new categories to the traditional ones, and I see these as research (regardless of pressures that exist not to do so).

Table 1
Some Research Categories and Descriptors

Basic research	to acquire new knowledge
Strategic research	to generate new knowledge in areas which have not advanced to the point where specific applications can be identified
Applied research	to develop knowledge for specific practical objectives (e.g., needs analysis)
Evaluatory research	to evaluate policies, programmes, or practices (e.g., curriculum evaluation)
Scholarship	to expand the boundaries of knowledge across disciplines by the analysis, synthesis and interpretation of ideas
Scholarship of teaching	to transform knowledge by bridging gaps in educational settings, (e.g., with exploratory studies)
Creative work	to generate ideas, hypotheses, images, performances or artifacts, leading to the development of new knowledge, understanding or expertise
Action research	to apply existing knowledge in the resolution of problems
Consultancy	to work with clients in professional contexts in problem solving
Developmental research	to develop, trial and improve artifacts/resources for professional use
Hermeneutic reflection	to develop understandings, interpretations, and applications in professional situations
Professional practice	to theorize about professional practice and make such practice more effective

If one accepts these categories then one may subsume some activities in the model under research. While the boundaries between the activities are intended to be fuzzy (or non-existent), I have retained them all as my view of research may not be accepted by all.

Research, like other activities associated with change, occurs at many levels. Individual teachers do research in many ways—exploratory studies, action research, informal enquiry, development research, and traditional academic research. While research can be viewed as an input to the change/development process, I would also argue that it is of most benefit to the researcher, and fits within growing professionally.

Unfortunately few teachers research policy or curriculum development. Without their input we use politically motivated research that is not always neutral, and international research (cultural imperialism) that may assume that education is to serve capitalism and consumerism, and ignore 'non-market values of humanitarianism, equity, and ecology' (Ilon, 2000).

Theorizing

An example of theorizing is what I am doing here. Based on experience, research, and the work of others (in particular enactivist[2] theory), I have conceptualized a different development model. The result is not right or wrong, nor has it been tested, but for me it makes sense of what I see happening. I assume people will critique it, and if it is useful it will be adopted (and adapted), then improved upon, and finally replaced. When theorizing I started with personal theories and assumptions about mathematics, and education. After these were made explicit I considered alternatives and compared my ideas with those of others. Such explication and discussions is desirable at school and regional level. There needs to be an understanding of the ideas that are generally accepted by teachers, and of new emerging ones that may influence things in the future.

Applicable theories may focus on learning, teaching, assessment and curriculum, but others may also need consideration. For example, theories about mathematics—is it a body of knowledge to be known, a human problem-solving endeavor, or an alternative way of making sense of one's world? Another theory might focus on contexts and applications, and this might depend on one's theory of learning and on what one thinks of as school mathematics. I see this as to do with what one thinks of as 'understanding' and Aoki (1987) summarized this for me when he discussed some ideas from Gadamer (1982, cited in Aoki, 1987).

> (Gadamer) confronts squarely the hermeneutic problem of application in the context of understanding, interpretation, and application, which to him, are all moments of the hermeneutic act. He states that "understanding always involves something like the application of the text to be understood to the present situation of the interpreter" and that application is an "integral or part of the hermeneutical act as are understanding and interpretation" ... The question concerning application raises the hermeneutic problem of the relationship between the general and the particular. At the heart of the problem is the notion that the general must be understood in a different way in each new situation. Understanding is, then, a particular case of the application of something general to a particular situation.

Theorizing helps when considering different perspectives. It enables assumptions to be questioned, theories made explicit, and possible conflicts identified. For example, behaviourism is concerned with *analysis* of subject matter into objectives for teaching and assessment, and constructivism emphasizes *synthesis* which requires us to look at the big ideas[3] within mathematics. With learning based on constructivism and assessment on behaviourism we have conflict. Another example involves *progression*. This underpins curriculum structure and assessment. Progression emerged as behaviourists analyzed subjects for teaching-now it is assumed to be the order in which things are learnt, and this is reinforced by assessment. If we consider how learners construct schemas our ideas of progression might be different. When it is used by the assessment industry it becomes a self-fulfilling prophesy.

An important ethical question related to theories is, does anyone have the right to impose any particular theories? I think not, but if a new theory is imposed many teachers

will resist it, and having only one theory may limit the exploration of new or alternative theories and progress may be retarded.

Developing Policy

While some policy is developed regionally, schools determine aims and rules, and teachers with students determine classroom rules—policy development occurs at all levels. When policies have desirable results their influence spreads. School and classroom aims and the ways that they are put into operation are important, but they reflect the values of decision-makers in particular contexts. I am concerned about imposing policies regardless of whether they are acceptable to people in other contexts. It is interesting to look at the interplay between national policies, espoused aims of education, school aims, classroom policies, mathematics education aims, and the enacted values of teachers. Often the result is a lowest common denominator rather than a celebration of difference.

Regional policies related to curriculum, assessment and resources have been used in various ways to control what is done in classrooms. Such policies have influenced the related development activities but the lack of wholehearted endorsement of these policies by schools supports the notion that links within the model are influential but not causal.

Developing Assessment

Assessment occurs at many levels. Region-wide assessment (or sampling to moderate examinations or standards) is common. In schools formal assessment occurs for records and reports, and in class informal assessment helps teachers planning. Self-assessment by students is often neglected yet it is needed if we are developing autonomous learners.

Schools are influenced by national (and international) assessment that often causes teachers to teach to the test. This means emphasizing things likely to be tested though 'not everything that can be measured, counts, and not everything that counts, can be measured'. In-school common assessment has a similar but somewhat lesser influence.

It would be good to have assessment policies and strategies that have a positive impact on learning and provide the required information. This is most likely to come from teachers who think of the desirable aspects of learning rather than from 'experts' with other agendas, and this is another example of an area needing teacher-driven development.

Developing Curriculum

For me curriculum means 'all planned activity for the classroom'. Curriculum documents are only part of the picture—assessment practices, rules and regulations from bureaucracies, teachers guides, and resources also influence the curriculum.

Regional curriculum development usually involves a number of teachers directly and more indirectly depending on the model used. If one assumes my complex model, then many more would be involved. When a regional curriculum is interpreted into school 'schemes' to suit particular situations, and then into lesson plans for particular classes with specific resources, we see every teacher really is a curriculum developer.

Numerous questions arise when one is developing curriculum—what should be in the document, who decides, and how do developers find out? Even in terms of mathematics there are questions—some countries do not teach statistics, and some universities do not teach geometry. Other questions relate to curriculum purpose—is it what students must know, what teachers must teach, or both? Linked to this is the issue of who is the curriculum for, if it is mainly for teachers then what structure best suits them?

Just as my model suggests a complex connected model rather than a linear one for development, perhaps the curriculum needs to reflect complexity. I prefer a focus on the 'big ideas' of mathematics, and a list of successfully trialled 'rich learning (mathematical) activities'[1] that could be used with the big ideas. The key role for teachers would be selecting appropriate and inclusive activities for students regardless of gender, culture, and ability, and then 'curriculum anticipating'. This would involve analyzing possible ways that a lesson might develop, working out the likely paths students will take, finding ways to extend the activity, and considering possible blind alleys.

Developing Resources

The first resource that comes to mind is the textbook. In some countries (e.g., USA) developing textbooks is thought of as developing curriculum. Elsewhere resources follow curriculum development. Regardless, resources influence lesson planning and teaching, that is the implemented curriculum. While resource production is usually initiated by small groups of authors, a research team, or a bureaucracy, teachers become resource developers as they adapt these to suit their classes, and as they produce work sheets to supplement texts or to use ideas from other sources. When such adaptations are discussed and shared with colleagues the influence moves beyond the single teacher level.

Resources include calculators and computers and these are important as they influence mathematics teaching. The influence of the technology is summarized by Engelbrecht & Harding (2001) in endnote 4. The use of these resources is a significant aspect of change and provides another example of the relationship between the eight activities and the three levels in my model.

An Example, Explore-Conjecture-Prove

Consider the notion *explore-conjecture-prove*. It may be desirable to introduce this to schools because it integrates processes (problem solving, reasoning, making connections and communicating) with content strands. If so, what could we do? It would be difficult to work in all eight activities at three levels, but there are things to do.

In terms of research we might find out what has been done in other countries, and survey those teachers to see if they found the notion relevant. We could encourage small research projects within present curriculum constraints to see if it was a viable approach. The results could then be shared so that others would be aware of the findings.

In terms of theory we could look to theories about 'what mathematicians do', we might consider theories about learning and how views of what mathematics is emerge, or we might see how explore-conjecture-prove fits with theories of schema construction. These theories would need to be discussed so that people at all levels become aware of them.

To influence policy we would communicate with policy makers—teachers, heads of departments, advisors, and regional developers. Communication is two-way so we might talk of our concerns, discuss possible solutions, suggest possible ways forward, and allow the decision-makers to think about our ideas. We could make submissions on draft curriculum documents, and suggest how the notion could work in practice.

Because assessment is important in development, we would communicate with assessment people, provide exemplars to show how such a notion could be assessed, and justify why it might not be able to be used in some ways. This might require teachers testing exemplars that could be done with exploratory studies.

To change curriculum we might begin at class level with activities for teachers, and then at school scheme level show how curriculum strands might be integrated. At national level we might use a similar process. In each case we could focus on 'curriculum anticipating' to see how such activities can be used and extended to make more connections. We may not be able to do all of this by ourselves and nor would we see such a process as being separate from resource and professional development, so we would be trying all the time to widen the group of interested people to achieve our goal.

In terms of resource development we would need many 'rich learning activities' for all class levels. We could design some resources ourselves and encourage others to contribute ideas. We could share these with writers of resources through journals and workshops so that more people would see how the ideas might be used in the classroom.

While we would be reflecting on this process as we did it, we would be encouraging teachers to be reflecting-on-action as they tried the activities. We would not be suggesting that what we had was an end product, instead we would be seeking further ways forward.

For the professional development component we could attend conferences and present papers on the idea, we could prepare kits for advisors to use in schools, and offer ourselves as resource people for workshops. If we were teaching in-service courses we would build this topic into our programmes as something to be discussed and researched.

While these eight activities have been presented as disconnected, we would attempt to integrate them because of the relationships between them. We would assume that it would take considerable time for people to take ownership of the idea and implement it with classes because we are not asking teachers to change the topics that they teach (content), but rather change the way they teach (identity). We would assume that modifications would occur, and would not be surprised whether the breakthrough occurred because of teachers pushing for change or with policy makers taking the initiative.

Conclusion-Complexity/Completion/Confusion/Challenge

Complexity—Educational systems at regional, local, school, and classroom levels form a nested group of complex, dynamic and self-organizing systems. Therefore, models for change need to recognize complexity and consider all the influences on development rather than think that some specific input will cause the desired change to be implemented. Presenting this model with eight activities and 28 links at each of at least three levels, is an attempt to do this.

Completion—The model offered is not complete. It does not explore how the links between activities operate, nor does it look at each activity and discuss how each might best be carried out. I feel sure that each of the eight activities are themselves complex and that the people involved will form a self-organising system in the development process.

Confusion—I imagine that my model has people perplexed by the lack of a straightforward way of going about things. If so, then this paper has been worthwhile. There seems to me that there is no one right way, and coping with complexity can appear overwhelming. I take heart in the saying 'think globally but act locally'. Our professional responsibility seems to be to do the best we can in the change activities we are involved in, implement change in our own immediate environments, accept the complexity, and don't loose heart when others are not willing to do the same.

Challenge—There is much to be done in improving the model:

- in identifying other activities in the development process,
- in finding ways to make the links between activities productive,
- in ensuring that interactions between the activities occur at and between levels, and

- in ensuring the model encourages continual change.

We need to be able to cope with multi-dimensional models for change and the uncertainty that is implicit with them.

References

Ahmed, A. (1987). *Better mathematics: A curriculum development study based on the Low Attainers in Mathematics Project.* London: Her Majesty's Stationery Office.

Aoki, T. T. (1987). Toward Understanding "Computer Application", *JCT: An Interdisciplinary Journal of Curriculum Studies, 7*(2), 61-71.

Begg, A., Davis, B., & Bramald, R. (in press). Obstacles to the dissemination of mathematics education research. In A. J. Bishop, C. Keitel, F. Leung, J. Kilpatrick, & K. Clements (Eds.) *Second international handbook of mathematics education,* Dordrecht: Kluwer Academic Publishers.

Davis, B. (1996). Teaching mathematics: Towards a sound alternative, New York: Garland Publishing.

Engelbrecht, J., & Harding, A. (2001). *Mathematics is not for grown ups,* Seminar presented at the Mathematics Education Unit of the University of Auckland.

Ilon, L. (2000). Knowledge, labour and education, *Compare, 30*(3), 275-282

Endnotes

1 What is a Rich Learning Activity?
- It must be accessible to everyone at the start.
- It needs to allow further challenges and be extendible.
- It should invite children to make decisions.
- It should involve children in speculating, hypothesis making and testing, proving or explaining, reflecting, interpreting.
- It should not restrict pupils from searching in other directions.
- It should promote discussion and communication.
- It should encourage originality/invention.
- It should encourage 'what if' and 'what if not' questions.
- It should have an element of surprise.
- It should be enjoyable (Ahmed, 1987).

2 Enactivism is an emerging theory about learning that draws from a number of discourses, among them phenomenology, constructivism, ecology, and systems and complexity theories. Enactivism might be considered as an elaboration of constructivist epistemologies. It views learning and knowing, as complex, emergent processes by which dynamic agents maintain fitness with one another and within dynamic contexts. Two of the key concepts within this shift in thinking are:
(i) an enlargement of the notion of cognitive (or learning) systems, and (ii) the combining together of knowledge, activity, and identity. On the first, a learning system is seen as any complex form that can adapt itself to changing circumstances. For the most part, such systems are dynamic and robust, able to change and adapt efficiently. Inherent in this notion is the broader definition of cognition as 'coming to know' which includes traditional rational thinking and other forms of learning. From such a perspective learning refers to transformations, those that expand the learner's potential range of action-and it is here that the second major concept fits into place. The suggestion that learning is a transformation is a reference to the physical character of a learning system. Upon learning, a systems' patterns of activity and its associations-internal and external, with and in other systems, undergo physical change. Put differently, learning affects the entire web of being, and it follows that what one knows, what one does, and who or what one is cannot be separated. (Begg, Davis, & Bramald, in press)

3 The 'big ideas' of mathematics would include notions such as:
- number (numbers in everyday life)
- measurement (comparing with 'standard' units)
- algebra (relations and functions)
- geometry (invariance)
- statistics (variation)
- doing mathematics (explore-conjecture-prove)
- problem solving (problem solving cycle, and problem solving strategies)

4 The influence of technology is nicely summed up by the following:
- Some mathematics becomes more important because technology requires it
- Some mathematics becomes less important because technology replaces it
- Some mathematics becomes possible because technology allows it
- Some mathematics can be taught using technology (Engelbrecht & Harding, 2001)