THE CONSEQUENCES OF IMPLEMENTING AN INCLUSIVE MATHEMATICS CURRICULUM

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ABSTRACT

This paper reports the results of a three-year evaluation of a major curriculum and teacher professional development project, the Junior Secondary Mathematics Resource Schools Project (JSMRSP), carried out in South Australia. The Junior Secondary Mathematics Resource Schools Project was established with a central purpose: "To enhance and improve the mathematical capability of all students." Through investment in expertise at the level of the six Project schools, the Education Department of South Australia hoped to facilitate the development of curricula and resources of value beyond local application.

The research design for the evaluation of the JSMRSP acknowledged the existence of distinct communities of interest with respect to the Project. The three-component research design generated a results covering a wide range of teacher and student outcomes. These outcomes included issue-specific case studies focussing upon particular Project goals and target communities. This paper reports those teacher and student outcomes which can be associated with the more general features of the JSMRSP.

Over the three years of the Project, teachers reported a growing satisfaction with their participation in the Project and a growing awareness, understanding, and endorsement of the Project's goals. Student outcomes suggest that the emerging "inclusive mathematics curricula" on the various Project sites succeeded in both cognitive and affective areas at least as well as other more conventional curricular practices. Evaluation of the Project's impact on increasing the successful participation in school mathematics of educationally disadvantaged (marginalized) groups suggests that some success can be claimed, even over the relatively short term of this research.

It is certainly possible to justify some degree of optimism regarding the consequences of this approach to curriculum development since increased student success and satisfaction seem to be emerging characteristics of mathematics classrooms within the JSMRSP.

BACKGROUND AND CONTEXT

The Junior Secondary Mathematics Resource Schools Project (JSMRSP) was a three year project (1991-3) set within Years 8-10 of schooling. It was run and fully funded by the Education Department of South Australia and, from the beginning of 1992, was incorporated as part of the Focus School Program. Focus Schools were expected to develop exemplary teaching and learning pedagogy in their focus area and to document this in ways that other schools can use. This involved preparation of print resources and a commitment to collaborate with other schools through leadership of local networks.

The JSMRSP was established through the allocation of resources to six schools. These resources took the form of a cash allocation to support buying materials, teacher release and travel, and the funding of a project coordinator in each of the schools. In order to establish a project "team" in each of the schools, further personnel funding was provided to enable two or three teachers in each school to be appointed as Key Teachers and to be given a small amount of release time for project duties.

Two sets of forces operated in the process of selecting the project schools. These were the need to:

1. Have one in each of the then Education Areas into which the state was divided (four in metropolitan Adelaide and two country Areas)
2. Choose schools such that each could take a special focus on a different aspect of educational disadvantage and/or targeted group.

This second criterion was linked to the school's setting or client group. Special focus areas were Aboriginal students, students in poverty, isolated students, girls, students from non-English speaking backgrounds and students with special learning needs and this provided a subtext for the general developmental work being done in the school. It is worthy of note that a proven track record or particular emphasis on mathematics as part of the school's background and practice were not used as criteria.

The JSMRSP operated in three concurrent phases: *Development*, *Outreach*, and *Dissemination*. This paper deals with data collected during the Development phase. The major focus of this phase was the development and documentation of inclusive and exemplary junior secondary mathematics programs, within the six Project schools, which reflected and incorporated current political, pedagogical and resource aspects. An extensive and detailed Project Evaluation was undertaken, and it is the data from the evaluation of this phase of the project which provides the basis for this paper.

It must be stressed that it was not a particular mathematics curriculum which was being evaluated, but, rather, an approach to coordinated, site-specific curriculum development, which enacted a specific social justice agenda, encouraged and supported a range of pedagogical practices, and specifically acknowledged the professional development needs of participant teachers.

STUDY DESIGN

The evaluation was structured around three purposes. These three purposes required distinctively different data collection procedures (see Clarke, Morony & Schmitt, 1993).

Purpose 1. *Informing progressive action*

The choice of data collection techniques for Purpose 1 reflected the principle that the most efficient progress towards teacher change would occur where the information likely to inform teaching practice was collected by the individuals required to act on that information.

Purpose 2. *Focussed goals and site-specific outcomes*

Some of the goals of the project were best documented in the form of site-specific case studies. The amalgamation of these case studies under themes which reflected the concerns of the project: inclusive curricula or community involvement, for instance, have the potential to inform the practices of other schools which share a particular concern. The purpose of an evaluation with respect to these goals was realised through site-specific case studies, collated in monographs combining related themes (see Note 1).

Purpose 3. *Accountability and the achievement of general Project goals.*

The overall goals of the Project over all sites could be summarised as "the development of school mathematics programs which will improve the mathematical capability of all students, together with professional development to facilitate the implementation of these programs in Project Schools and elsewhere". The success of the Project could be judged by the extent to which these general goals were achieved.

DATA COLLECTION

The data collection reported in this paper is related only to Purpose 3.

Teacher data collection

A **Skills Audit instrument** was developed on which teachers were asked to indicate their level of professional development with respect to specific teaching practices: their level of skill in the specific practices; their willingness to employ them; their experience in their use; their confidence in their use; and any related comments. This instrument was administered to participating Project teachers each year, commencing in term 4 of 1991. One goal was to detect the influence of length of participation in the Project on teacher skill acquisition.

In addition, changing **teacher beliefs about effective mathematics teaching** and their educational priorities were monitored through interviews. Interviews were conducted by the Project co-ordinator each year. A suitable interview protocol, employing a card-sorting technique, was devised for this project (adapted from McDonough, 1991).

An annual teacher questionnaire, administered in term 4 of each year, measured **participant teacher satisfaction and concerns** with the Project.

Student data collection

Project goals were characterised by certain key terms or phrases. One such term was "inclusive". The Project Evaluation collected data on the participation rate of identifiable student groups: Girls; NESB students; Aboriginal students; Economically-disadvantaged students; and, Special Education students. This data took the form of enrolment in specific mathematics classes and class attendance.

Student confidence was another key term. A survey instrument was developed for the measurement of student attitudes and, in particular, student confidence with respect to mathematics. This instrument was derived from a local adaptation of the Fennema-Sherman Mathematics Attitude Scales (Rowe, 1988).

Student perceptions of the classroom environment were monitored twice yearly in all participant classrooms on all sites. Items from the *Learning Environment Inventory* (Anderson, Walberg & Fraser, 1982) were adapted to form a suitable instrument, administered in terms 2 and 4 each year.

For the purposes of the Project Evaluation, **student cognitive outcomes** of the Project were measured using an instrument of open-ended tasks (the Common Assessment Tasks - CAT 1 and CAT 2, see Sullivan and Clarke, 1991; Clarke, 1993). This instrument was supplemented by an adaptation of the ACER PAT test, revised by the Project Team to improve local validity, and intended to measure conventional learning outcomes.

RESULTS AND DISCUSSION

Teachers

From analysis of the data, it appeared that Project teachers were particularly sensitive to the role of discussion and communication in their classrooms. Current practice was sometimes seen as different from the practice associated with effective teaching. These differences took two forms. Current practice was seen to give less value than that associated with effective teaching in the areas of: *students value other students' ideas*; *closed tasks*; *computers*; *teacher poses challenging questions*; *students ask questions and initiate discussions*; *students clarify and justify ideas*; *students use a variety of tools to solve problems and to communicate.* Further, current practice was seen as overemphasising particular approaches, as in the case of: *individual work*; *conventional mathematical terms*; *teacher explains and demonstrates*; *students work on textbook problems.*

Analysis of teacher responses to the Skills Audit instrument distinguished skill in a particular teaching strategy from experience and confidence in its use, and willingness to

employ it in the classroom. The high mean level of willingness on every item suggested a teacher sample committed to classroom experimentation, with a willingness to innovate. Areas in which teachers reported low levels of skill and confidence included the negotiation of the curriculum with students, alternative assessment strategies, and accessing community resources.

Participating teachers' concerns with the JSMRSP project in 1991 centred on a perceived lack of definition of their role and on what was seen as an excessive workload associated with involvement in the project. The 1992 Interim Evaluation Report highlighted this concern. Teacher satisfaction data collected in late 1992 when compared with 1991 data showed either stability or improvement on every measure of teacher satisfaction with the project. A significantly greater proportion of teachers reported that they had "learned a lot from Project training and development sessions" in 1992 than was the case in 1991. A significantly improved endorsement by teachers of the project's goals was also evident from a comparison of 1991 and 1992 data. Role definition and workload, while still of concern, were not as significant as in 1991.

Students

Students within the study were characterized with respect to five dichotomous variables: Participation in project classrooms; School card possession (a measure of socio-economic disadvantage); Aboriginality; Non-English Speaking Background; Sex. The following statistically significant differences were evident in both 1991 and 1992 data analyses:

1. Project students reported significantly higher levels of satisfaction with their mathematics classrooms than did non-Project students.
2. Project students were significantly less likely to perceive their classroom environment as difficult than were non-Project students.

Nonetheless, gender difference, for instance, remained a significant source of variance on several affective and cognitive measures, and it is not hard to conclude that the mathematics classroom remains a very different place for boys than it is for girls. To pursue this example: While these differences appeared to act to the detriment of girls' public image as mathematically able, the girls themselves appeared to retain a strong sense of self-worth and a relatively high level of optimism regarding successful participation in senior mathematics.

With respect to cognitive outcomes:

1. Project students performed at least as well as non-Project students at the same year level on all administrations of a test of conventional mathematical knowledge. In particular, comparison was made between the mathematical performance of Year 10 Project students in term 2, 1993, and Year 10 non-Project students in term 2, 1992. Since the Project classes spanned the Years 8 to 10, this represented a significant

comparison between Project and non-Project cohorts. In this comparison, Year 10 Project students performed significantly better on this test of conventional mathematical knowledge than did Year 10 non-Project students.

2. Project students performed significantly better than non-Project students at the same year level on all administrations of a set of open-ended mathematics tasks.
3. Project students were significantly more successful on all administrations of an extended problem solving task than were non-Project students at the same year level.

One long-term aim of the Project was to increase the proportions of students from marginalized groups participating in senior secondary mathematics. This goal relates more to retention than to participation. Over the course of this research, the data collected did not suggest a significant change in classroom demographics in senior mathematics. However, students were in no way disadvantaged by their participation in Project classes and significant positive outcomes of Project participation can be identified in both cognitive and affective domains.

It should be noted that, of the various factors which might have been associated with variations in student response, Project Participation was the most frequent source of variance and the most common distinguishing factor within the responses of a given student group. This is a non-trivial result and serves to emphasise the significant impact of the Project on student experience of school mathematics.

CONCLUDING REMARKS

The Junior Secondary Mathematics Resource Schools Project was established with a central purpose: "To enhance and improve the mathematical capability of all students." This was an ambitious goal. Its realisation was dependent on the collective expertise and enthusiasm of the project co-ordinators on the six Project schools, their associated "key-teachers" and other staff, and the co-ordination and support available to the Project as a whole. A distinctive aspect of the Project was the extent to which the interpretation of the Project's goals was *intended* to be site-specific. While all schools shared the common central purpose, each school offered a particular perspective on the teaching and learning of junior secondary mathematics. This perspective reflected the social, cultural and academic characteristics, and the interests, strengths and priorities of each school. The notion of an "inclusive curriculum", which pervaded Project documents, took on very distinctive meanings at each school.

A more specific detailing of the Project's goals placed emphasis on "equity and social justice", teacher professional development in the areas of "teaching and learning processes" and "resource management", "parent and community participation", and "fully documented, well trialled junior secondary mathematics programs". These goals provided the structure for the Project and the broad parameters for the project evaluation.

The research design for the evaluation of the JSMRSP acknowledged the existence of distinct communities of interest with respect to the Project. This paper has reported the student and teacher outcomes that can be associated with the implementation of this approach to curriculum development and the associated teacher professional development. Full details of the Evaluation can be found in Clarke (1994).

Several case studies arising from the JSMRSP are already in draft monograph form. These focussed monographs offer insight into attempts to deal with specific issues within the Education and Social Justice agendas.

While the Phase One *Evaluation Report* can report favourably on the outcomes of the Junior Secondary Mathematics Resource Schools Project, drawing attention to specific features, benefits and concerns, the capacity of a school or a school system to replicate the JSMRSP will depend upon the existence of a coherent and interrelated body of material:

- *Individual School Mathematics Programs*, including detailed documentation of key instructional and assessment strategies, and essential educational resources;
- The detailed portrayal of the *Process of Change* on school sites identified in sufficient detail to facilitate identification and application, and including detailed descriptions of the roles and activities of key personnel;
- Documentation of successful professional development strategies for use in either Phase One (in Resource Schools) or in Phase Two (in Outreach Schools).

Over the period of this research, Project teachers reported a growing satisfaction with their participation in the Project and a growing awareness, understanding, and endorsement of the Project's goals. Student outcomes suggest that the emerging inclusive curricula were succeeding in both cognitive and affective areas at least as well as other more conventional curricular practices. The lack of significant success in reshaping societal and cultural norms regarding the continuation of students into senior mathematics should not be interpreted as a failure of the first three years of the Project. Evaluation of the Project's impact on increasing the successful participation in school mathematics of educationally disadvantaged (marginalized) groups suggests that some success can be claimed at Years 8, 9 and 10. This reflects the success of the Project in generating positive outcomes for all students involved. It is certainly possible to justify some degree of optimism with respect to the consequences of Project participation, since increased student success and satisfaction seem to be emerging characteristics of mathematics classrooms within the JSMRSP.

NOTE 1: Copies of the Phase One Evaluation Report (Clarke, 1994), the Project monographs and other Project material can be purchased by writing to Barry Schmitt, Curriculum Division, Schools and Curriculum Unit, Education Department of South Australia, Gilles Street Primary School Campus, 91 Gilles Street, Adelaide, SA 5000, Australia.

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