UPCOMING CONFERENCES, NEWS RELEASES AND INFORMATION

The Alberta Advisory Committee for Educational Studies (AACES)

Reports of Research Funded by AACES

Teacher Development in Mathematical Problem-Solving

Purpose of Study

This study investigated an open-ended, experiential, problem-solving inservice program (PSI), framed in a constructivist perspective of learning, and its effects on teachers' thinking and teaching of mathematical problem-solving. Problem-solving was considered as a non-algorithmic process to solve non-routine mathematical problems, a process that requires high-level mathematical thinking.

Methodology

The participants were six elementary teachers (Grades 3–6) who disliked mathematical problem-solving. They volunteered to participate in the study because they were interested in improving their classroom processes (which they described as "traditional") when teaching mathematical problem-solving. The study was conducted as a descriptive, qualitative study. The teachers participated in a PSI program that directly and indirectly engaged them in problem-solving activities for 20 hours during their summer break. These activities included solving a variety of non-routine mathematical problems, but more important, the teachers were required to reflect on aspects of their experiences with problem-solving from different points of view: as students, as teachers and as laypeople. All PSI activities were tape-recorded and transcribed, and copies of all written work were collected. Participants were observed in their classrooms teaching problem-solving once before the PSI program and an average of three times each afterward. Each observation was followed by an in-depth, open-ended interview which was tape-recorded. The data were thoroughly examined to identify and compare patterns in the participants' thinking, attitudes and classroom behaviors prior to and following the PSI program.

Results

Prior to their participation in the PSI program, most of the teachers seldom taught problem-solving, but when they did, they focused on teaching algorithms based on key words and they guided students toward correct solutions. This process conflicted with problem-solving pedagogy that requires teachers to enable students to learn to think for themselves and to become independent problem-solvers. Following the PSI program, there were significant positive changes in the teachers' confidence in their ability to solve problems and in their teaching approaches. Positive changes were interpreted as a shift toward attitudes and classroom processes that reflected the recommendations of the National Council of Teachers of Mathematics professional standards for teaching mathematics.

Effects on Attitude

The most significant outcome, in terms of attitude, was the teachers' increased confidence in their own ability to solve both routine and non-routine problems within the context of their teaching. This shift in attitude seemed to have occurred as a result of a better understanding of problem-solving and of themselves as problem solvers. In general, the teachers' awareness resulting from this enhanced understanding seemed to free them from the traps of their past experiences and freed them to do things they thought were not allowed or valid when solving mathematics problems. It also shifted their view of problem-solving from a prescribed algorithmic process to an open-ended process in which the problem-solver had to be in control to interpret and solve the problem.

Effects on Teaching

The teachers were able to draw out particular aspects of the PSI experience to use as a basis of change in their teaching. As part of the PSI experience, they (collectively and individually) developed informal theories about teaching problem-solving, particularly with respect to teacher intervention in the students' processes. For example, collectively, they decided that teacher intervention to provide help should occur when students were stuck, off-track or lost. Although the nature of the intervention varied, the overriding principle was that the function of intervention should not be to tell students how to solve a problem, but to stimulate their thinking. The teachers implemented these theories in their classrooms in ways that enhanced their teaching of problem-solving, such as

- engaging students in problem-solving more often;
- being less dependent on a textbook;
- using more cooperative learning groups;
- having students share solutions and meanings;
- emphasizing process over final answer;
- listening more to students, focusing on the students' thinking behind "right" and "wrong" answers;
- using non-routine problems;
- considering alternative solutions; and
- asking non-leading questions and being more sensitive to the nature of intervention in the students' processes, that is, when and how they provided help.

Since the PSI program left it up to the teachers to determine how to change their teaching, each teacher decided on what was meaningful and important in a particular situation and when and how to integrate the new knowledge into it. Teachers transformed the knowledge obtained from the PSI experience to practical classroom processes that best suited each individual situation.

All of the teachers pointed out that after participation in the PSI program, they found teaching more challenging, but more interesting and rewarding, particularly because they were learning a lot from the students' thinking and because of the positive effects on their students' learning of problem-solving. They also found that the way in which they were teaching other areas of mathematics was being influenced by their problem-solving approaches.

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Variables Affecting Successful Implementation of a Framework for Teaching Mathematics with Meaning

Purpose of Study

Since initial work by Sigurdson and Olson (1992), several studies by the authors have focused on a classroom teaching framework for junior and senior high school mathematics. Although the use of the Framework for Interactive Teaching (FIT) results in achievement gains for the students, teachers report variable success in their efforts to implement this teaching approach. This study set out to look at how teachers were failing in the implementation and what teacher and classroom factors accounted for these failures. Research questions addressed were as follows:

1. What implementation difficulties do teachers encounter?
2. What teaching and classroom factors relate to its successful implementation?

Methodology

Two Grade 8 mathematics teachers implemented two units each—Geometry and Data Management. A research assistant working with the teachers developed the units according to the (FIT) principles. The general principles of FIT include daily homework, adequate preparation for homework, an emphasis on the meaning of mathematics and generally organizing the lesson so that a maximum amount of time is spent on learning mathematics. Both teachers were observed a minimum of six times each.

Results

Both teachers found it difficult to adhere to the FIT principles. A categorization of the difficulties identified three areas: lesson structure, making mathematics meaningful and teaching interactively.

Lesson Structure

The structure of the FIT lesson designates specific time in the lesson for student work and lesson development. To make this possible, time for other activities such as correcting homework must be severely curtailed.

With regard to lesson structure, the following implementation concerns were identified:

1. Limiting homework correction to two to three minutes is problematic. Teachers feel that students often have good questions during homework that should be discussed.

2. Discussions of mathematical meaning too easily expand to fill more than the "half of the lesson" time they are allotted.
3. The two above items indicate that the extra time spent in opening and development meant less time for seatwork and homework.

The FIT model makes teachers very conscious of time in a lesson. Related to structure is the tendency for some teachers to incorporate seatwork time into the development. This is now taken to be a useful modification of FIT. The complexity of the classroom lesson is a major factor in implementation. However, a key feature of the framework is that more learning takes place when a teacher actively tries to accommodate for these complexities.

Many of the above findings relate to a teacher's philosophy of teaching. Individual student needs inappropriately focus classroom time and energy on non-productive teaching activities. Most teachers however are very attuned to student needs and find it difficult to avoid these interruptions. Teachers often prefer to teach in a more casual, less focused manner, giving the students more time for individuals to work alone or in groups. The research shows that, over the long term, a high involvement of teachers in the lesson leads to higher student achievement.

Mathematical Meaning

Two concerns about adding meaning in the lessons stand out. Although the inservice attempted to give possibilities for meaning, teachers miss many opportunities for meaningful discussion. In these lessons, the meaning was supposed to "fit into" mathematics learning. In today's terminology, meaning is for making connections. Adding meaning is a subtle teacher activity. It may simply be an advanced "art form." Our teachers had not had enough practice at teaching with meaning.

The second general concern with meaning is that teachers tend to treat it as "discovery" learning. This relates to its "time-consuming" nature in lessons. The distinction between discovery learning and learning with meaning needs to be fully explored by teachers.

Interaction

The FIT model emphasizes teacher-student and student-student interaction. Teachers found it easy to interact over the homework corrections but not over the actual lesson. Students play an important role in interaction and perhaps more attention has to be paid to them learning how to interact. Interaction does not consist of casual comments but focused observations. Students often focused too closely on the mathematical procedures.

Reference

Sigurdson, S. E., and A. T. Olson. "Teaching Mathematics with Meaning." *Journal of Mathematical Behavior* 11 (1992): 37–56.

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AACES Grant Guidelines

1. AACES funds are quite restricted, totaling about $20,000 a year, hence its support of educational research activities is restricted both in the size of the grant that may be provided ($5,000 is the normal ceiling) and in the number of grants that may be allotted during any one year.
2. Grant applications will be assessed by AACES with particular consideration given to the variables of relevance to the preparation of teachers, elementary and secondary education, size of the project and anticipated allocation of funds requested relative to committee guidelines.
3. Nine copies of the grant application must be received in the office of the AACES secretariat prior to 4:30 p.m. on the published deadline date. The Ethics Review Committee Report and/or Central Office Approval Report must accompany the grant application at the time of submission. Faxed copies will not be accepted.
4. Grant applications received in the office of the AACES secretariat after the published deadline preceding a meeting of the Committee will not be considered at the forthcoming meeting. Applicants may, if they wish, have their applications considered at the next scheduled meeting.
5. Research which constitutes part or all of the work for a university course or degree will not be supported by AACES.
6. As AACES supports dissemination of research through its contributions to *Alberta Journal of Educational Research* and *Journal of Educational Thought*, it generally does not pay fees that may be charged by a journal for the right to be published.
7. Grants will not be given for activities whose major purpose is to produce commercial products, for example, books, texts, curriculum guides, audiovisual aids and the like.
8. If a proposal is judged worthy of support by AACES the following matters are relevant to the allocation finally awarded:
   (a) Often supported in whole or in part: research assistants' salaries; telephone and postage

charges; noncapital materials costs (for example, paper, pencils, tapes, film and so on); research-related travel expenses; transcription costs; consultants' fees.

(b) Not supported: honoraria for principal investigator or investigators; capital expenses (for example, filing cabinets, tape recorders, sets of books); computer time fees; computer software; expenses associated with conference attendance for travel costs inside the researcher's community. At the discretion of the committee, allowances for travel costs outside the researcher's community may be granted.

(c) Payment of funds: grants awarded will not normally be paid directly to a grant holder but will be disbursed through an audited account on which the grant holder may draw.

(d) Grants will not be provided for those activities for which the major purpose is professional development.

9. Proposals requesting funding for release time of school-based staff, AACES will consider funding only if the school or school jurisdiction involved agrees to match the amount requested from AACES.
10. An ethics review committee approval report from the institution of the principal investigator or a central office approval report must accompany the submission to AACES.
11. Projects must be initiated and some portion of the grant must be expended within one year of receipt of the grant.
12. Projects are to be completed within two years; however, the Grants Committee may, upon application, grant an extension of not more than one year.
13. A copy of the final report including an abstract of not more than 500 words must be submitted within six months of the termination date of the project. If the final report is not received within the specified time, AACES will not consider further proposals from the principal investigator for a period of three (3) years. The appropriate dean of the faculty of education or school jurisdiction superintendent will be informed in writing that the final report was not received prior to the deadline.
14. These reports may be circulated by AACES to participating organizations and interested parties.
15. Any grant applicant who has received an AACES grant but failed to meet all obligations within two years of the termination date for that grant is automatically excluded from consideration for further allocations.
16. Any published articles resulting from research funded by AACES should be forwarded to the office of the AACES secretariat.
17. Apply to Doreen Link at The Alberta Teachers' Association, Southern Alberta Regional Office (SARO), 540 12 Avenue SW Suite 200, Calgary T2R 0H4; phone 265-2672 in Calgary or 1-800-332-1280 from elsewhere in Alberta; fax 266-6190.

The sum of two natural numbers is 90. The sum of 25 percent of the first addend and 75 percent of the second addend is exactly 30. What are the two numbers?