Chapter 13

Algebra for Adult Students: the Student voices

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INTRODUCTION

In 1983, the National Commission on Excellence in Education published A Nation At Risk, a short, provocative document which initiated a scrutiny of United States education in every field and at every level. A leader in the ensuing mathematics education reform movement was the National Council of Teachers of Mathematics (NCTM), an organization which is primarily, but not exclusively, devoted to promoting quality elementary and secondary mathematics education. Their Curriculum and Evaluation Standards for School Mathematics contained suggestions for changes in course content, emphasis, methodology, and the use of technology for the learning and teaching of mathematics at the primary and secondary level. On the undergraduate level, the American Mathematical Association of Two-Year Colleges (AMATYC) and the Mathematical Association of America (MAA) later published guidelines for mathematical achievement in their respective jurisdictions.

One central theme of these reform efforts was a perceived need for all students to study algebra. The NCTM Curriculum and Evaluation Standards for School Mathematics states five general goals for all students, one of which is the ability to communicate mathematically (NCTM, 1989). Elsewhere in the same document algebra is described as "the language through which most of mathematics is communicated. It also provides a means of operating with concepts at an abstract level and then applying them, a process that often fosters generalizations and insights beyond the original context" (NCTM, 1989: 150). The reform literature attempts to identify the essence of algebra, the role of technology, and effective teaching strategies for conveying the first and incorporating the second. Taylor is one...
of several mathematicians who have challenged the traditional placement of the subject in the ninth grade where it serves as a gate which either admits students to further mathematics study or terminates their participation. He proposes that:

The opportunity to study algebra should always be available. One of the strengths of the educational system in the United States is the many opportunities it affords students who have not previously been successful. We must never give up on students or allow them to give up on themselves. With high expectations, encouragement, and effective instruction, the algebra course can be converted from a filter that screens people out to a pump that propels people forward toward opportunity. (Taylor in Edwards, 1990: 51-52)

In the United States, almost half the students pursuing undergraduate degrees are twenty-five years of age or older, students availing themselves of the opportunity of which Taylor speaks (Lally, 1995). It is commonplace for students in this category to require a first-time or refresher course in algebra, termed "developmental algebra", because they either never studied the subject or do not recall enough of the skills studied in secondary school to tackle college mathematics. An undergraduate research effort which attempted to incorporate many of the proposed mathematics education reforms into a developmental algebra course for adults is the subject of this chapter. The author gives prominence to the students’ voices throughout.

INTRODUCTION TO ALGEBRA FOR ADULT STUDENTS: THE RESEARCH PROJECT

Soon after the publication of the NCTM Standards document, the dean of the adult college at a major US research university shared her concerns that students from her college worked at a disadvantage when placed in developmental algebra with traditional age students. The dean, herself a mathematics professor, suggested to mathematics education faculty at the university that an algebra course based upon the recommended K-12 reforms might be beneficial for those students. Several teachers of undergraduate mathematics were in the doctoral program in mathematics education at the time and they expressed an interest in designing and offering such a course. The resulting course, Introduction to Algebra for Adult Students (IAAS), was the product of that research project. The design team examined developmental mathematics at the university level in light of the NCTM Curriculum and Evaluation Standards for School Mathematics and at the same time grappled with the problems faced by adult students returning to inathematics study. It should be noted that during the planning stages of IAAS only the NCTM Standards were available in published form so it
served as the principal planning tool. Classes of IAAS were already being conducted when MAA and AMATYC published recommendations for developmental mathematics standards at the undergraduate level. Later comparisons of the course with these documents, however, showed post facto compliance with their suggestions.

Introduction to Algebra for Adult Students has now been offered for six years. The author was a member of the team which designed the course and an instructor during the first two years that it was offered. Her doctoral dissertation was an examination of the course from four perspectives (Ramus, 1997). One of those perspectives is that of the students. At the end of the second year, the thirteen members of the experimental class were invited to be interviewed about the course. Eight students were able to participate in the interviews which were conducted by a third party using a formal protocol (Appendix). These interviews were audio and video taped and then transcribed. The transcriptions were analyzed using qualitative methods. It is these interviews which provide the student voices of this chapter. The interviewees ranged in age from thirty to fifty. The individuals identified as R, E, and L are males. J, S, A, G, and C are females.

In performing the analysis, the author was often in the difficult position of being the researcher and the subject, at least in part, of the research itself. In categorizing the students’ comments every effort was made to separate remarks which described a generic, good instructor from traits particular to the researcher. Even when the student voice spoke of a personal trait, for example, a sense of humour, the author attempted to identify a teaching technique, the use of humour to enhance the comfort level, as the characteristic valued by the student. The reader should keep this in mind when listening to the voices as quoted in this chapter.

**ALGEBRA FOR ADULT STUDENTS: THE COURSE**

The creation and implementation of MAS was a collaborative effort between the administration of the adult college, the Mathematics, and the Mathematics Education departments at the university. The target student population was humanities majors who had not fulfilled their mathematics requirement for graduation and who seemed least able to master algebra in courses at the university taught using a traditional approach and text. The representatives of the mathematics department asked that the content be roughly equivalent to the content of the parallel traditional course but the expected level of notational proficiency was relaxed to reflect the limited needs of the students. The mathematics education researchers asked for freedom to design a course which might turn out to be very different from
what the mathematics department and, in fact the algebra students, was accustomed to experiencing. The adult college dean asked that her students complete the course with an ability to reason mathematically and to communicate using the language of mathematics, algebra, without losing heart in the process.

From the outset, the design team envisioned a problem-centered course where a central problem was explored in a collaborative way by students working in small groups or as a whole class exercise. Each class period would begin with the problem which the students would be asked to solve using any method they could devise. After a reasonable amount of time, the various solutions and strategies would be put on the blackboard and, in the ensuing discussion, commonalities would be identified and algebraic generalizations revealed. Often one student would pose a question which was answered by another student who might raise a different issue. This work \, odd then be followed by additional problems similar to the "opener" and students \ would be encouraged to look for pattern among the solutions and try to generalize and find a rule which could then be applied in future problems. There would be no pre-ordained schedule and the student mastery of the material would determine the pace.

One book which served as a guide during the planning phase was a slim volume of essays entitled *Algebra for Everyone* The topics to be covered by the course were suggested by one of those essayists:

> The concept, principles and methods of algebra constitute powerful intellectual tools for representing quantitative information and then reasoning about that information. The central concepts of algebra include variables: functions, relations, equations and inequalities and graphs. (Christmas and Fey in Edwards, 1990: 62)

These concepts became the focus of the course. The course material was structured to present algebra as a generalized arithmetic. This allowed the students, adults who were proficient at accomplishing everyday mathematical tasks, to examine mathematics as they knew and used it and to attempt to develop abstract rules to explain their algorithms. In the words of the professor directing the research project, "Algebra is the way we talk about how numbers behave when we don't know the numbers" (Davis, private communication). Another of his maxims, "Never answer a question until it is asked:" encouraged the teachers to lecture minimally and to function more like discussion leaders than instructors. Classes were conducted using a constructivist approach \, dieren the teacher is the facilitator and the student is the builder of his/her own knowledge base. While a single definition of the term has yet to be achieved, the guiding principles of constructivism are that knowledge must be actively constructed by learners and that coming to know is a process of organizing and adapting to the world
as experienced by the learner (Gadanidis, 1994). Perhaps the best metaphor to describe the conduct of the class would be that of playing a game of pinball. This game, popular in gaming arcades in the U.S., consists of propelling a small metal ball into a case filled with several levers which redirect the ball and cause points to be scored. Once the ball, in the case of IAAS the question, is released, the outcome is determined by a mix of chance and skill. This loose structure was tempered at times by student demand for direction from the instructor as well as for adequate practice of the constructed schema.

Introduction to Algebra for Adult Students did bear similarities to the traditional versions of the class. The instructor and students met for eighty minutes, twice a week, for thirty weeks. Standard university tutoring, offered to all developmental students, was available. The class met in a regular university classroom. There were no computer facilities available for the instructors or students. The location of the class was restricted because the students were accustomed to attending other classes in nearby buildings before and after IAAS met.

Points of dissimilarity were the composition of the class which was exclusively part-time, adult night students. Instead of instructors from the mathematics department, the course was staffed by graduate students from the mathematics education doctoral program. During the pilot year it was team taught. In the second year there was one instructor, the author. Graduate students from the mathematics education masters and doctoral programs observed class sessions. Some of these observers provided a limited amount of tutoring keyed to the teaching style prevalent in the class sessions offered to tutor students from the class outside of class meeting times.

**IAAS FOR ADULT STUDENTS: STUDENT VOICES**

*Math Histories*

When asked if they had had problems with mathematics in the past, the responses were polarized. Two of the students said that their memories were pleasant. S had taken 3 years of high school math, finishing with Algebra II and Trigonometry. Until that third year, she had liked and done well in math: but did not like all the formulas in trigonometry. Later in her interview, S shared the thought that she might have majored in math if she had encountered IAAS earlier in her collegiate experience. A. who was actually planning to major in mathematics at the time of the interview, described herself as "always good in math...never disliked it or struggled with it." She viewed mathematics as being "like a puzzle and there's a light
at the end of the tunnel that you can see." A believed that once the work was explained she generally did not find herself struggling with it.

The other six interviewees had less favourable math histories. R reported a fair aptitude for math in elementary school and then a disastrous year in junior high school, when he was placed in an accelerated class. He felt that this had left him a little behind and created a phobia for math that culminated in his failing algebra. He attributes some of his problems in math classes to a reluctance to ask questions. L remembered always having problems with mathematics when he studied the subject in Hungary. He blames the heterogeneous grouping of students that placed him in the same class as outstanding mathematicians. He felt uncomfortable asking questions because "Why should I prove I was stupid?"

C admitted avoiding math classes "like the plague." She attributed her avoidance to a fear of not understanding it because she could never get the concepts and felt that there were too many rules to memorize. While she managed to pass her high school courses: C never was really comfortable nor secure with the material. E described math as his weakest subject. He had "mostly negative feelings" about other math courses he had in the past and, like C, felt that he could pass a math course but his knowledge was marginal and lie did not feel that he had accomplished very much.

J was within five courses of graduation when the math requirement caught up with her. She had attempted one of the traditionally taught courses at the university. Math 023. and felt that the pace and the presence of traditional students worked against her in the mainstream class. In her words:

I tried to take an 023 course here. Um, I guess it's your basic algebra course, and they moved at such a rapid pace that I couldn't keep up. So, they would give you an assignment on maybe Monday, and we'd review it in the next class. And then they'd give you another series of problems, or another type of problem the next class and say. 'OK, we're moving on,' and for me, I can't do that. I need to sit and I need to think about it, and work a few problems out, maybe a week at a time.

G had perhaps the most traumatic math history of those interviewed. She recounted a tale of an introductory algebra course taken at a community college with an adjunct instructor who battled illness and ineptness throughout the semester, to the detriment of the students. G went on to attempt algebra five more times, encountering "massive anxiety attacks" fought off with biofeedback and medication, culminating with eventual withdrawal or failure each semester.

**Differences in Introduction to Algebra for Adult Students**

When asked to describe differences between this course and those which interviewees had taken, several points emerged. L cited the homogeneous
nature of the student population as a significant difference of IAAS. Me was willing to ask questions because the person next to him might have the "same question in his or had head." He said that this course had helped him to get rid of his shyness. In her interview, J alluded to the same feelings about questions, namely, that she felt free to ask them. She says, "I guess because we're all adults in the same boat, she doesn't make us feel uncomfortable about saying, 'O.K., I'm the dummy. Could you explain it to me again?' Because we don't all think we're the dummies, but we just haven't learned it yet." R said basically the same thing, but even more emphatically. He told the interviewer that "probably the most important thing I've gotten out of the class is strangely enough, and it had nothing to do with math, it's the fact that I've gotten over this feeling of not asking questions."

R attributed this change to the “non-threatening” atmosphere of the class:

First of all, the atmosphere is very different. Kathy was extremely understanding. She goes out of her way to give a lot of positive reinforcement, ... she has enormous patience. Much more than I have... She doesn't take anything for granted in terms of what she thinks is important. She assumes that a fair amount of her students maybe don't understand what she just said and she'll ask, she always goes out of her way, she doesn't put you on the spot. I know I hated, as most people did, getting up at the board or being called on. She doesn't do that.

S felt that the class was "totally different than any other class I've ever had. Period." When asked to elaborate, she echoed the thoughts of her classmates and then added a discussion of clarity of explanations. S said that in other math classes the instructor "would not, or could not explain for me and some of the other students but they know what they were doing but they couldn't explain it, which made it very difficult." She felt that, in her past classes, she and other students had eventually stopped asking questions because of this situation. S contrasted that experience with her experience in IAAS:

In had class, she can actually explain so that you understand. You know, which makes it pleasant to be there. It's nice to come here because it's like, this woman is not an ogre: whereas in the past. I've had some math teachers that would tell me well, if you don't understand it, just go over the samples in the book, and I would be, like, totally lost.

R felt that student confidence was fostered by a series of small successes based on incremental activities. J concurred and described the practice of tackling problems of incremental difficulty as a difference she saw in the course.

J saw her confidence carrying into her work life. She had changed jobs during the academic year and said that she had attempted algebra problems
Katherine Safford

that she never would have touched in the past on corporate entrance exams. That idea was echoed by G who said that she now spoke up more at meetings and attributed this to confidence gained in IAAS. She listed the positive, success-oriented flavor of the class as the main difference she saw in this class. Rather than telling the students that half would be gone by the midterm (G's previous experience) the IAAS instructor told the students, in G's words, "We're gonna get through this."

Another difference that G reported was the exercises the instructor had assigned in the first classes to make the class work together. In her words:

In the very beginning she started. I've had this in other classes where they have you work with a partner and you introduce that person, so you're already interacting with other students, and you kinda get to know each other on a different level. Where in the previous math classes it was almost set up that you stayed very separate. You know... so just by being comfortable in the class, you know, and being more, made aware that we're all here at the same level, and that we're all gonna get through it together. Um, that made a big difference.

The interviewees who commented on similarities of this class to other classes felt that the material was the same as that they had encountered in previous classes. E said that he had experienced some of the short-term memory problems he had in the past. G admitted to having minor panic attacks like those she had experienced in the past but being able to work through them because of strategies she learned in IAAS.

**Differences Outside of Class Sessions**

Students were asked if, outside of the class sessions, there was any difference in the way they related to the course. Both J and A reported that the assistance of one of the graduate student observers outside of the class sessions made a positive contribution to their first-semester experience. Both felt that the assistance of someone who had observed the class and understood the instructor's style of instruction was a real asset. J said that this provided consistency. For a previous math class she had gone to the campus Learning Center for help but had not been satisfied. In her words:

The problem I have with that is that not all the students (the tutors) there are on the same level. And not all the students there understand an adult's concern about how they do problems.

She contrasted this situation with that of a graduate student tutor who "observed how our professor taught us. And then she said, 'This is what she wants you to do.' And it was easier."
G reported that, by contrast to her previous experiences, she now looked forward to the class and it had become her "source of sanity" in a chaotic life. She not only looks forward to coming to classes but participates a lot more than she has in the past. R saw a difference in his discourse with his children as a result of his coursework. In the past, his wife helped his daughter with her math and he would help with her English. He now felt that he had more interest in the subject and that taking IAAS had "enhanced my capability as a, quote, teacher of my own children."

**Surprising Elements**

When the students were asked if they found anything surprising about the course, several different responses surfaced. Three students were surprised that they could do the work. In C's words, "The biggest surprise to me was that I got it! That was just, that was just something that, I mean I sit there: especially first semester when I got the final I was like, this has to be wrong. This, I mean, I got it. I really think I got it." A repeated this theme, perhaps less exuberantly, when she said, "Well, it's not as hard as I thought it would be and that's surprising, you know, ... when you hear the word algebra, most people kinda like cringe ...you know, just to hear the word algebra, but it's. it's not that bad." E found his ability to ease into the math itself surprising because he had not thought that he would be able to adapt so easily.

G found the student interaction surprising. She said that this interaction, particularly working together, was encouraged more than in other classes. She felt it was manifested in both small-group and whole-class discussion and will be discussed at length in its own section.

S also commented on the instructor as a surprising element of the class. In her words:

Most professors don't interact with their students like Kathy interacts. Most of them will not take the time to go over something over and over and over again even if it seems as though every one else has gotten it, she takes the time to make sure that everyone has gotten it, and she doesn't make anyone feel, 'That's a stupid question' or 'That's a foolish question.' You know, which is nice.

J also responded that the patience of the instructor surprised her, in her words:
Katherine Safford

She has a lot of patience. And even if we don't get it, we're not...we're not skipped over. She makes every effort for us to try to get it. And she'll say, 'Well, look at it this way.' She gives us other ways to look at it.

L was surprised by what he called the "humanity" of the course. He had attended university in Europe and felt that, while the American system was perhaps less rigorous, it was more human. He admitted that this might be attributed to his adult status, but that he felt a much closer connection with the instructor than with any he had studied with in Europe. In his words: "It was a good feeling. In education it is a good feeling."

**Attitudinal Change**

All of the interviewees felt that their attitude had changed as a result of taking the course, although the degree of change varied. Those who liked math before the course felt that their fear of algebra had been mitigated. Student A said that she had always thought algebra was different from math and now she sees that "It's not like it's something from outer space that is very, very difficult, it's math, it's [a] thing that I know." S said that she would not be afraid to take another math course now that she has completed this one. G, who has to take statistics for her degree program, said that she had previously felt intimidated by algebra but no longer does, and she feels she'll "be okay" in the statistics class.

For three students, an incremental gain in self-confidence measured their advancement. Both E and J shared a willingness to tackle a problem, an attitude that was absent before they took this course. In her own words, J's attitude toward math had been "horrible...I'd just make faces at you, oh, like, 'Get away from me.'...now I'll at least make an attempt to solve the problem." She attributed the change in her feelings to the fact that it was an adult class. J felt that the sense of community this evoked created an even playing field, a feeling that "We're all in the same boat."

E contrasted his increased confidence with old feelings of math avoidance and fright. He told the interviewer, "I definitely feel more confident now as far as if I am given a problem...I think I have a better chance than I ever had of solving [it]." L, the Hungarian student, had difficulty finding the right words to describe his improved attitude. He stressed his ongoing respect for the subject but the fact that he had never felt close to it because of personal fear. Now, although he would not characterize himself as confident, he did think that success at problem solving had resulted in some increase in happiness and confidence.

R took a philosophical stance when asked this question. He felt that an intangible like mathematics was not something about which one should have an attitude. He felt that his attitude towards math pedagogy had undergone a
change. R said, "I think now that I feel that not enough has been done in terms of math pedagogy. And I think that you can teach people math in a different fashion."

The Instructor

R continued his discussion of the course by describing the pedagogical approach of the instructor, referring back to an earlier discussion concerning the way rules were taught and learned in the class:

[Some instructors say] this is the way you, this is the formula for say, the quadratic equation, this is what you're going to do. But the way she does it, really helps to develop some understanding. In other words, trying to find a repeating principle and then after we've worked through it a while, um, then it's fairly successful at that. then, she'll state what the rule is. I find what that really does is, one, as she say, you really own the concept more. Also, from my standpoint, I just find it much more interesting that way.

C echoed R's response when she told the interviewer that it was the instructor's approach that set her apart. In her words:

Probably the biggest part of it is not standing there and saying this rule applies to this type of problem situation. We work it out and then we go from there... It wasn't that, you know, she gave the rules first and said this is it, this is how you're going to know to determine it. We just worked problem after problem after problem until we got it. That kind of thing. Illustrations, handouts, problems from the workbook. And just keep working at 'em until you get 'em. And then she said, 'Okay, well here's some rules you can follow.

Three of the interviewees commented on the clarity of the instructor's explanations and her persistence in the face of student misunderstanding. Repeating a thought she had introduced earlier in her interview, S said:

She can explain, and she will explain, as I've said in the past. I've had professors who knew what they were doing, but perhaps couldn't explain something to me so that I could understand. And, you know when you ask someone something over and over and over again, sometimes the professor can get a little irritable. ... never gets irritable. She gives everyone an opportunity in the class.

C concurred with S when she discussed what she termed the "concern" of the instructor. She said:

She's concerned. She wants to make sure that the message that she is trying to get across is understood, and not understood by one or two, by everyone. We'll go back over stuff if necessary. If she finds that we are not, we're clueless as to
what she's saying, she'll go a whole other route to try to get us to understand what it is she's saying. So I guess it's patience. It's the individual concern.

The third student who commented on this aspect of the class pedagogy said that "If you don't understand a problem, what she'll try to do, she'll ask you what it is you don't understand about it, and then she tries to explain it that way. That's very helpful." He said that, out of all his courses, this is the first time an instructor has done that.

G felt that the instructor was more insightful than instructors she had encountered in the past, a trait that might not be replicable. She said that the instructor could "read people" by picking up facial expressions and body language, so that even if students were saying that they understood, their body language told a different tale, and this instructor was skilled at recognizing that fact. G continued by saying that even when you "get caught" the class was in no way intimidating because the instructor did not put you down and say "Well you should know that by now" or "Well why are you here if you can't figure that out?" which are phrases she recalled from former instructors.

L alluded to his previous discussion of the humanity and adult nature of the class. He described the instructor as being more accessible than instructors he had studied with in Europe, but attributed this to the combination of the ages within the class and the differences in the American education system and mentality. He described the instructor as being "a part of the class." In L's words: "It is very nice. She knows the math. She gives some part of her knowledge but she is not a dictator."

**Student Cooperation and Interaction**

Students interacted within the class sessions in both large and small-group encounters. Specific tasks were assigned to be worked on cooperatively in small groups based on the work of Johnson et al (1984). When working in whole-class mode, the class frequently functioned as a "large co-operative group" volleying around questions, insights, and answers until an acceptable level of student satisfaction was attained. In the interview the question was posed, "Some people feel that students can help other students to understand math. Do you think that this is true?" In every case, the response was an enthusiastic, "Yes."

Perhaps the most surprising finding, from the researcher's perspective, was the student responses concerning small-group work. Graduate student observers in their reports on the class had noted no effective group work. This, in fact, had been the perception of the instructor, namely that the students sat in small groups in acquiescence to her requirements, but that no classical cooperative group work took place.
The interviewees saw things differently. In response to this query, they said that, not only had they worked in small groups, but that it had been very helpful. Upon reviewing the testimonies, the difference probably hinges on the word classical. The instructor was accustomed to observing the structured groups frequently employed in elementary and secondary education settings. In those groups, members are generally assigned tasks such as group leader and recorder. Often the teacher determines the group membership based on criteria such as academic ability and personality traits. Groups in IAAS self-selected and functioned informally, as will be described by the students.

R was the most mathematically adept student in the class. His discussion of groups reinforces the educational theory that high-achieving students can benefit from group work. In comparing this math course to others he had taken, he said:

We work in groups, which I had never done before. I don't care to work in groups, but I like the fact that you can talk to...Well, it seems to relax everyone else, too, it just seems to and I also find it a benefit to me of being in a group atmosphere is, in my case. that I can by talking to other students when they ask me questions I find it helps crystallize my thinking.

Later, when asked specifically about students helping one another, he responded, "It helps me when somebody asks me a question because it really makes, it forces me to concretize in my mind what I'm doing because I don't seem to be very good at that." R describes his approach to group work, which reflects the way that groups functioned within this class:

When somebody asks me, I don't like when I'm asked until I've already worked it out because I find that is very distracting. I like to work on my own. I never, when we form groups, I just don't, I need a minute to...I find it distracting when someone says, 'Well how do you think?' I seem to have my own way of approaching it and I like that first minute or so to decide where I'm going. I don't tend to rely on other people because obviously in that situation, I mean the instructor, yes. but my assumption is that the person on my left and right knows as little as I do at that point so let me rely on me first and then I'm more than happy to discuss back and forth to see if they have a better way.

S frequently worked with R and gave her perspective on group work when she told the interviewer:

Working in the groups,...it helps, you know, it's helped me a lot...getting views of other people. Because, even though I might think I have the answer, or sometimes I will do something and I'm not sure if I did it right, and getting someone else's point of view might remind me, well. we did such and such in
class or back then we might have blah-blah-blah. and this is how it should be done. And they will show me, it's not like, you know, you're all alone.

A alluded to R’s desire to first work on tasks alone when she said:

Sometimes it [working in groups] does help, and other times it, you know, sometimes you just wanna work alone. You wanna figure it out or if you stumble over something that you can't figure out then you prefer to work with someone else, but sometimes you just prefer just to do it alone. just to see if you can do it by yourself.

C justified the value of group work when she repeated the old adage, "Two heads are better than one." She said group work had been very helpful to her because she experienced different ways of getting the same answer to class problems and that was "Absolutely" a good thing.

This ability to help each other extended beyond the small groups and into whole-class discussion. When reviewing suggested solutions, students were encouraged to ask others to explain their answers. At times, the instructor would seek help from students to rephrase a student question or to couch an instructor explanation in peer language. C had experienced great difficulty mastering signed number operations. She referred to that difficulty when she shared:

... a good example with this negative number blockage that I had. When someone in the class, you know, they kept hearing me saying the same thing over and over because maybe I, and probably I didn't hear what I was saying and they noticed just by what I was saying where my problem was And that's when: I can't think other name, but that's when she said to me, 'Jot down these four rules.' About the negative numbers. and I wrote them on the top of the paper and then when I went back to the workbook to do the problems, I would go back and forth to them.

J said that she had benefited from peer assistance when struggling to understand some concepts. "Sometimes, one of the students that may be sitting next to you will say, 'No. You looked at it the other way. Look at it this way.' 'Cause someone in the class may understand it quicker. or find another way to make it work.” L, too, had learned with the assistance of peers. He shared his experiences when he told the interviewer that he had not felt shy asking the student next to him to help him understand something difficult.

S spoke at length on this topic, stressing the fact that she welcomed students sharing different viewpoints or solutions because it helped her to see where she had gone wrong, although she emphatically asserted her unwillingness to back away from her solutions until others had won her over to their thinking. She shared:
You know, if this is what I have, I will tell you... this is what I have. now it may be wrong. but this is how I did it. And thus, I will explain the whole thing. Naturally, it could be wrong, but, you know, unless somebody shows me something else. I will stick to my answer. And normally, you know I, you know, another student will say 'It's done this way or such-and-such,' or Kathy will ask someone else, and they will explain it to me, so like, I don't feel bad.

J covered both small-group and whole-class interaction in her response to the interviewer's question. When asked if students could help other students she replied:

Yes, that can happen... some students do help a lot. There are students in our class who say, 'No, you're looking at it wrong. Look at it this way. This is what she really means.' Um, some students remember it from high school. Some people are more proficient... Sometimes we figure it out together. Whereas I may get one part of the problem, and they say. 'No, you're supposed to divide at the end, or you're supposed to subtract or multiply at the end.' I go. 'Oh, that's what I'm doing wrong.' and you combine the two and go. 'all right, let's see what we do,' and then work it out. Um. yeah. two students can help one another a lot. very much so.

G compared this class to the others she had taken and failed:

In the other classes we helped each other. There were, there's always somebody you can connect with in class. Outside of class we helped each other. But within the class... because of the mood of the class and the instructor... You really did not want to let on to other people that you didn't know what you were doing... Several of the instructors I had taught higher math, and that's where their mindset was. So they were very impatient if you, if you didn't know it. And they went very fast and, like I said it was like, you know 'If you can't do this, then, you know, you shouldn't even be here.' It [working together with other students] pulls you more together. You know, you don't feel like you're alone that you're the only one that doesn't know this. You know, in this class you realize that it's just the basic. You know, If I knew it, I wouldn't be here.

The interviewer asked G if she had experienced that helping in IAAS and she replied, "Oh, a lot! A lot! There, there's quite a few times where Kathy'll be working, trying to get us to understand something, and somebody'll verbalize it in their own way and I'll be like, 'Yeah, OK, I got that.'" And when asked if she had been in a position of learning from the other students, G said, "Yeah, but I would have never done that in another class."

And finally, E related a time when he was able to help some of the other students and said that it had made him feel good to do so. He said:
Recently we went over some geometry trying to find the area of a certain property or whatever. Some people don't feel too comfortable with it but, for some reason, I didn't have much of a problem at all understanding it and someone else did. And I just offered my help and they were able to see it more clearly.

**Suggestions for Improvement**

Five students could think of nothing that would improve the course. R summed up his feelings when he said:

> J think, all things taken into consideration, the level of ability of the people in the class, I really couldn't, I think that it's really a pretty remarkable achievement. I think the class works really well and I'm sure that there is a way to improve it but I really couldn't speak to it, I'm not an educator. But my own experience... I find nothing.

Three students suggested ways they felt the course could be enhanced. G wanted more homework in the first semester. This reflected the problem discussed earlier by the instructor, who could not find a suitable text and was frequently writing and reproducing her text on the same day that the class met. It was only in the second semester, once signed numbers had been covered, that a commercial workbook could be used to relieve that pressure. G acknowledged that fact and said that she saw no way to improve the second semester.

A expressed a wish that the instructor was more available for private consultation. She suggested evening office hours. In her words:

> Sometimes it would be nice if you could meet with your instructor. I mean it's good to work with the tutor, but if you could have the time to just sit down with your instructor... one-on-one, that would be nice.

This also reflected a problem recognized by the instructor but difficult to overcome. All of the students worked days, many only arrived on campus as class began at 6:00 p.m. Some went on then to another class immediately after IAAS finished. Those who did not go to another class generally just wanted to go home after a full day of work. The instructor agrees that, if offered again, "By Appointment" office hours should be an option and students should be encouraged to avail themselves of it.

J was of the opinion that small-group work had slacked off during the second semester and should be more strongly encouraged for the duration of the course. There were some difficulties in posing the question to L, the English as a Second Language (ESL) student. It would appear that he interpreted the question as "What would you tell a different instructor to do," and his response is, therefore, an affirmation of what he liked rather than a
suggestion for change. He asked that future instructors continue the practice of "no question is stupid" because that policy had been "a big help to us."

**Recommendations for Continuation**

There was unanimous agreement that the course should continue to be offered for adult students. G answered enthusiastically, "Definitely. I don't know why they waited so long." E thought that the class "helped me tremendously" and should be continued for UC students. S felt that "...personally, they should have classes like this in every college." L felt that the course would even be useful for non-humanities majors in the calculus pipeline.

J spoke strongly in favor of a separate course for adult students. She said:

> I think it should continue because it's at an adult pace...It fills a need here...for an adult trying to make it through Rutgers...you know, we don't have many classes where we're among our peers. Totally among our peers...It's intimidating sometimes, when you have this kid, like I said, sitting next to you, who hasn't been out of high school six months, and he whizzes right through.

C echoed J but incorporated elements of the course in her discussion:

> It's the process and the method with which this class is taught which is very assuring, can be very comfortable. It was understandable, it was on a level that I could understand it yet she didn't make me feel like I was someone, that I was not smart enough and that's why I was there...You known that kind of a thing. You know, I felt much like I was an adult in the class.

It was R who supplied the most eloquent testimonial to, and argument for, IAAS:

> I would say that, if you look at the practical results, and at least by my standard, the way I would judge it, it seems to work. The people seem interested, much more interested in a math course than people before and you have to realize that the people there are hard cases, people who had a strong distaste...a dislike of the subject. They don't, they seem to have less of it each week. In the first few weeks, there seemed to be a lot of resistance, there was a lot of fear...People come to class each week, they do the work, they feel, they're more empowered. And the fact of it is, people learn at different rates: people have problems with different subjects. So, if it takes a little longer to get the job done, it's a lot better than not getting the job done at all. these same people would be taking, this one woman in the class told me she took three or four algebra classes, failed them each time. And I really feel quite confident that if she had taken this course in the beginning, she wouldn't have wasted all that time and the resources of the
University. She would have gotten through it and she would have felt a lot better about it. That would be my argument.

DISCUSSION

Each of the collaborating parties who planned IAAS had their parochial goals for the course. The mathematics department was concerned that students would emerge from the course knowing the rules of algebra and possessing the capability to use algebra to communicate mathematically. While that was actually evaluated in a different section of the author's dissertation, clearly the students felt that the same material was covered. Those who had taken algebra prior to enrolling in IAAS all attested that this was the case.

The mathematics education agenda was far more ambitious. Representatives of that discipline conceived a course radically different from the traditional developmental algebra course which they were accustomed to teaching. They wanted to re-order the sequence of topics, employ cooperative learning techniques, incorporate discovery learning strategies, and capitalize on the knowledge base which adult students bring to the learning experience. In attempting to overcome math anxiety or even phobia, they hoped to offer a course which was so radically different from those previously experienced by the students that the students would not associate the class with negative experiences nor dredge up half-remembered, and possibly erroneous, ways of solving problems.

The change in topic sequence would seem to have had no negative effect nor did the student-established pace. By the end of the course, students could perform algebraic manipulations and successfully negotiate the translation of verbal problems into notation and find solutions. No one indicated in their interview that they felt shortchanged in mastery of the subject. Cooperative learning, although not the classic model, was approved by all the interviewees. Research findings from other disciplines and other educational levels were echoed in statements by both skilled and struggling students that collaboration yields positive results.

Determined efforts to give all questions respect contributed substantially to an environment where learning could flourish and dissipated anxiety in the students, even those who had failed a traditional version of the same course. As the person who is described as "patient" I feel compelled to say that on occasion that patience took every bit of strength I had. It is rewarding to know that students recognized and valued it. The adult homogeneity of the class was credited as contributing to the ambience of the group. The possibility of looking foolish was more acceptable among peers.
Perhaps the most rewarding aspect of the interviews, from a designer viewpoint, was the successful incorporation of constructivist strategies into the course. Students felt ownership of the rules which they had constructed from observing patterns in their solutions. Oversight and vigilance must be maintained so that students who perceive incorrect patterns and therefore construct erroneous rules, are guided in the right direction. Students did, however, request additional practice so that the rules would become routine. As an educator, I have come to value drill and practice more after discussions held with these students.

Finally, the dean who wanted a course which would capitalize on the strengths of adult students while overcoming their reservations about taking algebra need only read the endorsements for continuing the course at the university to know that she "backed a winner" when she gambled on Introduction to Algebra for Adult Students.

**CONCLUSIONS**

The findings suggested by the student voices might be categorized in three ways: the course, the instructor, and the students themselves. As far as the course is concerned, the students indicated that they felt the rules of mathematics had more meaning for them because they had developed the rules themselves. The homogeneity of the class encouraged an openness to ask questions and to offer solutions. They felt that the material was essentially the same as that which they had attempted to master in traditional courses. While they enjoyed discovering the rules themselves, some students felt that more practice in applying newly mastered concepts was needed for mastery. Students believed that they had benefited from interaction with other students in both small group and whole class discussions.

The profile of an effective teacher which emerged portrayed someone who was patient and treated the students with respect. Clarity of presentation and persistence in pursuit of student understanding of the course topics were valued by the students. Humor kept the atmosphere light and contributed to student comfort levels. The availability of tutoring by graduate students with teaching styles similar to the instructor enhanced student learning outside the classroom. Knowles (1978: 92), in discussing theories of learning in a democratic culture lists four basic characteristics of an educative environment: “1) respect for personality; 2) participation in decision making; 3) freedom of expression and availability of information; and 4) mutuality of responsibility in defining goals, planning and conducting activities, and evaluating." It would seem that students in Introduction to Algebra for Adult Students concurred with his opinion.
Students felt that their attitude towards mathematics and confidence in their ability to "do" mathematics had changed in a positive direction. This confidence carried over into other areas of their lives. Students recognized applications of algebra in their daily lives. All the students who were interviewed felt that the course should continue to be offered at the university as it filled a real need for the returning adult student.

APPENDIX

INTERVIEW PROTOCOL

Interview Protocol
Mission Algebra
April, 1995
Student's Name:
Occupation:
Approximate Age:
Gender: Ethnicity:
Interviewer:
Date:

a. Introduce myself and thank the person for coming. Why are you taking this particular course?

1. Did you take any college level math classes before this one?
   What classes?
   (IF not) What was the last math class you have taken? How long ago?
2. Have you had any problems with math in the past?
   (If yes) Are you able to identify those problems?
3. Describe your feelings about mathematics classes you have taken in the past.
   What have you liked about them?
4. Do you find this class to be different from other math classes you have taken?
   How is it different? How is it similar?
5. Outside of the class sessions themselves. are there differences in how you relate to this course (from other courses you've taken)?
   Ways you prepare? Interactions with other people about the math? Homework? Tests?
   Other? Are the similarities?
6. What (if anything) have you found surprising about this class?
7. Mow would you describe your attitude toward math before beginning this class?
8. Do you think your attitude has changed over this year?
   (If yes) In what ways has it changed?
   To what would you attribute any change?
9. Do you think that the instructor is different from math instructors you have had before?
   (if yes) In what ways?
10. This is an algebra class. If someone asked you what algebra is. what would you respond?
11. Can you think of a time when you have needed or used algebra in your daily life?
For instance? 

12. Some people feel that students can help other students to understand math. Do you think that this is true? Does this ever happen with this class? Describe. Has this involved you directly? In what ways? 

13. Are there things that you wish the instructor did differently in this class? Explain. 

14. If the head of the department asked you whether this class should continue to exist, how would you respond? 

REFERENCES 


